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一、摩擦学国家重点实验室第四届学术委员会暨第一届咨询专家委员会第五次会议纪要

(2008年10月24日)

清华大学摩擦学国家重点实验室第四届学术委员会暨第一届咨询专家委员会第五次会议于2008年10月24日—25日在北京召开。共有16位学术委员会委员、10位咨询专家委员会委员到会。参会委员名单见附录一。

10月24日上午，于西郊宾馆举行了摩擦学国家重点实验室成立二十周年的小型庆祝活动。出席庆祝活动的有教育部、国家自然科学基金委、清华大学科研院、清华大学机械学院的相关领导，全国摩擦学界的多位老前辈，以及到会的各位学术委员会和咨询专家委员会委员。中国机械工程学会摩擦学分会以及许多兄弟院校、相关单位及个人发来贺信、贺电，热烈祝贺清华大学摩擦学国家重点实验室成立二十周年。庆祝会上实验室第一任主任温诗铸院士做了摩擦学国家重点实验室二十年发展回顾，实验室现任主任雒建斌教授汇报了实验室发展现状。出席庆典活动的来宾名单见附录二。

10月24日下午，全体参会委员于清华大学精仪系召开讨论会。会议由学术委员会主任钟掘院士主持。首先由孟永钢教授介绍实验室自主研究课题情况。各位参会委员对上午的工作汇报及实验室今后的发展方向进行讨论。委员们各抒己见，并提出许多建设性意见。会议记录见附录三。

讨论会的最后，参会委员对申请2008年度摩擦学国家重点实验室开放基金的课题进行评审。本年度共有4个重点项目和7个自由申请项目获得摩擦学国家重点实验室开放基金资助，资助金额共计66万元。获得基金资助的课题名称和资助金额见附录四。

10月25日上午，全体参会委员参加了由会议组织的学术研讨会专家报告会。会上由熊有伦院士、李玉卓教授、町田尚博士、孙立宁教授、史铁林教授和汪家道副教授做了学术报告。研讨会日程和报告题目见附录五。

学术委员会主任签字

2008-11-10

二、2008 年摩擦学国家重点实验室情况简介

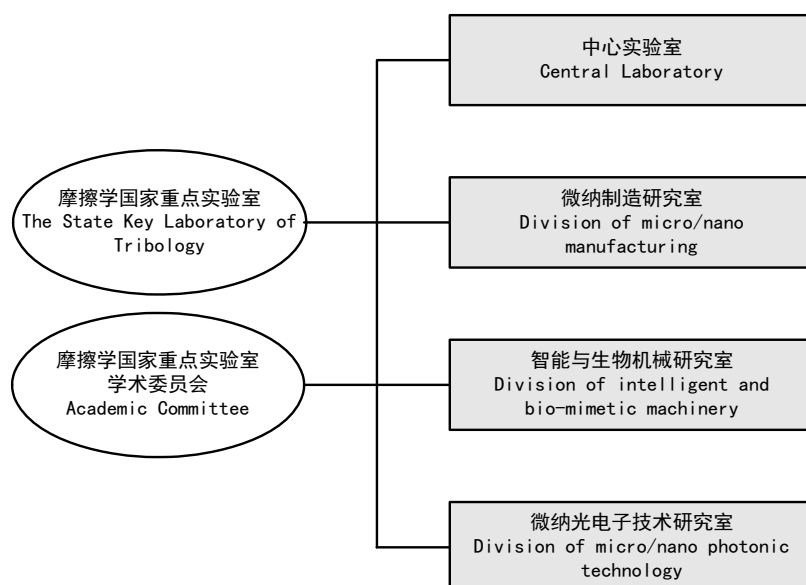
1. 实验室概述

清华大学摩擦学国家重点实验室是经原国家计委和原国家教委批准建设的国家重点实验室，1986 年开始筹建，1988 年 11 月通过验收。实验室实行学术委员会指导下的实验室主任负责制，经教育部批准，温诗铸、陈大融曾先后分别担任第一、二届和第三届实验室主任，雷天觉和谢友柏曾先后担任实验室学术委员会主任。实验室现任主任由清华大学雒建斌教授担任，中南大学钟掘院士担任学术委员会主任。

经过十几年的发展和调整，摩擦学重点实验室已形成一个以摩擦学理论与技术、表面科学与技术、微纳制造理论与技术、智能微系统设计、制造技术、微纳光电器件测试理论与技术为主要研究方向的科学研究和人才培养基地，承担着多项国家 973 计划项目、863 计划项目、国防专项课题、自然科学基金重大与重点项目以及大量国际合作和企业合作研究项目。2005 年获教育部创新团队，2007 年获国家自然科学基金优秀群体。

摩擦学国家重点实验室目前有固定人员六十多人，其中教授、研究员 20 名，副研究员、副教授 32 名。有博士学位者 50 人，占固定研究人员总数的 75%。实验室拥有中国科学院院士，俄罗斯工程院外籍院士、俄罗斯自然科学院外籍院士、白俄罗斯技术工程院外籍院士、长江学者特聘教授、国家杰出青年基金获得者和教育部跨世纪优秀人才。

摩擦学国家重点实验室组织结构图



摩擦学国家重点实验室负责人

名誉主任	温诗铸	院士
主任	雒建斌	教授
副主任	孟永钢（常务）	教授
	陈 悬	教授
	巩马理	教授
	季林红	教授
秘 书	张晨辉	副研究员

2. 科研情况概述

2006 年科技部正式批准了摩擦学国家重点实验室研究方向调整计划，确定实验室的主要研究方向为：

- 1) 摩擦学理论与技术
- 2) 表面科学与技术
- 3) 微纳制造理论与技术
- 4) 智能微系统设计、制造技术
- 5) 微纳光电器件测试理论与技术

2008 年，实验室围绕上述主要研究方向组织队伍和力量，积极组织 and 参与国家重点基础研究项目的立项和申报、国家科技支撑计划的立项和申报、国家自然科学基金重大研究计划的立项和国防创新研究项目的申报工作，作为项目总体负责单位承担“973”计划项目 1 项，雒建斌教授任首席科学家。作为主要参加单位新承担了另外一个“973”计划项目的部分课题。此外还负责承担了创新研究群体的研究项目 1 项。

2008 年，实验室承担在研课题 80 多项，在国内外学术刊物及学术会议发表论文 134 篇，其中 SCI 收录 54 篇，EI 收录 16 篇。编写英文专著 2 本，中文专著 4 本。此外，获得国家发明专利授权 27 项。获国家科技进步二等奖 1 项。

(1) 中心实验室（摩擦学研究所）

2007 年新申报并获得资助的主要科研项目包括：（1）分别参加了中科院兰州化学物理所、上海交通大学、西安交通大学负责承担的 3 个 973 计划项目，均已正式启动，课题经费合计约 650 万元，为今后 5 年的基础研究的开展打下了基础；加上 2003 年已经启动的 2 个 973 计划课题，在国家重点基础研究计划方面承担的任务增强，地位也更加稳固；（2）新申报并获得资助的国家自然科学基金项目 2 项，加上在研的 8 项（含 1 项重大项目和 1 项杰出青年基金项目），达到 10 项。在国内继续保持领先地位；（3）新

签订并已启动的国际合作研究项目 1 项，加上在研的 2 项，共有 3 项。国际合作研究在
项目数和经费数方面保持稳定增长。

初步统计发表学术论文 141 篇，其中 SCI 收录论文 71 篇，其中有一部分论文发表
在影响因子较高的国际刊物，在 APL（应用物理快报）发表 2 篇，在 JAP（应用物理学
报）发表 2 篇，较前几年有较大增长，论文的总档次也有明显提高。获授权发明专利
1 项。

与国际间的学术交流进一步活跃。有 28 人次出国讲学、短期工作访问或参加国
际学术会议。在国际会议上作特邀报告 6 人次。2008 年实验室邀请美国 Easion 公司
的朱东博士，和英国 MML 公司的张爱阳博士来实验室做长期访问学者。另外，还邀
请了以色列的 I.Etsion 教授来实验室作短期交流和访问。与美国 GM 公司、荷兰
QUAKER 公司、日本 NSK 公司、Panasonic 公司、IHI 公司以及韩国 KIST 开展国际
合作研究项目，继续提升实验室在国际学术界和产业界的影响力。

此外，2008 年 9 月 23~27 日，本实验室成功举办第五届中国摩擦学国际会议暨第
一届 IFToMM(国际机构学及机器科学联合会)摩擦学讨论会（CIST2008 &
ITS-IFTToMM2008）。参加会议人员超过 400 人，其中国外人员超过 100 人。

➤ 人员情况：

共 24 人，中科院院士 1 人，俄罗斯工程院外籍院士 1 人，教授、研究员 7 人。
副教授、副研究员 8 人，讲师、助理研究员 2 人，高工 3 人，其它 4 人。

所 长：邵天敏

副所长：孟永钢、路新春、田煜

书 记：孟永钢

➤ 研究方向：

1. 纳米摩擦学
2. 表面形貌的摩擦学效应
3. 摩擦、磨损状态转化
4. 摩擦磨损行为及其控制

主要研究内容和进展：

课题名称：纳米间隙中流体输运规律及承载原理，“973”计划项目

课题时间：2003-2008，项目负责人：温诗铸

在本年度中开展了以下工作：围绕计算机硬盘系统磁头/磁盘纳米间隙中稀薄气体的输运规
律、润滑设计以及磁头飞行高度的测试问题，从表面力和热效应两个方面对超薄气膜润滑理论
进行了更深入的理论研究和数值模拟，揭示出气膜润滑动态特性和气浮力与温度之间的一些关
系；进一步改进了磁头承载面结构的优化设计方法，使优化设计出的磁头结构更加精细，并提
高了优化计算效率；利用本课题组提出的对称共路外差干涉测量技术，测量和分析了硬盘盘片
偏摆运动的规律；通过测量磁头悬臂力和提取磁信号强度的方法对磁头工作过程中的动态特性

有了较全面的认识。本年度共发表学术论文 12 篇，培养博士研究生 1 人、硕士研究生 2 人。

课题名称：高性能电子产品设计制造精微化、数字化新原理和新方法，“973”计划项目

课题时间：2003-2008，项目负责人：雒建斌

本年度，在抛光工艺研究取得较大进展。在保持和继续提高超精表面亚纳米级加工质量的同时，通过优化抛光工艺大大提高了材料去除率，改进了超精表面加工的生产效率。抛光表面加工对象由计算机盘片、硅片和铜抛光继续拓展到器件芯片和蓝宝石抛光，标志着本课题研发的表面制造技术已进入大面积工业应用阶段。利用电化学和表面分析技术揭示了铜抛光中氨基酸与有机酸体系抛光液由化学作用实现材料去除的机理，加深了对化学机械抛光机理的认识；分析了纳米颗粒与硅基体碰撞过程中平动能与转动能、变形能、热耗散能之间的能量转换，揭示了原子分子尺度的材料去除和损伤发生机制；在计算机模拟的基础上分析了 DLC 膜最小极限膜厚的预测值，提出了 DLC 膜中 SP3 结构形成的修正模型。设计研制了超薄膜 FCVA 沉积系统，制备成功了厚度为 1.9nm 并具有良好机械性能的超薄类金刚石（DLC）膜。配合抛光表面检测及改性，对超精表面检测系统和探针设计进行了优化，建立了数据采集处理系统，检测了系统的热噪声和纵向分辨率，对标准样品进行了初步测量实验。本年度共发表论文 44 篇，其中 SCI 收录 14 篇，申请专利 1 项。

课题名称：降低螺旋桨空蚀噪声的研究，总装创新计划

课题时间：2006-2008 项目负责人：陈大融

在本年度中开展了以下工作：研究确定了流场中的微米/亚微米级颗粒、微气泡，以及壁面微凸体是造成空蚀的关键因素，通过对空蚀发生机理、空蚀损伤机制、材料表面物理特性的研究，验证了空蚀发生机理，并从中导出了抑制空蚀发生的指导原则。通过实验，获得了微颗粒导致空蚀发生的证据；表面形貌影响空蚀发生与发展的证据、空蚀损伤过程主要是力学过程的证据、空蚀与腐蚀同时存在并互相影响的证据、微颗粒直接参与空蚀过程的证据、材料表层物理特性影响空蚀过程的证据，以及材料电极电势随空蚀发生过程变化的证据。研究还获得了空蚀发生过程中表面形貌作用的计算依据，对空泡溃灭物理过程、微射流强度、空泡溃灭过程的温度效应，以及表面形貌对近壁面颗粒运动轨迹的影响进行了分析计算。在对近壁面流场分析、微颗粒与微气泡运动轨迹、表面形貌导致空化研究的基础上，将空蚀发生机理与抑制的研究演化为微气泡与纳米级颗粒、间隙，以及纳米级长程力构建的问题；在对表面电子态密度分布、材料电极电势对空蚀发生过程影响研究的基础上，获得抑制空蚀发生的研究与材料表层电极电位密切相关的结论。通过对空蚀发生机理与抑制技术的研究，正在形成界面力学行为控制的基本原则。

课题名称：高温透平叶片冲蚀发生、发展与抑制的宏微观机理，“973”项目子项

课题时间：2007-2010，项目负责人：陈大融

本课题计划任务是：通过理论分析、计算和实验，在国际学术领域率先对水蚀发生机理在理论上作出明确的解释。依据空蚀发生机理，对抑制水蚀发生的叶片表面设计与制造理论、技术进行研究，获得具有完全自主知识产权的关键技术。经过一年的研究工作，已经全面完成了计划任务、实现了中期阶段目标。迄今为止，本课题共发表 SCI 论文 6 篇，其中包括在 Journal of Applied Physics 发表的 Study on effect of microparticle's size on cavitation erosion in solid-liquid system，在 Tribology Letters 发表的 Experimental and Numerical Investigations on Development of Cavitation Erosion Pits on Solid Surface 等；其它文章发表 3 篇。已经录用待发表的 SCI 检索论文 8 篇，在国际会议上提交学术报告 1 篇次，在国内会议作特邀报告 1 次。研究获得的突出进展主

要包括：获得微颗粒在空蚀发生过程中起关键作用的证据、获得表面形貌影响空蚀发生与发展的证据、提出空蚀损伤机制、获得表面物理特性对空蚀的影响，基本完成水蚀实验装置研制。

课题名称：超低摩擦机理中跨尺度及复杂性问题的研究，国家自然科学基金

课题时间：2007-2009，项目负责人：胡元中

在本年度中开展了以下工作：摩擦过程的计算机模拟。针对碳纳米管和类金刚石(DLC)薄膜两种系统分别开展了计算机模拟研究。包括碳纳米管在石墨基底上的运动和摩擦行为，以及 DLC 薄膜对金刚石表面及加氢饱和表面的摩擦特性。分析了界面原子的运动与摩擦行为的对应关系，界面状态和势函数对摩擦大小的影响，在此基础上研究了源于原子分子作用的摩擦发生的机理。研究展示了不同的界面作用，如化学键作用和范德华作用等对摩擦特性的影响，并进一步证明，表面相对运动中引发界面原子的法向趋近一分离运动、进而导致的横向力对称性破缺和摩擦力产生。这一结论增进了我们对摩擦起源的理解和认识。

课题名称：微/纳摩擦学，国家自然科学基金

课题时间：2006-2009，项目负责人：孟永钢

在本年度中开展了以下工作：通过对硅微机械侧壁面摩擦磨损试验前后的表面形貌、磨粒形态和成分进行细致观测和分析，深化了硅微机械摩擦磨损机制的认识，为后续工作中建立干摩擦条件下的微摩擦磨损物理模型打下了基础。在气体薄膜润滑分析中计入表面力的影响，在表面纹理的润滑分析中计入纹理分布的影响，为 MEMS 器件和磁头滑块的润滑设计提供了更精确的分析模型和方法。从挥发性、润湿性、润滑性和可控性等几方面考察了几类有机分子对硅微机械润滑的适用性，从中筛选出两种综合性能较好的有机分子润滑材料，为后续开展有润滑 MEMS 器件的研制创造了条件。应用气体薄膜润滑分析和遗传算法进行了磁头滑块承载面的优化设计，并利用微加工工艺在硅基片上加工出模拟磁头，为开展磁头飞行状态的测量和气体薄膜润滑理论的实验验证打下了基础。

课题名称：纳米间隙中流体输运规律及承载原理，“973”计划子项目

课题时间：2003-2008，项目负责人：温诗铸

围绕计算机硬盘系统磁头/磁盘纳米间隙中稀薄气体的输运规律、润滑设计以及磁头飞行高度的测试问题，从表面力和热效应两个方面对超薄气膜润滑理论进行了更深入的理论研究和数值模拟，揭示出气膜润滑动态特性和气浮力与温度之间的一些关系；进一步改进了磁头承载面结构的优化设计方法，使优化设计出的磁头结构更加精细，并提高了优化计算效率；利用本课题组提出的对称共路外差干涉测量技术，测量和分析了硬盘盘片偏摆运动的规律；通过测量磁头悬臂力和提取磁信号强度的方法对磁头工作过程中的动态特性有了较全面的认识。本年度共发表学术论文 12 篇，培养博士研究生 1 人、硕士研究生 2 人。

课题名称：高温自润滑长寿命复合涂层制备及其摩擦学行为研究，国家自然科学基金

课题时间：2006-2008，项目负责人：路新春：

在本年度中开展了以下工作：(1)复合电沉积方法制备 Ni-W-CeO₂ 镀层。采用复合电沉积方法制备了 6 组含 CeO₂ 不同含量的 Ni-W-CeO₂ 复合镀层，研究了常温及高温下的摩擦学性能以及抗高温玻璃热腐蚀性能，发现 CeO₂ 微粒含量为 wt8.5~9.5%时，镀层与熔融态玻璃之间摩擦系数降为 0.25 左右，CeO₂ 微粒的加入能够非常显著的提高 Ni-W 镀层的抗玻璃热腐蚀的能力。(2)超音速等离子(SPS)热喷涂层。采用新型外送粉超音速等离子热喷涂的方法制备了 8 种 La₂O₃ 和 CeO₂ 掺杂 Cr₃C₂-NiCr 涂层。试验结果表明，在高温 973K 时，在载荷为 13.23N 时，复合涂层的高温摩擦系数较原涂层降低了 33%，由 0.6 降低为 0.4。同时，对 8 种复合 CoCrW 涂层

进行了的常温抗磨损能力进行了测试, 载荷为 2N, 频率为 200 刻划/分, 刻划长度为 5 mm, 持续时间为 10 min, 试验结果显示, 复合涂层较原涂层的抗磨损能力提高了一倍以上, 同时涂层的显微硬度得到了提高, 显微结构得到了细化。发表论文 10 篇。

课题名称: 电力机车受电弓弓网摩擦磨损研究, 横向协作项目

课题时间: 2007-2009, 项目负责人: 邵天敏

在本年度中开展了以下工作: 本课题于 2007 年 10 月份正式开展研究工作。对国内外在此方面的研究情况、相关标准、专利及信息等进行了调研; 并开展了相关实验设备研制的前期工作; 对搜集到的目前在用各种滑板的微观结构进行了初步分析。正在撰写调研报告, 已完成试验装置的初步设计。

课题名称: 材料表面/界面结构的润滑抗磨性能及其控制, “973” 计划项目

课题时间: 2007-2012, 项目负责人: 邵天敏

在本年度中开展了以下工作: 本课题是“973”项目子课题的组成部分, 该子课题由中国矿业大学与清华大学共同承担, 于 2007 年 5 月份正式开展研究工作。本年度主要工作进展包括: 1) 改进和完善了实验室现有的表面薄膜沉积系统; 2) 以 TiN/Ti 多层膜为对象研究了调制比、调制周期等对多层表面结构断裂韧性、表面硬度、摩擦磨损特性的影响; 3) 研究了 CN_x 膜的制备技术以及工艺参数对 CN_x 膜中 N 含量的影响, 并进一步考察了 N 含量对薄膜结构和硬度的影响规律; 4) 开展了基于导光纤聚焦进行激光表面微加工的试验研究。初步获得了特征尺寸小于 4 微米的表面微观结构。

课题名称: 超疏水表面形貌的界面效应影响研究, 国家自然科学基金

课题时间: 2007-2009, 项目负责人: 汪家道

在 2007 年 1 月至 2007 年 12 月期间, 完成了预计的研究内容, 根据计划书中的研究内容, 具体的完成情况如下: 建立了随液滴体积增加和减少的接触角预测模型, 基于该模型讨论了液滴在横向凹槽形貌上的铺展机理, 以及气泡存在时对接角的影响。分析结果表面横向凹槽中的气相对接触角的影响机理同纵向凹槽中气相对接触角的影响机理完全不同。为考察表面曲率变化对真实接触角的影响, 建立了一个液滴在球形固体表面和锥形固体表面上的液滴热力学平衡模型, 结果表明目前几乎所有文献上关于曲率对固液界面间的真实接触角无影响的假设是不成立的。利用分子动力学仿真, 分析了不同端基表面的电子结构对表面自由能的影响。分析结果表明利用表面端基注入改变表面电子结构来实现低表面自由能的方法是可行的。

课题名称: 表面特性对水基润滑成膜特性的影响规律, 国家自然科学基金

课题时间: 2007-2009, 项目负责人: 张晨辉

在本年度中开展了以下工作: 1) 纯水在不同材料表面上的成膜特性研究。发现材料表面的接触角越大, 水的膜厚越大。在水中加入表面活性剂以后, 水的膜厚降低, 并且表面活性剂浓度越大, 膜厚越低。2) 高水基乳液成膜特性研究。研究了不同浓度的乳液的成膜特性, 发现即使浓度只有百万分之五, 乳液仍然能够形成润滑膜。3) 自组装膜表面改性研究。使用全氟硅烷对玻璃表面进行改性, 将玻璃表面的接触角增大到近 110 度。研究了制备了自组装膜后样品的摩擦学特性。发现在仅有少量水润滑条件下具有较低的摩擦系数。

课题名称: 微尺度下表界面动态粘着接触机理与 MEMS 粘附控制的研究, 国家自然科学基金

课题时间: 2006-2008, 项目负责人: 张向军

在本年度中开展了以下工作: 完成微观黏着接触摩擦试验机的研制开发, 实现微纳米级动态黏着接触观测, 出口台湾虎尾科技大学 1 台, 并协助国内其他高校复制加工; 研究了动态湿

黏着接触过程以及黏着力变化规律，发现当受限液体达到微纳米厚度时，会出现传统毛细效应难以揭示的铺展（spreading）和收缩（shrinking）效应，该效应揭示了树蛙等湿黏着生物黏着爪垫快速黏附与解黏附的机理；采用修饰探针技术研究了微纳米间隙液体的边界滑移与剪切效应，发现滑移长度与固-液界面相互作用密切相关；研究了不同润滑剂在接触区的剪切行为，揭示了润滑剂特性与固-液界面行为的关系；耦合湿黏着接触和静电黏着接触探究了外加电场下黏着的耦合行为。2007年度，发表SCI收录文章1篇，EI刊源录用2篇，国际会议报告1人次。培养硕士生1名。通过德国DAAD与国家留学基金委的资助，作为PPP项目到德国Ilmenau理工大学物理系进行学术访问3人次。

课题名称：非牛顿介质动态特性的频域表征及在微通道流中的应用，国家自然科学基金

课题时间：2006-2008，项目负责人：陈皓生

在本年度中开展了以下工作：在非牛顿介质动态特性的频域表征方面，采用频域特征参数表征非牛顿介质的动态特性，并通过流变实验对采用频域参数表征Maxwell流体类非牛顿介质的粘度变化、第一正应力差和松弛效应和合理性进行了实验验证。结果表明，Maxwell流体的剪切粘度和第一正应力差函数与自然频率和阻尼比两个频域参数有关，Maxwell流体的粘度具有典型的一阶传递函数模型的系统响应；推导了在周期性沟槽形貌作用下的非牛顿介质雷诺方程，完成了对滑动轴承非牛顿介质润滑的计算。在此基础上，考虑到润滑介质在近壁面流动时底层流动将受到表面形貌的影响，进一步通过计算和实验研究了周期性沟槽表面形貌的高度、波长和方向对非牛顿介质润滑效果的影响。通过实验和计算分析了粘弹性流体在表面沟槽的周期性影响下的润滑结果，认为具有沟槽的表面上的阻力并不总是高于或总是低于光滑表面上的阻力，而是受到沟槽的周期波长及其对非牛顿介质表观粘度相互作用的影响。

课题名称：流变液机理及应用研究，省部级项目

课题时间：2005-2009，项目负责人：田煜

在本年度中开展了以下工作：针对不同胶体系统中存在的阻塞和力网络链问题，对具有类似结构并可以通过外电场控制的电流变液进行了试验。测试了这种悬浮液中颗粒在电场和拉伸的共同作用下的变化过程，颗粒链的密度随着拉伸应变的增加先指数增长，随后缓慢的增长，响应的对应了电流变液中颗粒在阶跃电场作用下由于极化颗粒相互之间的作用产生的快速的单链形成过程，和单链形成后链与链之间的作用所形成的链聚集的较慢的多链结构过程。另外研究了电流变液在具有不同表面形貌的电极表面的剪切和压缩，实验结果表明，具有一定形貌设计的电极可以明显增强电流变液的剪切和压缩强度，对提高相关电流变器件的力学性能有重要参考和指导意义。

(2) 微纳制造研究室

微纳制造研究室包括先进制造装备及其控制、精微加工工艺与装备、机器人及其自动化等主要研究方向。本年度承担了国家自然科学基金项目、863项目、国际合作项目等。发表论文8篇，其中SCI收录3篇，获授权发明专利9项。

➤ 人员情况：

微纳制造研究室的科研人员为16人，另有博士后流动研究人员15人，其中正高级职称（教授、研究员）4人，副高级职称（副教授、副研究员、高级工程师）12

人。绝大部分为中青年教师并具有博士学位。目前在读博士研究生 50 余人，硕士研究生 60 余人。

主任：陈 悬

副主任：王立平、杨向东

➤ 研究方向：

- 先进制造装备及其控制
- 精微加工工艺与装备
- 机器人及其自动化

(3) 智能与生物机械研究室

本室承担并圆满完成了机械学院的机械设计基础系列课程的教学任务，同时，在科研上也取得较大成绩。本年度承担了国家自然科学基金项目、总装十五预研项目、863 项目、国际合作项目等。发表论文 16 篇，其中 SCI 收录 2 篇，获授权发明专利 4 项。

➤ 人员情况：

分室现有教师 21 人，其中教授 3 名，副教授 10 名，高级工程师 1 名。

主任：季林红

副主任：阎绍泽、贾晓红

➤ 研究方向：

现代设计理论与方法、机构学与机械动力学、智能机械结构、生物机械与康复工程、CAD、以及创新产品的研制与开发。

(4) 微纳光电子技术研究室

微纳光电子技术研究室 2007 年度先后承担了国家重大基础研究(973 计划项目)、“十一五”预先研究、国际合作等重大项目，2007 年度研究经费达到了 1000 万元。发表论文 30 余篇，其中 SCI 收录 21 篇。

➤ 人员情况：

现有正高级职称人员 2 人，副高级职称人员 2 人，中级职称人员 2 人，博士研究生约 10 人，硕士研究生约 10 人。

主任：巩马理

副主任：柳 强

➤ 研究方向：

主要围绕先进和新型激光技术开展高功率、效率、高光束质量、小型化以及微型化激光器件的研制工作。

➤ 主要研究内容：

高功率固体激光技术，光纤激光基础技术，微型固体激光技术，激光频率变换技

术、超高重复频率固体激光器技术、无线光通信等内容。

1. 光纤激光器基础研究（973 项目）

课题期限：2006. 1-2008. 12, 首席科学家：巩马理。经费：2850 万元

研究了增益导引光纤和纳米倏逝波光纤实现大模场的机理，建立了高功率光纤激光器理论，完成两种百微米大模场光纤的设计和纤芯直径 100 微米双包层光纤的试样；初步验证了纳米倏逝波光纤实现增益可能性；完成了脉冲光纤放大器和调 Q 光纤放大器理论工作，对单级和多级脉冲光纤放大器进行了分析；对高功率光纤的热效应进行了分析。

2. 千瓦级固体激光模块技术

课题期限：2006. 1-2010. 12, 项目负责人：柳强 巩马理。经费：900 万元

2007 年度主要对 500kHz 全固态种子源激光器进行了优化设计和两级预放大实验研究，重点解决了放大过程中光束质量恶化、提取效率不高、晶体损伤等问题。实现了重复频率 500kHz，平均功率 108W，脉冲宽度 48ns，光束质量 $M^2 \leq 2$ 的激光输出，平均转换效率达到了 45%。

3. 微型固体激光器

课题期限：2006. 1-2010. 12, 项目负责人：张海涛 王东生。经费：250 万元

综合考虑增益和效率的关系，在进一步放大功率的同时，保证了放大在空间和时间上的均匀性，完成了微型高重频脉冲激光种子源、高增益一级放大器、二级放大器的级联调试。达到的技术指标如下：激光波长：1.06 μ m，脉冲重复频率：500kHz~1MHz，脉冲宽度：~10ns，峰值功率： ≥ 3 kW。

3. 科研人员

摩擦学国家重点实验室目前有固定人员 67 人，其中教授、研究员 20 名，副研究员、副教授 32 名。有博士学位者 50 人，占固定研究人员总数的 75%。实验室拥有中国科学院院士，俄罗斯工程院外籍院士、俄罗斯自然科学院外籍院士、白俄罗斯技术工程院外籍院士、长江学者特聘教授、国家杰出青年基金获得者和教育部跨世纪优秀人才。

(1) 实验室固定研究人员（姓氏拼音顺序）

姓名	性别	出生日期	职称	专业	研究方向
温诗铸	男	1932-11	正高	机械工程	微纳米机械学与智能材料摩擦学
王玉明	男	1941.01	正高	机械工程	润滑与密封
陈大融	男	1946-12	正高	自动控制	表面形貌摩擦学效应研究
胡元中	男	1946-09	正高	机械工程	分子动力学模拟
雒建斌	男	1961-08	正高	机械工程	纳米级薄膜润滑研究
路新春	男	1966-05	正高	材料科学	纳米级薄膜润滑研究
孟永钢	男	1961-12	正高	机械工程	微纳米机械学与智能材料摩擦学
邵天敏	男	1963-09	正高	材料科学	表面涂层/薄膜技术与应用
田煜	男	1975-05	副高	机械工程	微纳米机械学与智能材料摩擦学
张向军	女	1968-08	副高	机械工程	微纳米机械学与智能材料摩擦学

汪家道	男	1971-11	副高	机械工程	表面形貌摩擦学效应研究
郭丹	女	1970-05	副高	固体力学	旋转机械动力学与机械故障诊断
潘国顺	男	1965-12	副高	材料科学	表面涂层/薄膜技术与应用
陈皓生	男	1975-11	副高	机械工程	表面形貌摩擦学效应研究
张晨辉	男	1974-12	副高	机械工程	表面工程
刘宇宏	女	1978-06	中级	化学	分子膜润滑
赵乾	男	1975-10	中级	物理	电磁材料
及开元	男	1950-09	副高	机械	机械
杨文言	女	1955-07	副高	电镜	电镜
秦力	男	1970-12	中级	机械	网络
赵磊	女	1963-07	初级	高中	实验员
戚玉华	女	1953-10	其他	高中	办事员
何永勇	男	1967-07	副高	转子动力学	旋转机械动力学与机械故障诊断
郭炎	男	1953-11	副高	电子	电子
巩马理	男	1959-10	正高	光学	纳米测量
季林红	男	1962-01	正高	机械设计	微机械、仿生机械
阎绍泽	男	1964-01	正高	机械设计	智能机械
王人成	男	1966-01	副高	机械设计	智能机械
郝智秀	女	1966-12	副高	机械设计	智能机械
刘莹	女	1965-12	副高	机械设计	机械学
刘向锋	男	1961-11	正高	机械设计	机械学
贾晓红	女	1972-12	副高	机械设计	生物机械
索双富	男	1963-08	副高	机械设计	智能机械
肖丽英	女	1969-6	副高	机械设计	机械学
王子羲	男	1972-8	中级	机械设计	机械学
赵景山	男		副高	机械设计	机械学
闫平	女	1965-09	正高	光学	纳米测量
张海涛	女	1973-03	副高	光学	纳米测量
黄磊	男	1977-09	中级	光学	纳米测量
陈恳	男	1954-11	正高	机械制造	微纳制造
周凯	男	1954-09	正高	机械制造	机械制造
冯之敬	男	1948-04	正高	机械制造	微纳加工
李勇	男	1962-02	正高	机械制造	微纳加工
王立平	男	1967-07	正高	机械制造	先进制造装备及其控制
郁鼎文	男	1962-10	副高	机械制造	微纳加工
冯平法	男	1966-02	副高	机械制造	微纳加工
韩福柱	男	1966-12	副高	机械制造	微纳加工
田凌	女	1963-02	正高	机械制造	微纳加工
吴志军	男	1960-10	副高	机械制造	微纳加工
朱煜	男	1965-01	正高	机械制造	纳米精度运动
刘成颖	女	1960-04	副高	机械制造	纳米精度运动

吴丹	女	1966-10	副高	机械制造	精密与超精密加工
李铁民	男	1971-01	副高	机械制造	纳米精度运动
褚福磊	男	1959-09	正高	力学	智能微系统设计、制造技术
王慧	女	1945-03	正高	动力机械	摩擦学理论与技术
叶佩青	男	1963-11	正高	微纳制造	微纳制造理论与技术
刘莉	女	1965-04	副高	微纳制造	微纳制造理论与技术
刘辛军	男	1971-03	副高	微纳制造	微纳制造理论与技术
柳强	男	1971-06	副高	光学	微纳光电测试理论与技术
尹文生	男	1968-06	副高	微纳制造	微纳制造理论与技术
张辉	女	1969-09	副高	微纳制造	微纳制造理论与技术
付成龙	男	1980-08	中级	微纳制造	微纳制造理论与技术
卢文秀	男	1974-02	中级	机械学	摩擦学理论与技术
杨东超	男	1975-05	中级	微纳制造	微纳制造理论与技术
杨开明	男	1970-09	中级	微纳制造	微纳制造理论与技术
张鸣	男	1973-11	中级	微纳制造	微纳制造理论与技术
赵彤	男	1972-12	副高	微纳制造	微纳制造理论与技术
杨向东	男	1966-05	副高	机械制造	微纳制造理论与技术

(2) 实验室流动人员（姓氏拼音顺序）

姓名	性别	专业	学位	加入时间
陈霸东	男	计算机应用	博士	2008-5-1
陈旭	男	机械制造	博士	2008-1-1
陈旭鹏	男	机械工程	本科	2005-7-1
程嘉	男	机械设计及理论	博士	2008-1-1
董立立	男	机械设计及其自动化	博士	2008-8-1
付伟	男	机械设计及理论	博士	2007-7-1
郭丽峰	男	测试计量技术及仪器	博士	2007-9-1
侯悦民	女	机械设计及理论	其他	2008-1-1
黄伟峰	男	流体力学	博士	2006-7-1
金国	男	机械工程及理论	博士	2007-4-1
靳厚忠	男	机械设计及理论	博士	2006-1-1
李成	男	仪器科学与技术	博士	2007-3-1
李海霞	女	仪器科学与技术	博士	2007-7-1
李锦明	男	测试计量技术及仪器	博士	2004-4-1
李学军	男	机械电子工程	本科	2007-4-1
林春深	男	机械设计及理论	博士	2007-1-1
刘峰斌	男	仪器科学与技术	博士	2007-3-1
刘经宇	男	计算机应用	博士	2008-8-1
吕善进	男	机制	博士	2007-3-1
吕晓仁	男	机械设计及理论	博士	2008-10-1
罗经	男	机械设计及理论	博士	2008-1-1

马天宝	男	机械工程	博士	2007-9-1
田丽	男	机械设计及其自动化	硕士	2008-7-1
佟浩	男	机械制造及其自动化	博士	2008-7-1
万玉民	男	未统计	其他	1901-1-1
王爱明	男	机械设计及其理论	博士	2007-11-1
尉鹏	男	机械设计及其自动化	硕士	2008-7-1
吴军	男	机械工程自动化	博士	1901-1-1
徐登峰	男	机械工程	博士	2007-7-1
徐明刚	男	机械	博士	2007-7-1
徐艳姬	女	材料学	博士	2006-7-1
许岩	男	机械设计及其自动化	硕士	2008-7-1
杨学智	男	未统计	其他	1901-1-1
杨忠学	男	微电子与固体电子学	其他	2006-4-1
于海娟	女	光学工程	博士	2007-3-1
于湘涛	男	机械工程自动化	博士	2007-6-1
张炜	男	机械设计及其理论	博士	2007-7-1
赵明	男	材料加工工程	博士	2006-7-1
周明	男	机械电子工程	博士	2006-4-1
朱春霞	女	机械制造	博士	2008-1-1

(3) 人才情况

称号	姓名	获得年份
科学院院士	温诗铸	1999
杰出青年基金	雒建斌	2000
长江学者	雒建斌	2003
杰出青年基金	褚福磊	2004
杰出青年基金	孟永钢	2005
杰出青年基金	路新春	2008
新世纪人才	何永勇	2005
新世纪人才	柳强	2006
新世纪人才	田煜	2007

三、2008 年摩擦学国家重点实验室年度报告

1. 研究工作和水平

2006 年科技部正式批准了摩擦学国家重点实验室研究方向调整计划, 确定实验室的主要研究方向为:

- 摩擦学理论与技术
- 表面科学与技术
- 微纳制造理论与技术
- 智能微系统设计、制造技术
- 微纳光电器件测试理论与技术

2008 年, 实验室围绕上述主要研究方向组织队伍和力量, 积极组织和参与国家重点基础研究项目的立项和申报、国家科技支撑计划的立项和申报、国家自然科学基金重大研究计划的立项和国防创新研究项目的申报工作, 作为项目总体负责单位承担“973”计划项目 1 项, 雒建斌教授任首席科学家。作为主要参加单位新承担了另外一个“973”计划项目的部分课题。此外还负责承担了创新研究群体的研究项目 1 项。

2008 年, 实验室承担在研课题 80 多项, 在国内外学术刊物及学术会议发表论文 134 篇, 其中 SCI 收录 54 篇, EI 收录 16 篇。编写英文专著 2 本, 中文专著 4 本。此外, 获得国家发明专利授权 27 项。获国家科技进步二等奖 1 项。2008 PE Publishing Prize by the Editor and Editorial Board of the Journal of Engineering Tribology

实验室在本年度取得的主要研究进展包括:

1) 摩擦学理论与技术研究方面

在 DLC 膜超低摩擦机理方面, 从剪切诱导石墨化相变、表面氢吸附层润滑两个现象入手, 使用分子动力学模拟的方法, 探索了 DLC 膜摩擦过程中复杂的物理化学作用, 对超低摩擦机理进行了解释。

开展了含有气相润滑系统的八极静电旋转式微摩擦磨损试验 MEMS 器件的设计与加工研究, 并研制了 MEMS 器件摩擦磨损可靠性测试台。在微轴承气体润滑设计理论、测试技术及其在计算机硬盘中应用方面取得一些重要进展。

2) 表面科学与技术研究方面

继续开展表面疏水性能方面的研究, 通过荷叶表面形貌和机理分析, 获得了液滴在不同比表面上的扩展机制和液滴下气体存在的条件, 为了更精确、快速地进行表面接触角和液滴表面张力等的测量, 发展了一种新的测量方法和系统。

在界面减阻方面, 提出了一种摩擦副间的气泡减阻概念和实现方案, 同时也完成了间断横向凹槽的固液界面减阻实验。

在表面材料调制和结构制备的装备研制方面, 对课题组原有的激光真空弧薄膜沉积

装备和多弧离子镀设备进行了完善，为获得精确的表层材料调制结构提供了制备手段。继续开展表面微观几何织构制备技术研究，提出了基于光纤聚焦的激光微加工及基于掩膜沉积技术的表面织构制备技术。

3) 微纳制造理论与技术研究方面

在 Cu 表面平坦化机理方面，由表面平坦化过程硬质颗粒切削和冲击等效应共存的复杂状态出发，探索了表面平坦化的机制。

针对 IC 制造中的化学机械抛光技术，开展了铜化学机械抛光液中络合剂和缓蚀剂的作用机理研究，采用电化学测试和 XPS 元素分析的方法研究了抛光液中络合剂和缓蚀剂对铜的作用机理。

开展了双光子微纳加工研究，基于飞秒激光双光子聚合原理，搭建了真三维微纳加工系统，并对系统结构、光学光路等进行了优化。同时，在运动部件控制系统软件、实时加工监测软件系统等方面开展了大量工作。

4) 智能微系统设计制造技术研究方面

开展了微型机械结构动力学特性分析，结果表明结构断裂降低了微机械结构的固有频率，而结构固定增大了微机械结构的固有频率，因此，可以通过检测微机械结构的固有频率来判断其是否存在缺陷。结合单元运动微分方程和节点受力平衡方程，还可对微机械结构进行瞬态分析，求得系统节点的瞬态响应，进而对缺陷行为进行仿真甚至对缺陷参数进行辨识。

5) 微纳光电器件测试理论与技术研究方面

开展了用于微纳加工的紫外和皮秒激光器研制。研究了原理性实验，采用一个高功率的振荡器和两级单通放大器构成 MOPA 结构的新型激光器。研究了一种新型结构的激光腔，实现了单端连续锁模输出，平均输出功率高于 5W。

2. 实验室建设和人才培养

本年度，郁鼎文、刘向锋晋升为教授，陈皓生、赵景山晋升为副教授。

3. 开放交流与运行管理

2008 年实验室继续坚持对国内外的开放，新立项开放基金课题 11 项，资助金额达 66 万元。实验室的大型仪器设备 20 多台套（包括 2005 年新增的场发射环境扫描电子显微镜、纳米力学性能测试系统、CETR 多功能摩擦磨损试验仪等）全面对外开放服务，为开放基金课题以及校内外的相关科研项目提供了大量高质量的测试服务。

2008 年 9 月 23~27 日，本实验室成功举办第五届中国摩擦学国际会议暨第一届 IFToMM(国际机构学及机器科学联合会)摩擦学讨论会（CIST2008 &

ITS-IFTtoMM2008)。参加会议人员超过 400 人，其中国外人员超过 100 人。

与国际间的学术交流进一步活跃。有 28 人次出国讲学、短期工作访问或参加国际学术会议。在国际会议上作特邀报告 6 人次。2008 年实验室邀请美国 Easion 公司的朱东博士，和英国 MML 公司的张爱阳博士来实验室做长期访问学者。另外，还邀请了以色列的 I.Etsion 教授来实验室作短期交流和访问。与美国 GM 公司、荷兰 QUAKER 公司、日本 NSK 公司、Panasonic 公司、IHI 公司以及韩国 KIST 开展国际合作研究项目，继续提升实验室在国际学术界和产业界的影响力。

四、人才培养和学术活动

1. 研究生培养

清华大学摩擦学国家重点实验室有硕士点四个，分别为机械制造及其自动化、机械电子工程、现代设计理论与方法以及光学工程。博士点两个，分别为机械工程和光学工程。博士后点两个：机械工程和仪器仪表。

2008年，在校硕士研究生78人，毕业20人，在校博士研究生73人，毕业25人，博士后在站27人，出站7人。

研究生和博士后情况：

类别	个数	在校/站人数	毕业或出站人数
硕士点	4	78	20
博士点	2	73	25
博士后点	2	27	7

2. 学术活动

(1) 参加大型国际会议情况

类别	报告题目	会议名称	报告人	时间	地点
Plenary	Tribology in Nanomanufacturing	5th China International Symposium on Tribology (CIST 2008) and 1st International Tribology Symposium of IFToMM (ITS-IFToMM 2008)	雒建斌	2008-9-24	北京
Invited	Micro-bubble behaviors in nano-scale lubricating films under external electric field	2nd International Conference on Advanced Tribology 2008	雒建斌	2008-12-1	新加坡
Keynote	Active Control of Sliding Friction	CIST & ITS-IFToMM 2008	孟永钢	2008-9-25	北京
Invited	Fundamentals of Friction	CIST & ITS-IFToMM 2008	胡元中	2008-9-25	北京
Invited	Application of Laser in Surface Technology	CIST & ITS-IFToMM 2008	邵天敏	2008-9-26	北京
Invited	Influence of Surface Textures on Tribological Performance of Materials, – a Review of Surface Texturing Research in China	63th STLE Annual Meeting	邵天敏	2008-5-1	Cleveland Ohio, USA

Invited	Mechanism and applications of chemical mechanical polishing	CIST & ITS-IFToMM 2008	路新春	2008-9-26	北京
Invited	光刻机超精密工件台自主创新与关键技术研究	2008 中国国际光刻机设备技术论坛	朱煜	2008-3-1	上海

(2) 国内外期刊任职

姓名	学位	杂志	职位	任职时间
胡元中	博士	PIMech E part J: Journal of Engineering Tribology	Associate Editor	2002-12-1
胡元中	博士	摩擦学学报	编辑委员会委员	2002-8-1
雒建斌	博士	wear	编委	2004-10-1
雒建斌	博士	科学通报	编委	2002-10-1
雒建斌	博士	摩擦学学报	编委	2002-10-1
雒建斌	博士	wear	编委	2004-10-1
雒建斌	博士	Surfaes and Coatings Technology	编委	2005-1-1
雒建斌	博士	Surface Science and Engineering	编委	2006-1-1
雒建斌	博士	Tribology-Materials, Surfaces & Interfaces	编委	2007-1-1
雒建斌	博士	科学通报	编委	2004-1-1
雒建斌	博士	摩擦学学报	副主编	2005-10-1
雒建斌	博士	润滑与密封	编委	2007-1-1
路新春	博士	Journal of Bionics Engineering	编委	2004-1-1
邵天敏	博士	中国表面工程	编委	2004-2-1
巩马理	博士	Semiconductor Photonics and Technologies (国内英文版)	编委	2003-1-1
巩马理	博士	激光技术	编委	2001-1-1
路新春	博士	Journal of Bionics Engineering	编委	2004-1-1
朱煜	博士	半导体学报	常务理事	2007-1-1
柳强	博士	激光技术	编委	2006-1-1
陈皓生	博士	系统仿真学报	编委	2005-2-1
刘辛军	博士	罗马尼亚布加勒斯特科技大学学报 "Romanian journal UPB Scientific Bulltin, Series D: Mechanical Engineering"	编委	2008-11-1

(3) 代表性国际来访学术活动

编号	姓名	国别	职称	时间	来访形式
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1.	Chung Kyun Kim, Kyung Jong Kim, Siyoul Jang, Hyung-Kyu Kim, Jang Ho, Moon Jung-Gi	韩国	教授	2008.7.10	学术报 告、交流
2.	Dong Zhu	美国	博士	半年	合作研究
3.	张爱阳	英国	博士	2008.1-12	合作研究
4.	I. Etsion	以色列	教授	2008.9.14-9.28	讲学、交 流
5.	Alexander N. Popov	白俄罗斯	副教授	2008.12.11-12.28	合作研究
6.	Bo Zhao	美国	博士生	2008.7.20-8.20	合作研究
7.	Thomas Haensel	德国	博士生	2008.9.19-10.9	合作研究
8.					
9.					

五、实验室环境和设备

设备管理制度和条例

(1) 实验室仪器设备管理规定

1. 实验室的所有仪器设备由仪器设备管理员负责总管理，各分室所用设备由分室管理人员负责具体管理。
2. 固定资产做到账、物、卡以及数据库完全相符。
3. 新进设备要及时建卡入账。
4. 本实验室设备一般不许借出，各分室互借要进行登记。
5. 仪器设备及配件定位存放。
6. 仪器设备登记、验收、上交等均需实验室主任签字。
7. 仪器设备如有损坏、丢失要写出报告，说明原因、过程，分清责任，并由实验室主任签属意见，及时上报。因违章造成的损失，要按有关规定进行赔偿。
8. 仪器设备的说明书由各分室管理员管理，借出要登记并按时归还。

注：大型设备的管理按照学校有关规定执行

(2) 大型实验室仪器设备管理规定

1. 确定仪器技术管理负责人，该负责人负责仪器的管理与使用。
2. 建立完整的操作规程（另行列册）。
3. 建立仪器工作日记。记载仪器一般情况，管理人员必须按日如实填写。
4. 建立样品预约时间表。
5. 建立仪器维修与维护档案。如果仪器出现故障，视具体情况决定个人或请公司维修工程师进行维修，维修前后做如实记录。
6. 专人管理仪器技术资料。有关操作说明，任何人不得携出室外。只能在实验室内阅读。
7. 建立样品接受、“验关”制度，有专人负责验收。放射性样品、带有磁性样品、腐蚀性样品一律拒收。如发现隐瞒现象，尚未造成事实者予以批评教育；如已对系统造成损坏，要及时报请学校，索取赔偿。
8. 仪器实行全年工作制，每日必须对电、气、水做检查。
9. 设立仪器保养制，每周末对主要工作件做检查；每年末对仪器主要技术指标做一次检测。
10. 定期对备件状况做出检查，按学校规定日期申报零备件采购清单。
11. 有计划地聘请国内外有关专家，交流仪器使用、维护及管理经验。
12. 定期向学校报告仪器使用情况及设备性能。
13. 操作人员按规定的主要仪器参数进行操作，不可随意更改。如遇特殊情况，必须按使用手册规定的范围调节，并登记备案。

(3) 实验室仪器设备借用制度

根据清华大学固定资产管理条例，在保证实验室使用的前提下，仪器设备可以向外出借。

1. 校外借用仪器设备凭单位介绍信，必须经校方及系方负责人同意且签署意见后，方可借出。

2. 外系借用一般仪器必须有该系证明、负责人签字且经我系负责人同意，最后由实验室根据使用情况，确定借出与否。
3. 根据学校规定借到校外的仪器设备，原则上按照每天收取 1%-5% 的租金（连续期间节假日除外），所得款项作为更新仪器设备之用。
4. 借用期限一般为两个星期，到期续借需办理续借手续，逾期不还，有权加收两倍以上租金，且及时追回。
5. 凡本室因工作需要外携仪器设备，工作结束后而仪器继续由外单位借用者，应按照上述条文办理出借手续。
6. 借用单位负责借出仪器设备的维护，保证按期归还，如有损坏及逾期不还的情况，可停止对该单位借出，损坏者依损坏赔偿制度给予赔偿。
7. 仪器设备借出前应进行必要的技术测试，且提出维护注意事项，借用单位应注明：借用单位、借用人、仪器设备名称、借出及归还日期、借用单位电话号码，以便催还。
8. 本教研室人员借用仪器设备要进行登记，负责保管好并按期归还。
9. 各实验室的常规教学仪器设备一般不外借，特殊情况须经各室主管人员同意后，方可外借。

(4) 仪器设备损坏（遗失）赔偿规定

根据清华大学设备仪器管理条例，结合摩擦学实验室具体情况，特制订如下条例：

1. 在发生损坏、遗失仪器设备事故后，迅速查明情况和原因，当事人应及时上交书面报告，详细说明情况，由实验室主任和管理人员提出处理意见，报系实验室与资产的负责人审核，并报学校实验室与设备处。
2. 经技术人员、管理人员和领导组成的鉴定小组查证：凡属责任事故，当事人要承担责任和经济赔偿；凡属非责任事故，可以不赔偿，但要研究事故成因，防止再次发生。
3. 在计算经济赔偿时可考虑以下情况：
4. 损坏、遗失零配件的，只计算零配件的损失价值；
5. 局部损坏可以修复的，只计算修理费；
6. 损坏后质量显著下降，但仍能使用的，应按其质量下降程度酌情计算损失价值；
7. 损坏或遗失仪器设备一般可按新旧程度合理折旧。
8. 赔偿费的偿还期一般不得超过半年，如果赔偿金额较大，赔偿者一次交款有困难时，可申请分期或缓期交清，属于几个人共同承担责任事故的，应根据各人责任大小和认识态度分别承担赔偿费。
9. 赔偿费的收入只能作为修理或补充仪器设备的经费。

(5) 实验室人员管理制度

1. 本实验室所有工作人员应以祖国的教育事业为重，做到认真负责、教书育人。并且不断加强业务学习，提高业务水平，紧跟时代发展。积极实验室的建设和管理工作，为教学科研服务。
2. 本实验室实行人员上班考勤制度，设有专职考勤人员，实验室工作人员必须遵守考勤制度。如因故不能按时上班，必须事先向实验室主任和考勤员请假。
3. 实验辅导人员要在实验前十分钟到达实验室，并对实验过程做适当的记录。保证人身及设备安全，发现问题及时报告。
4. 每年年末教研组根据实验室工作人员的工作业绩进行年终总评，给予表扬奖励。

(6) 实验室技术人员岗位职责

1. 实验室技术人员应忠于党的教育事业，兢兢业业做好工作。遵守和贯彻学校和实验室关于实验室的各项管理规定，努力完成自己的本职工作。
2. 熟练掌握实验室的各项实验的原理和实验技术，熟练掌握实验仪器的使用方法，能维修所在实验室仪器的一些小毛病。
3. 掌握实验室设备的运行情况，发现仪器设备运行不良时应马上采取措施并及时报告、维修。
4. 积极参加实验改革，努力学习新的实验技术、新器件的使用，尽快掌握本实验室新购进的设备的使用方法。
5. 有实验时提前开门，实验中积极辅导，发现问题及时解决，实验完后应整理好设备、关闭电源、关好门窗。
6. 负责实验室的安全、环境卫生工作及设备管理工作。

六. 2008 年科研项目 and 成果

1. 2008 年在研项目

(1) 省部级（以上）课题（按项目排序）

项目类别	项目名称	编号	负责人	起始时间	结束时间
省部级项目	北京市科技新星计划 A 类	2006A59	刘辛军	2006-9-1	2009-8-1
国家自然科学基金	表面特性对水基润滑成膜特性的影响规律	50605034	张晨辉	2007-1-1	2009-12-1
国家自然科学基金	超低摩擦机理中跨尺度及复杂性问题的研究	50675111	胡元中	2007-1-1	2009-12-1
国家自然科学基金	超低摩擦机理中跨尺度及复杂性问题的研究	1306008	胡元中	2006-1-1	2008-1-1
"973"计划	超精表面制造与改性中的纳米粒子行为与分子迁移机制	1303007	雒建斌	2003-1-1	2008-1-1
国家自然科学基金	超疏水表面形貌的界面效应影响研究	1306009	汪家道	2006-1-1	2008-1-1
省部级项目	短波长频率变换技术研究	9140A02010306JW01	柳强	2006-7-1	2008-6-1
国家重大工程项目	舵机结构数字化建模	13333333	贾晓红	2007-12-1	2008-6-1
国家自然科学基金	放电点分布的混沌行为及其放电状态的早期预测方法研究	1305046	韩福柱	2006-1-1	2008-12-1
国家科技重大专项	飞机喷涂机器人技术与系统研究	1310002	陈悬	2007-1-1	2008-12-1
"973"计划	非连续工况下重载装备的界面行为与力学特性	2006CB705403	张晨辉	2006-9-1	2011-8-1
国家自然科学基金	非牛顿介质动态特性的频域表征及在微通道流中的应用	13100007	陈皓生	2006-1-1	2008-12-1
"973"计划	高功率泵浦新方法	60359020202	黄磊	2006-1-1	2008-12-1
"863"计划	高灵活性新型并联机器人机构及其运动品质设计和实验研究	2006AA04Z227	刘辛军 张辉	2006-12-1	2008-12-1
省部级项目	高速亚微米微细电火花加工设备及其加工工艺方法研究	1300005	韩福柱	2006-1-1	2008-12-1
"973"计划	高温透平叶片冲蚀发生、发展与抑制的宏微观机理	1300004	陈大融	2007-9-1	2009-12-1
国家自然科学基金	高温自润滑长寿命复合涂层制备及其摩擦学行为研	50575121	路新春	2005-12-1	2008-12-1

	究				
国家自然科学基金	高性能电子产品设计制造精微化、数字化新原理和新方法	2003CB716201	雒建斌	2003-11-1	2008-10-1
国家自然科学基金	高性能核电站冷却剂主泵机械密封的建模与理论分析	2006BAF01B05-4	刘向锋	2007-11-1	2008-11-1
"973"计划	高压微间隙中的润滑及其尺度效应	2007CB607604	路新春	2007-1-1	2010-12-1
支撑计划	功能部件关键技术研究	13200002	王立平	2006-11-1	2009-12-1
"973"计划	光纤激光克服热效应及端面抗损伤新方法	61359020303	张晨辉	2006-1-1	2008-12-1
"863"计划	核电高压容器高效磨削加工智能装备研制	130000	王立平	2006-12-1	2008-12-1
国家自然科学基金	机器人机构优化设计新方法理论体系及关键技术研究	50505023	刘辛军	2006-1-1	2008-12-1
国家自然科学基金	机械动力学	1310004	褚福磊	2005-1-1	2008-12-1
省部级项目	降低螺旋桨空蚀噪声的研究	1320005	陈大融	2006-1-1	2008-12-1
支撑计划	截瘫患者行走训练系统研究	2006BAI22B03	贾晓红 王人成	2006-12-1	2009-12-1
"863"计划	金属合金材料的交叉融合型高深宽比阵列微细加工技术	1303000	李勇	2006-12-1	2008-12-1
省部级项目	军工略	1320006	阎绍泽	2006-12-1	2009-12-1
国家科技重大专项	军民两用小型智能机器人	1310000	陈悬	2007-8-1	2008-3-1
省部级项目	流变液机理及应用研究	200432	田煜	2005-1-1	2009-12-1
省部级项目	脉冲光纤激光器中光纤调Q技术研究	9140A02012007JW0102	柳强	2007-9-1	2009-4-1
"973"计划	脉冲光纤理论	613590102	闫平	2006-1-1	2008-12-1
国家重大工程项目	模拟过载动感座椅系统开发	13200000	王立平	2005-1-1	2008-12-1
"973"计划	纳米间隙中流体输运规律及承载原理	2003CB716205	温诗铸	2003-11-1	2008-11-1
国家自然科学基金	偏瘫患者神经康复运动再学习系统设计与生物反馈控制研究	50575122	贾晓红	2006-1-1	2008-12-1
"973"计划	全断面掘进系统性能仿真与试验	2007CB714007	冯平法	2007-7-1	2011-8-1
省部级项目	全固态千瓦级激光器模块技术	51302010103	柳强 巩马理	2006-1-1	2010-12-1
省部级项目	全固态千瓦级激光器模块技术	5130201010	柳强	2006-1-1	2010-12-1
"973"计划	全光纤调Q新方法种子	61359020302	柳强	2006-1-1	2008-12-1

	源技术				
"973"计划	全光纤功率扩展技术	61359020301	闫平	2006-1-1	2008-12-1
"973"计划	三维微结构高能束加工中纳米精度创成原理	2003CB716204	郁鼎文	2003-11-1	2008-8-1
"973"计划	数学机械化方法及其在信息技术中的应用	2004CB318007	李铁民	2004-1-1	2009-12-1
"863"计划	双足机器人的稳定性与仿生控制策略研究	1300001	陈悬	2006-12-1	2008-12-1
国家自然科学基金	双足跑步机器人混杂周期轨道稳定性与时不变控制策略研究	13100008	陈悬	2006-1-1	2008-12-1
国家自然科学基金	微/纳摩擦学	1305038	孟永钢	2006-1-1	2009-1-1
国家自然科学基金	微尺度下表界面动态粘着接触机理与 MEMS 粘附控制的研究	1305051	张向军	2006-1-1	2008-1-1
支撑计划	微纳米系统中摩擦的微观机制及能量耗散过程的研究	13200003	胡元中	2003-11-1	2008-10-1
省部级项目	微型固体激光器	51302010111	张海涛 王东生	2006-1-1	2008-12-1
"973"计划	温度自适应光纤激光器	61359020401	巩马理	2006-1-1	2008-12-1
国家自然科学基金	新一代仿人型残疾人假手系统及理论的研究	50435040	刘宏 / 王人成	2005-1-1	2008-1-1
国家自然科学基金	旋转机械常见故障的非线性动力学特性及以故障精确诊断技术研究	50425516	褚福磊	2005-1-1	2008-12-1
"863"计划	影像引导消融治疗肿瘤技术装置研制	1300002	陈悬	2007-1-1	2008-12-1
支撑计划	远洋船舶压载水物理净化处理技术	2006BAC11B05	季林红	2007-4-1	2009-12-1
"863"计划	支持产品创新设计的多学科协同建模/仿真方法及实现技术	2006AA04Z112	田凌	2006-7-1	2008-12-1
国家自然科学基金	制造业信息化中信息差原理及其应用研究	1310006	周凯	2006-1-1	2008-12-1
国家科技重大专项	智能管道清污机器人	13100001	陈悬	2007-6-1	2008-8-1
支撑计划	智能下肢假肢的研制	2006BAI22B07	杨鹏	2006-12-1	2009-12-1
"973"计划	重载大惯量装备的快速高精度协调控制	1300003	王立平	2006-7-1	2011-7-1

(2) 重要国际合作项目

合作国别	项目名称	合作单位	负责人	开始时间	结束时间
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日本	Theory and Experimental Research On Water-Based Lubricant Used In Bearing	日本精工株式会社 (NSK)	潘国顺	2007-2-1	2009-2-1
美国	点接触下高水润滑液的成膜特性研究	奎克化学 (中国) 有限公司	雒建斌	2006-1-1	2008-12-1
日本	基于电火花加工的数字化研究	Makino Miling Machine Co.,Ltd and Makino Asia PTE.	韩福柱	2006-1-1	2008-12-1
日本	基于仿真模型的转子/轴承系统参数辨识理论与实验研究	NSK (日本精工株式会社)	郭丹	2006-1-1	2008-12-1
德国	聚合物固体润滑涂层磨损预测的计算机模型研究	博世 (中国) 投资有限公司	胡元中	2007-10-1	2009-9-1
日本	无线激光通信技术及其应用	日本三菱重工	张海涛	2003-11-1	2008-3-1
日本	原子级光滑表面抛光研究	日本	潘国顺	2005-8-1	2010-8-1
日本	紫外光纤激光器研究	日本日立 Via 机械	巩马理	2005-2-1	2008-1-1
国际合作	Hardware enablers for FUTURE MOBILE COMMUNICATION DEVICES: flexibility, biomimicry, and modularization	国际合作	陈恳	2007-4-1	2008-3-1

(3) 横向协作项目

项目类别	课题名称	负责人	开始时间	结束时间
企、事业单位委托项目	半导体发光二极管 (LED) 蓝宝石基片表面超精抛光技术及抛光液研究	潘国顺	2007-1-1	2008-12-1
企、事业单位委托项目	电力机车受电弓弓网摩擦磨损研究	邵天敏	2007-9-1	2009-9-1
企、事业单位委托项目	汽车电泳生产线用滚浸运输机开发	王立平	2007-4-1	2008-12-1
企、事业单位委托项目	水下航行体新型高效减阻技术研究	李勇	2007-6-1	2009-6-1
企、事业单位委托项目	ICAD 软件协同设计与冲突管理系统	田凌	2007-4-1	2010-10-1
企、事业单位委托项目	慢走丝电火花加工机加工设备及加工工艺	韩福柱	2004-9-1	2014-8-1
企、事业单位委托项目	高功率人眼安全光纤激光器	张海涛	2006-1-1	2008-12-1
企、事业单位委托项目	微观摩擦黏着仪研制开发	张向军	2007-12-1	2008-1-1
企、事业单位委托项目	清分捆扎一体机	索双富	2006-1-1	2008-1-1

企、事业单位委托项目	测试分析	朱煜	2007-11-1	2008-3-1
企、事业单位委托项目	冷连轧机主传动机械系统扭振分析	张向军	2007-9-1	2008-3-1
企、事业单位委托项目	化学机械抛光工艺研究	潘国顺	2007-10-1	2008-3-1
企、事业单位委托项目	粽子捆扎打结设备的研发	王子羲	2007-9-1	2008-5-1
企、事业单位委托项目	200mm/300mm 刻蚀机等离子体仿真	朱煜	2007-12-1	2008-12-1
企、事业单位委托项目	齿轮箱润滑技术以及润滑油选用标准研制	孟永钢	2007-1-1	2008-12-1

2. 科研成果

序号	专利名称	专利号	国别	发明人
1	一种微小型机器人的平面运动机构及其装置	ZL200410068971.6	中国	阎绍泽;秦阵;温诗铸;张付兴
2	一种基于激光诱发原位化学反应的表面改性装置	ZL200610011701.0	中国	金永吉;邵天敏
3	用于双包层光纤激光器的声光调Q方法及其装置	ZL200510056766.2	中国	巩马理;陈刚;闫平;柳强;张海涛;李晨;黄磊;叶昌庚
4	一种级联光参量振荡激光器	ZL200610112765.X	中国	巩马理;何发红;黄磊;柳强;陆丹;闫平;陈刚;张海涛;李晨
5	一种手指手腕伸屈康复训练手柄	ZL200410009466.4	中国	季林红;王子羲;毕胜;阳小勇
6	阿基米德螺线式菲涅耳透镜的金刚石车削加工方法及装置	ZL200610088865.3	中国	叶佩青;赵彤;张辉;汪劲松;李维谦
7	一种袋类包装搬运码垛机器人手部	ZL200610113033.2	中国	陈恳;杨向东;李金泉;贾振中
8	Corner-pumping method and gain module for high power slab laser	US7388895B2	美国	Gong Mali ; Li Chen ; Liu Qiang ; Yan Ping ; Chen Gang ; Zhang HaiTao ; Cui Ruizhen
9	被动散热的小热沉半导体激光条	ZL200610011366.4	中国	巩马理;黄磊;殷聪
10	外腔式电控激光波长编码输出方法及其双波长激光器模块	ZL200510011115.1	中国	巩马理;陈刚;闫平;柳强
11	内腔式电控激光波长编码输出方法及其双波长激光器模块	ZL200510011118.5	中国	陈刚;巩马理;闫平;柳强
12	全光纤调Q激光器的方法及装置	ZL200610011607.5	中国	巩马理;闫平;柳强;黄磊;陈刚;张海涛;李晨;彭博
13	新型倾斜驱动方式的三维物镜驱动装置	ZL200510011573.5	中国	巩马理;何发红;黄磊;闫平;柳强;陈刚;李晨
14	具有多次反射折叠光路结构的激	ZL200710001009.4	中国	巩马理;黄磊;何发红;柳

	光放大器及激光谐振腔			强;闫平;陆丹;王琦
15	单自由度直线平移式空间六连杆机构	ZL200610113112.3	中国	赵景山;褚福磊
16	新型偏瘫康复辅助训练机器人手臂固持器	ZL200510011515.2	中国	季林红;张秀峰
17	阵列微细型孔的电化学加工工艺	ZL200510073178.X	中国	李勇;龚姗姗;陈旭鹏;彭良强
18	一种电火花线切割加工电极丝温度检测装置	ZL200610012163.7	中国	韩福柱;程刚

七. 2008 年发表论文

在国内外学术刊物及学术会议发表论文 131 篇，其中 SCI 收录 87 篇。

1. 论文目录

国外期刊：

论文题目	作者	刊物名称	卷、期、章节、页	SCI 检索号
Thermal effect at the incipient stage of cavitation erosion on a stainless steel in ultrasonic vibration cavitation	Chen H.S., Li J., Liu S.H.	Journal of Fluids Engineering	131:024501(2 008)	ISI: 000262531 400011
Transition of frictional states and surface roughness effects in lubricated contacts	Wang S., Hu Y.Z., Wang W.Z.	Proceedings of The Institution of Mechanical Engineers Part J-Journal of Engineering Tribology	222(J3):407-4 14(2008)	ISI: 000256246 700024
Tribological and anti-corrosion properties of Ni-W-CeO ₂ coatings against molten glass	Han B.L., Lu X.C.	Surface & Coatings Technology	202(14):3251- 3256(2008)	ISI: 000254867 700015
Tribological behavior of diamond-like carbon film with different tribo-pairs: A size effect study	Xie G.X., Zheng B.R., Li W., Xue W.	Applied Surface Science	254(21):7022- 7028(2008)	ISI: 000258997 700060
The difference between synergistic erosion-corrosion and corrosion of mild steel in SiC suspension	Zhao M., Wang J.D., Chen D.R., Hao X.P., Wang B.Y.	Journal of Alloys and Compounds	466(1-2):421- 428(2008)	ISI: 000260483 400075
Spherical dendritic particles formed in cavitation erosion	Chen H.S., Liu S.H., Wang J.D., Chen D.R.	Materials Letters	62:2707-2709 (2008)	ISI: 000256780 700047
Spreading dynamics of functional droplets	Li X., Hu Y.Z., Liang L.	Applied Surface Science	255(5):3336-3 341(2008)	ISI: 000261299 200133
Spreading of droplets on lubricant-patterned substrates	Li X., Hu Y.Z., Jiang L.	Journal of Chemical Physics	128(19):1949 04(2008)	ISI: 000256205 200053

Phase transformation during silica cluster impact on crystal silicon substrate studied by molecular dynamics simulation	Chen R.L., Luo J.B., Guo D., Lu X.C.	Nuclear Instruments & Methods In Physics Research Section B-Beam Interactions With Materials and Atoms	266(14):3231- 3240(2008)	ISI: 000257623 900004
Positron annihilation study of the micro-defects induced by cavitation in mild steel	Zhao M., Wang J.D., Chen D.R., Hao X.P., Wang B.Y.	Physica B-Condensed Matter	403(17): 2594-2596(20 08)	ISI: 000257915 100011
Preparation of alpha-alumina-g-polyacrylamide composite abrasive and chemical mechanical polishing behavior	Lei H., Lu H.S., Luo J.B., Lu X.C.	Thin Solid Films	516(10):3005- 3008(2008)	ISI: 000254634 600030
Mechanical properties of La ₂ O ₃ doped diamond-like carbon films	Zhang Z.Y, Lu X.C., Luo J.B., Liu Y., Zhang C.H.	Surface and Coatings Technology	202(9):1621-1 627(2008)	ISI: 000252637 700006
Micro-bubble phenomenon in nanoscale water-based lubricating film induced by external electric field	Xie G.X., Luo J.B., Liu S.H., Zhang C.H., Lu X.C.	Tribology Letters	29(3):169-176 (2008)	ISI: 000253205 500001
Microstructure and mechanical properties of CeO ₂ doped diamond-like carbon films	Zhang Z.Y., Lu X.C., Guo D.M., Xu J., Luo J.B.	Diamond and Related Materials	17(3):396-404 (2008)	ISI: 000255475 300028
New SFA Techniques for Studying Surface Forces and Thin Film Patterns Induced by Electric Fields	Zeng H., Tian Y., Anderson T.H., Tirrell M., Israelachvili J.N.	Langmuir	24:1173-1182 (2008)	ISI: 000253130 900009
Inelastic damages by stress wave on steel surface at the incubation stage of vibration cavitation erosion	Chen H.S., Liu S.H.	Wear	266:69-75(20 08)	ISI: 000261538 800009
Formation and coalescence of linear chains in growth of nanostructured sp-sp(2) amorphous carbon films	Ma T.B., Hu Y.Z., Wang H.	Chemical Physics Letters	462(1-3):104- 108(2008)	ISI: 000258828 900025
Formation of linear carbon chains during the initial stage of nanostructured carbon film growth	Ma T.B., Hu Y.Z., Wang H.	Journal of Applied Physics	104(6):06490 4(2008)	ISI: 0002601193 00164

Experimental study of cavitation damage on hydrogen-terminated and oxygen-terminated diamond film surfaces	Chen H.S., Li J., Liu F.B., Chen D.R., Wang J.D.	Wear	264:146-151(2008)	ISI: 000251843 100017
Extrusion formation mechanism on silicon surface under the silica cluster impact studied by molecular dynamics simulation	Chen R.L., Luo J.B., Guo D., Lu X.C.	Journal of Applied Physics	104(10):1049 07(2008)	ISI: 000262605 800154
Fabrication of carbon nanotube field emission film by electrophoresis deposition and sintering	Peng Y.T., Hu Y.Z., Wang H.	Colloids and Surfaces A- Physicochemi cal and Engineering Aspects	329(3):161-4(2008)	ISI: 000260703 400006
Effect of external electric field on liquid film confined within nanogap	Xie G.X., Luo J.B., Liu S.H., Zhang C.H., Lu X.C., Guo D.	Journal of Applied Physics	103(9):09430 6(2008)	ISI: 000255983 20012
Effect of hydrodynamic pressures near solid surface in the incubation stage of cavitation erosion	Chen H.S., Wang J.D., Li Y.J., Chen D.R.	I Mech. E., J, Journal of Engineering Tribology	222(J4):523-5 31(2008)	ISI: 000257929 100001
Effect of nanoparticle impact on material removal	Xu X.F., Luo J.B., Lu X.C., Zhang C.H., Guo D.	Tribology Transactions	51(6):718-722 (2008)	ISI: 000260120 800003
Effect of substrate morphology on the roughness evolution of ultra thin DLC films	Zhong M., Zhang C.H., Luo J.B.	Applied Surface Science	254(21):6742- 6748(2008)	ISI: 000258997 700009
Effect of surface physicochemical properties on the lubricating properties of water film	Liu S.H., Luo J.B., Li G., Zhang C.H., Lu X.C.	Applied Surface Science	254(22):7137- 7142(2008)	ISI: 000258998 700004
Cavitation damages on solid surfaces in suspensions containing spherical and irregular microparticles	Chen H.S., Wang J.D., Chen D.R.	Wear	266:345-348 (2008)	ISI: 000261538 800040
Criteria for entrapped gas under a drop on an ultrahydrophobic surface	Wang J., Chen D.	Langmuir	24(18):10174- 10180(2008)	ISI: 000259120 500039
Damages on steel surface at the incubation stage of the vibration cavitation erosion in water	Chen H.S., Li J., Chen D.R., Wang J.D.	Wear	265(5-6):692- 698(2008)	ISI: 000257452 500015

A novel method of arraying permanent magnets circumferentially to generate a rotation magnetic field	Zhang W., Meng Y.G., Huang P.	IEEE Transactions on Magnetics	44(10):2367-2 372 (2008)	ISI: 000259572 400018
A revised Hilbert-Huang transformation based on the neural networks and its application in vibration signal analysis of a deployable structure	Xun J., Yan S.Z..	Mechanical Systems and Signal Processing	22(7):1705-17 23(2008)	ISI: 000257866 600014
A simple method to calculate mobility with Jacobian	Yang D.C., Xiong J., Yang X.D.	Mechanism and Machine Theory	43(9):1175-11 85(2008)	ISI: 000256708 400008
A study of the effect of model geometry and lubricant rheology upon the elastohydrodynamic lubrication performance of metal-on-metal hip joints	Wang W.Z., Jin Z.M., Dowson	Proceedings of The Institution of Mechanical Engineers Part J-Journal of Engineering Tribology	222(J3):493-5 01(2008)	ISI: 000256246 700033
Adaptive filtering under minimum information divergence criterion	Chen B.D., Zhu Y., Hu J.C., Sun Z.Q.	International Journal of Control, Automation and Systems	7(2):157-164(2009)	ISI: 000264798 300001
Adhesion and Friction Force Coupling of Gecko Setal Arrays: Implications for Structured Adhesive Surfaces	Zhao B.X., Pesika N., Rosenberg K., Tian Y, Zeng H.B., McGuiggan P., Autumn K., Israelachvili J.	Langmuir	24:1517-1524 (2008)	ISI: 000253130 900049
An on-chip micro-friction tester for tribology research of silicon based MEMS devices	Guo Z.S., Meng Y.G., Wu H., Su C.J.	Microsystem Technologies	14(1):109-118 (2008)	ISI: 0002488115 00013
Dimensional synthesis and dynamic manipulability of a planar two-degree-of-freedom Parallel manipulator	Wu J., Wang J.S., Wang L.P., Shao H.	Proceedings of The Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science	222(6):1061-1 069(2008)	ISI: 000257833 700019
Dynamic dexterity of a planar 2-DOF parallel manipulator in a hybrid machine tool	Wu J., Wang J.S., Li T.M., Wang L.P., Guan L.W.	Robotica	26:93-98(200 8)	ISI: 000252696 900009

Efficient multi-folded Nd : YVO4 slab amplifier	Gong M.L., Wang Q., Huang L., Lu D., Liu Q.	Optics Express	16(5):3349-3355(2008)	ISI: 000254121300057
End-pumped 300 W continuous-wave ytterbium-doped all-fiber laser with master oscillator multi-stage power amplifiers configuration	Yin S.P., Yan P., Gong M.L.	Optics Express	16(22):17864-17869(2008)	ISI: 000260865900074
Experimental demonstration of isotropic negative permeability in a three-dimensional dielectric composite	Zhao Q., Du L.k., Zhao B., Xie H., Huang Q., Li X., Zhou J., Li L.	Physical Review Letters	101(2):027402 (2008)	ISI: 000257553700065
Experimental Research on Vibration Assisted EDM of Micro Structures with Non-circular Cross Section	Tong H., Li Y., Wang Y.	Journal of Materials Processing Technology	208(1-3):289-298(2008)	ISI: 000260690500041
Ferrite-based magnetically tunable left-handed metamaterial composed of SRRs and wires	Kang L., Zhao Q., Zhao H.J., Zhou J.	Optics Express	16(22):17269-17275 (2008)	ISI: 000260865900015
Gait Synthesis and Sensory Control of Stair Climbing for a Humanoid Robot	Fu C.L., Chen K.	Ieee Transactions On Industrial Electronics	55(5):2111-2120(2008)	ISI: 000255677200022
Homing strategy for a redundantly actuated parallel kinematic machine	Wang J.S., Wu J., Wang L.P., Li T.M.	Journal of Mechanical Design	130(4):0445011-0445015(2008)	ISI: 000254292600015
HYDES: A Web-based hydro turbine fault diagnosis system	Song G.X., He Y.Y., Chu F.L.	Expert Systems With Applications	34(1):764-772(2008)	ISI: 000250295300078
Identification of dynamic parameter of a 3DOF parallel manipulator with actuation redundancy	Wu j., Wang J.S., Wang L.P.	Journal of Manufacturing Science and Engineering	130(4):0410121-0410127(2008)	ISI: 000257878200012
Investigations on Transverse-Mode Competition and Beam Quality Modeling in End-Pumped Lasers	Gong M.L., Lu C.Q., Yan P., Wang Y.X.	Ieee J. Quantum Electron.	44(11-12):1009-1019(2008)	ISI: 000261544400004
Magnetic control of negative permeability metamaterials based on liquid crystals	Zhang F.L., Zhao Q., Kang L., Gaillot D.P., Zhao X.P., Zhou J., Lippens D.	Applied Physics Letters	92:193104 (2008)	ISI: 000256564200120

Magnetic tuning of electrically resonant metamaterial with inclusion of ferrite	Kang L., Zhao Q., Zhao H.J., Zhou J.	Applied Physics Letters	93:17 (2008)	ISI: 000260571 800024
Novel Q-switching method with mechanical all-fiber module	Gong M.L., Peng B., Liu Q., Yan P.	Laser Physics Letters	5(10):733-736 (2008)	ISI: 000259740 000007
Numerical investigation of metamaterials infiltrated by liquid crystal	Zhang F.L., Zhao Q., Gaillot D.P, Zhao X.P., Lippens D.	J. Opt. Soc. Am. B	25(11): 1920-1925 (2008)	ISI: 000261399 800023
Optimal kinematic design and application of a redundantly actuated 3DOF planar parallel manipulator	Wu J., Wang J.S., Wang L.P.	Journal of Mechanical Design	130(5):05450 31-0545035(2 008)	ISI: 000255644 600017
Orientation capability, error analysis, and dimensional optimization of two articulated tool heads with parallel kinematics	Liu X.J, Bonev I.A.	Journal of Manufacturin g Science and Engineering -Transactions of The ASME	130(1):01101 5(2008)	ISI: 000255132 200015
Q-switched operation with Fox-Smith-Michelson laser cavity	Huang X, Huang L, Gong M.L.	Laser Physics Letters	5(3):189-192(2008)	ISI: 000254163 300004
Servo Scanning 3D Micro-EDM Based on Macro/micro-dual-feed Spindle	Tong H., Li Y., Wang Y., Yu D.W.	International Journal of Machine Tools & Manufacture	48(7-8):858-8 69(2008)	ISI: 000255466 800014
Single-passed passively mode-locked Nd:YVO4 picosecond laser with SESAM	Wushouer X., Yu H., Gong M.L., Yan P.	Laser Physics	18(11):1164-1 170(2008)	ISI: 000260854 700019
Study on combined influence of inter-asperity cavitation and elastic deformation of non-Gaussian surfaces on flow factors	Meng F.M., Qin D.T., Chen H.B., Hu Y.Z., Wang H.	Proceedings of The Institution of Mechanical Engineers Part C-Journal of Mechanical Engineering Science	222(6):1039-1 048(2008)	ISI: 000257833 700017
Theoretical and experimental study on transverse mode competition in a partial-coiled multimode fiber laser	Yuan Y., Gong M., Li C., Yan P.	Laser Physics	18(1):52-57(2 008)	ISI: 000252806 700009
Thermal analysis of a novel compact packaged passively cooled laser diode array	Yin C., Huang L., He F.H., Gong M.	IEEE Transactions On Components and Packaging	31(3):642-649 (2008)	ISI: 000259573 600014

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Tunable negative permeability in an isotropic dielectric composite	Zhao Q., Du B., Kang L., Zhao H.J., Xie Q., Li B., Zhang X., Zhou J., Li L.T., Meng Y.G.	Applied Physics Letters	92(5):051106(2008)	ISI: 000253016 500006
Vibration-assisted Servo Scanning 3D Micro EDM	Tong H., Wang Y., Li Y.	Journal of Micromechan ics and Microenginee ring	18(2):501-508 (2008)	ISI: 000252966 100011
Unusual stress behaviour of CeO ₂ -doped diamond-like carbon nanofilms	Zhang Z.Y., Lu X.C., Luo J.B.	Philosophical Magazine Letters	88(2):145-151 (2008)	ISI: 000252989 100006
103W high beam quality green laser with an extra- cavity second harmonic generation	Liu Q.,Yan X.P.,Gong M.L.,Fu X., Wang D.S.	Optics Express	16(19):14335- 14340(2008)	ISI: 000259271 900004
16.4 W laser output at 1.34 μ m with twin Nd : YVO ₄ crystals and double-end-pumping structure	Lu C.,Gong M., Liu Q., Huang L., He F.	Laser Physics Letters	5(1):21-24(20 08)	ISI: 000252640 500002
2 MHz AO Q-switched TEM ₀₀ Grazing Incidence Laser With 3 at.% Neodymium Doped Nd:YVO ₄	Yan X.P., Huang L., Liu Q., He F.H., Fu X., Wang D.S., Gong M.L.	Ieee J. Quantum Electron.	44(12):1164-1 170(2008)	ISI: 000261544 400025
A 108 W, 500 kHz Q-switching Nd:YVO ₄ laser with the MOPA configuration	Yan X.P., Liu Q., Fu X., Wang Y.X., Huang L., Wang D.S., Gong M.L.	Optics Express	16(5):3356-33 61(2008)	ISI: 000254121 300058
A chamfered-edge-pumped planar waveguide laser	Gong M., Zhang H., Kang H., Wang D., Huang L., Yan P., Liu Q.	Laser Physics Letters	5(7):518-521(2008)	ISI: 000257568 000006

A configuration of the water-jet guided pump for the fiber laser	Gong M., Huang L., Huang Y., Zhang H., Yan X., Yan P.	Laser Physics Letters, 2008	5(10):584-587 (2008)	ISI: 000259740 000006
A diode side-pumped YAG/Nd : YAG/YAG composite crystal laser	Kang H., Zhang H., Wang D., Huang L., Yan P., Liu Q., Gong M.	Laser Physics	18(8):947-950 (2008)	ISI: 000258408 000003
A fundamental mode miniature acousto-optically Q-switched Nd : YVO4 laser with short pulse width at high repetition rates	Wang Y., Huang L., Zhang H., Yan X., Liu Q., Gong M.	Laser Physics Letters	5(4):286-290(2008)	ISI: 000255734 200006
A high efficient one-end-pumped TEM00 laser with optimal pump mode	Yan X., Liu Q., Huang L., Wang Y., Huang X., Wang D., Gong M.	Laser Physics Letters	5(3):185-188(2008)	ISI: 000254163 300003
An end-pumped planar waveguide laser with an optical to optical conversion efficiency of 58%	Kang H.X., Zhang H., Yan P., Wang D.S., Gong M.	Laser Physics Letters	5(12):879-881 (2008)	ISI: 000261632 600004
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A double common-path heterodyne interferometer for the measurement of flying height modulation	Lin D.J., Yue Z.Y., Song N.H., Meng Y.G., Yin C.Y.	Measurement Science and Technology	19(5):055303(2008)	ISI: 000255662 100016
Modal analysis of rubbing acoustic emission for rotor-bearing system based on reassigned wavelet scalogram	He Y.Y., Yin X.Y., Chu F.L.	Journal of Vibration and Acoustic, Transaction of The ASME	130:061009-1 ~061009-8(20 08)	ISI: 000260310 300009
Molecular dynamics analysis micro-mechanism of ductile machining single crystal silicon by means of nanometric cutting technology	Han X.S., Hu Y.Z., Yu S.	European Physical Journal-Appli ed Physical	42(3):255-262 (2008)	ISI: 000257337 500012

Enhance mechanical performance of electrorheological fluid by patterning electrodes	Zhang M.L., Tian Y., Zhou M., Meng Y.G., Wen S.Z.	Advances In Heterogeneous Material Mechanics	775-77(2008)	
A PIV system for two-phase flow with nanoparticles	Xu X.F., Luo J.B., Yan J.	International Journal of Surface Science and Engineering	2(1-2):168-175(2008)	
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2. 国内期刊:

论文题目	作者	刊物名称	卷、期、章节、页	检索号
Affected zone generated around the erosion pit on carbon steel surface at the incipient stage of vibration cavitation	Chen H.S., Li J., Liu S.H., Chen D.R., Wang J.D.	Chinese Science Bulletin	53: 943-947(2008)	ISI: 0002543605 00019
Effect of roughness and wettability of silicon wafer in cavitation erosion	Jiang N.N., Liu S.H., Chen D.R..	Chinese Science Bulletin	53(18): 2879-2885(2008)	ISI: 0002592715 00020
175-W continuous-wave master oscillator power amplifier structure ytterbium-doped all-fiber laser	Yan P., Yin S.P., Gong M.L.	Chinese Optics Letters	6(8):580-582(2008)	ISI: 0002586398 00011
Isotropic negative permeability composite based on Mie resonance of the BST-MgO dielectric medium	Zhao q., Kang L., Du B., Zhao H.J., Xie Q., Li B., Zhou J., Li L.T., Meng Y.G.	Chinese Science Bulletin	53(21):3272-3276(2008)	ISI: 0002605107 00003
Modelling of spreading process: effect from hydrogen bonds	Li X, Hu YZ, Jiang L	Chinese Physics B	17(8):3035-3039(2008)	ISI: 0002584802 00045
Numerical distortion and effects of thermostat in molecular dynamics simulations of single-walled carbon nanotubes	Li R., HuY.Z., Wang H., Zhang Y.J.	Chinese Physics B	17(11):4253-4259(2008)	ISI: 0002616075 00011

Step kinematic calibration of a 3-DOF planar parallel kinematic machine tool	Chang P., Wang J.S., Li T.M., Liu X.J., Guan L.W.,	Science in China Series E-Technological Sciences	51(12):2165-2177(2008)	ISI: 000261607500011
The spreading behaviour of perfluoropolyether droplets on solid surfaces	Guo X.Y., li X., Hu Y.Z., Wang H.	Chinese Physics B	17(3):1094-1100(2008)	ISI: 000254288400057
氢、氧终端掺硼金刚石薄膜的电子结构	刘峰斌, 汪家道, 陈大融	物理学报	57:1171-1176(2008)	ISI: 000253432100088
Influence of modulating ratio on friction and wear Behavior of TiN/Ti multilayer coatings	Gong H.F., Shao T.M., Zhang C.H., Xu J.	Journal of Inorganic Materials	23(4):758-762(2008)	ISI: 000257928900025
Coupled simulative analysis for drive characteristic of micro-comb structures	Zhu Y., Guo D.	Gongcheng Lixue/Engineering Mechanics	25(7):206-211(2008)	
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2. 专著

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3. 主要论文摘要

【1】 Thermal Effect at the Incipient Stage of Cavitation Erosion on a Stainless Steel in Ultrasonic Vibration Cavitation

【作者】 Chen H.S., Li J., Liu S.H.

【刊名】 Journal of Fluids Engineering

【年卷期】 February 2009 -- Volume 131, Issue 2, 024501

【关键词】 bubbles, chemical analysis, hardness, stainless steel, surface roughness, tempering, ultrasonic applications, vibrations, wear

【摘要】 An ultrasonic vibration cavitation erosion experiment was performed to study the thermal effect during the erosion process. The ring affected zone was observed on the sample surface around the erosion pit at the incipient stage of the cavitation erosion. The results of the surface testing on roughness, hardness, and chemical composition proved that the zone was caused by thermal effect, and that the zone surface experienced a tempering process with the temperature higher than 300°C. Numerical simulation results show that the high temperature domain in the bubble directly contacting the solid wall is a necessary condition for the occurrence of the tempering process on the zone surface, or the heat in the bubble can hardly be transferred to the solid wall under the effects of the great temperature gradient in the bubble and the quick cooling process in the water.

【2】 Transition of frictional states and surface roughness effects in lubricated contacts

【作者】 Wang, S. Hu, Y. Z. Wang, W. Z. Wang, H.

【刊名】 Journal of Fluids Engineering

【年卷期】 2008 222 J3 407-414

【关键词】 lubrication state, thin film lubrication, surface roughness friction model, thin-film lubrication, elasto-hydrodynamic lubrication mixed lubrication, topography, tribology, behavior, fluids, shear

【摘要】 In order to investigate frictional performances in different lubrication regimes and effects of surface roughness, the friction on engineering surfaces with different roughness patterns and amplitudes were measured. Results show a smooth transition of lubrication states from full-film hydrodynamic lubrication to mixed and boundary lubrication. Data from the tests also suggest that the transition of friction regimes is affected by roughness amplitude. It is observed that not only the smoother surfaces give rise to the lower critical velocities of transition from full-film to mixed lubrication, but also the friction coefficients at the point of the transition are much smaller for the smoother surfaces. For the transition from mixed to boundary lubrication, however, effects of roughness amplitude are insignificant. As a result, it is concluded that under the same contact conditions, different features in roughness cause the system to transit in different routines from one lubrication regime to another. Furthermore, a computer model, based on the deterministic solution of mixed lubrication combined with modelling of theological variation in ultra-thin films, has been presented to predict friction in overall lubrication regimes. At last, the comparisons of simulation and experimental results show satisfactory agreements.

【3】 Tribological and anti-corrosion properties of Ni-W-CeO₂ coatings against molten glass

【作者】 Han BL, Lu XC

【刊名】 Surface & Coatings Technology

【年卷期】 2008, 202(14): 3251-3256

【关键词】 rare earth oxide, ni-w-ceo₂, composite coating, high temperature tribological properties, rare-earth, ni-w, corrosion-resistance, composite coatings, al-n, microstructure, alloy, electrodeposition, oxidation, films

【摘要】 Composite plating was used to prepare Ni-W infused rare earth oxide CeO₂ composite coatings. The high temperature friction behavior and corrosion resistance of the coatings against molten glass were investigated by using a high temperature tribometer. A microhardness tester and an environmental scanning electron microscope equipped energy dispersive spectroscopy were employed to investigate the microhardness and the surface morphology of the composite coatings respectively. The results show that the brittle fracture, high temperature tribological properties and the corrosion resistance of Ni-W infused CeO₂ Coatings are superior to those of a standard Ni-W coating. CeO₂ particles decrease the friction coefficient from nearly 0.5 to about 0.25 during the

composite coatings sliding against the molten glass at about 973 K, and proper quantities of CeO₂ decrease the variation of the friction coefficient value. Furthermore, CeO₂ can improve the corrosion resistance of the Ni-W coatings at high temperature effectively. (c) 2007 Elsevier B.V. All rights reserved.

【4】 Tribological behavior of diamond-like carbon film with different tribo-pairs: A size effect study

【作者】 Xie GX, Zheng BR, Li W, Xue W

【刊名】 Applied Surface Science

【年卷期】 2008, 254(21):7022-7028

【关键词】 dlc film, tribological properties, afm/ffm, bod method, size effect, amorphous-carbon, substrate bias, dlc coatings, deposition, contact, environment, adhesion, raman

【摘要】 A friction force microscope (FFM) with different probes and a ball-on-disk (BOD) tribo-meter were used to investigate the tribological properties of diamond-like carbon (DLC) films. DLC films were prepared by chemical vapor deposition (CVD) method by altering the deposition parameters, and their morphologies and structural information were examined with an atomic force microscope (AFM) and the Raman spectrum. The wear traces of the DLC films after frictional tests were analyzed by an optical microscope. It is found that surface roughness and adhesion play important roles in characterizing the tribological properties of DLC films using FFM. Moreover, the debris accumulation is another significant factor affecting the frictional behavior of DLC films, especially for the sharp tip. The difference in coefficients of friction (COFs) obtained by the BOD method among different DLC films under water lubrication is much smaller than the case without water lubrication. The variation trends in COF for the. at tip and the BOD test are similar in comparison with the result obtained with the sharp tip. The wear traces after frictional tests suggest that DLC films under water lubrication are prone to be damaged more readily. (C) 2008 Elsevier B. V. All rights reserved.

【5】 The difference between synergistic erosion-corrosion and corrosion of mild steel in SiC suspension

【作者】 Zhao M, Wang JD, Chen DR, Hao XP, Wang BY

【刊名】 Journal of Alloys and Compounds

【年卷期】 2008 466(1-2): 421-428

【关键词】 metals and alloys, vacancy information, oxidation, positron, spectroscopies, photoelectron spectroscopies, cavitation erosion, positron Behavior, defects, alloys, fe

【摘要】 The synergistic erosion-corrosion and corrosion characteristics of mild steel were studied by using rotating disk apparatus and immersing in 0.05 wt.% SiC suspension, respectively. The difference between cavitation erosion and corrosion was determined by scanning electron microscope (SEM), positron annihilation lifetime spectra (PALS) and X-ray photoelectron spectroscopy (XPS). It was found that the propagation of cracks in pit area induced by cavitation erosion did not appear in the course of corrosion. The PALS results showed that the size and number of vacancy cluster induced by cavitation erosion was much larger than that induced by corrosion damage. The results of core level band spectra indicated that there were chemical shifts in the case of cavitation erosion and no chemical shifts except 40 min corrosion in immersion process. The results of valence band spectra implied that the oxidation of mild steel induced by cavitation erosion was more than that induced by corrosion damage. (C) 2007 Elsevier B.V. All rights reserved.

【6】 Spherical dendritic particles formed in cavitation erosion

【作者】 Chen H.S., Liu S.H., Wang J.D., and Chen D.R.

【刊 名】 Materials Letters

【年卷期】 2008, 254(21):7022-7028

【关键词】 cavitation erosion, thermal effect, spherical particle, dendritic rolling contact fatigue, engine, debris

【摘 要】 Micro spherical particles were found in a vibrating cavitation erosion experiment. Examination of the spherical particles reveals the dendritic pattern on the surface and the hollow structure of the interior. The surface and interior structures of the particle are also related to the particle's size. For smaller particle, the dendritic structure is replaced by the fine cell and the interior becomes solid. Such special structures are considered to be the result of particle's solidification from molten state at a rapid cooling rate, which happens in a special transient environment with transient high temperature and high pressure provided by cavity collapsing. The specific area and surface tension force are the main reasons for the different structures of the particles in different size. (C) 2008 Elsevier B.V. All rights reserved.

【7】 Spreading dynamics of functional droplets

【作 者】 Li X1,Hu YZ,Liang L

【刊 名】 Applied Surface Science

【年卷期】 2008, 255 (5) : 3336-3341, Part2

【关键词】perfluoropolyether, molecular dynamics simulation, thin film, lubrication, spreading, amorphous-carbon surfaces, lubricant films, molecular-dynamics, stability analysis, perfluoropolyether, mechanisms simulation

【摘 要】 Spreading dynamics of functional droplets on. at substrates has been carefully studied. The spreading profiles correspond with the lubricant microstructures. Such correspondence indicates that functional lubricant molecules may transform from a bi-polymer structure to a layering structure during the spreading processes. The molecule movements are demonstrated to include flow-down, surface migration and fill-in processes. Especially, single functional molecule movement is tracked to reveal the detailed microscopic mechanism. The molecule movement is demonstrated to be significantly hindered by the hydrogen bonds among functional end groups. During flow-down process, the single molecule partly breaks the hydrogen bonds. As one end group of the molecule has arrived at the substrates, the other drags other molecules in droplets to flow-down. During surface migration process, the single molecule moves on the substrates combined with other molecules through the hydrogen bonds. (C) 2008 Elsevier B.V. All rights reserved.

【8】 Spreading of droplets on lubricant-patterned substrates

【作 者】 Li X, Hu YZ, Jiang L

【刊 名】 Journal of Chemical Physics

【年卷期】 2008, 128 (19) : 194904

【关键词】 amorphous-carbon surfaces, perfluoropolyalkylether films, molecular simulation, end-groups, growth, simulation

【摘 要】 Droplet spreading behaviors on lubricant-patterned substrates are investigated by using molecular dynamics simulations to explore application potentials in magnetic storage drive systems. Microscopic spreading processes are studied by both potential fields of lubricant-patterned substrates and single molecule movements in lubricant droplets. The potential fields indicate that the wall molecules patterned on the substrates attract the mobile ones in the lubricant droplets. Due to the attraction force, the mobile molecules experience difficulties in diffusing freely along the substrates. The single molecule movements in lubricant droplets demonstrate that during the diffusion process, the mobile molecules encounter, adsorb, encompass, and disengage the wall ones. The spreading behaviors are significantly impacted by the bonded

ratio. The potential fields indicate that as the bonded ratio increases, the attractive regions of wall molecules merge to overlap, which indicate combined interactions formed by the adjacent wall molecules. (c) 2008 American Institute of Physics.

【9】 Phase transformation during silica cluster impact on crystal silicon substrate studied by molecular dynamics simulation

【作者】 Chen RL, Luo JB, Guo D, Lu XC

【刊名】 Nuclear Instruments & Methods In Physics Research Section B-Beam Interactions With Materials and Atoms

【年卷期】 2008, 266(14):3231-3240

【关键词】 amorphous phase transformation, impact load, silica cluster, molecular dynamics simulation, ultra-micro-indentation, mixed systems

spherical indenters, amorphous-silicon, surface, implantation, bombardment, dependence

【摘要】 The process of a silica cluster impact on a crystal silicon substrate is studied by molecular dynamics simulation. At the impact loading stage, crystal silicon of the impact zone transforms to a locally ordered molten with increasing the local temperature and pressure of the impact zone. And then the transient molten forms amorphous silicon directly as the local temperature and pressure decrease at the impact unloading stage. Moreover, the phase behavior between the locally ordered molten and amorphous silicon exhibits the reversible structural transition. The transient molten contains not only lots of four-fold atom but also many three- and five-fold atoms. And the five-fold atom is similar to the mixture structure of semi-Si-II and semi-bct5-Si. The structure transformation between five- and four-fold atoms is affected by both pressure and temperature. The structure transformation between three- and four-fold atoms is affected mostly by temperature. The direct structure transformation between five- and three-fold atoms is not observed. Finally, these five- and three-fold atoms are also different from the usual five- and three-fold deficient atoms of amorphous silicon. In addition, according to the change of coordination number of atoms the impact process is divided into six stages: elastic, plastic, hysteresis, phase regressive, adhesion and cooling stages. (C) 2008 Elsevier B.V. All rights reserved.

【10】 Positron annihilation study of the micro-defects induced by cavitation in mild steel

【作者】 Zhao M, Wang JD, Chen DR, Hao XP, Wang BY

【刊名】 Physica B-Condensed Matter

【年卷期】 2008, 403(17): 2594-2596

【关键词】 cavitation, positron doppler broadening measurement, positron annihilation lifetime, micro-defects, mild steel, erosion, alloys, damage

【摘要】 Cavitation-induced micro-defects in mild steel after cavitation experiment in the fluid field have been studied by positron Doppler broadening measurement and positron annihilation lifetime spectra (PALS). Depth-resolved positron Doppler S-parameter (DPDS) results showed that S-parameter increased and micro-defects between the surface and the bulk has obvious variation with depth during the cavitation process. From the positron lifetime results, it was found that the size and number of micro-defects increase with the development of cavitation. These results suggest that more micro-defects are generated in mild steel bulk during the cavitation process than those in the mild steel surface layer region, although more micro-defects seen in the mild steel surface layer. Moreover, the size of micro-defects in mild steel bulk increases remarkably owing to their transfer and aggregation. (C) 2008 Elsevier B.V. All rights reserved.

【11】 Preparation of alpha-alumina-g-polyacrylamide composite abrasive and chemical mechanical polishing behavior

【作者】 Lei H, Lu HS, Luo JB, Lu XC

【刊 名】 Thin Solid Films

【年卷期】 2008, 516(10):3005-3008

【关键词】 chemical mechanical polishing, glass substrate, alpha-alumina, graft polymerization, composite abrasive, nanoparticle impacts, hollow spheres, coatings, surface, deformation, particles, size

【摘 要】 α -Alumina-g-polyacrylamide (α -Al₂O₃-g-PAM) composite abrasive was prepared by surface graft polymerization. The composition, structure and morphology of the product were characterized by Fourier transform infrared spectroscopy, X-ray photoelectron spectroscopy, time-of-flight secondary ion mass spectroscopy, and scanning electron microscopy, respectively. Then, the chemical mechanical polishing performances of the composite abrasive on glass substrates were investigated. Atomic force microscopy images show that the average roughness of the polished glass substrate surface can be decreased from 0.74 nm for pure α -Al₂O₃ abrasive to 0.45 nm for α -Al₂O₃-g-PAM abrasive. (c) 2007 Elsevier B.V. All rights reserved.

【12】 Mechanical properties of La₂O₃ doped diamond-like carbon films

【作 者】 Zhang, Zhenyu; Lu, Xinchun; Luo, Jianbin; Liu, Yang; Zhang, Chenhui

【刊 名】 Surface and Coatings Technology

【年卷期】 2008, 202(9):1621-1627

【关键词】 unbalanced magnetron sputtering, dlc, la₂o₃, tribological, properties, ion-beam deposition, thin-films, tribological properties, corrosion-resistance, a-c, coatings, microstructure, performance, stresses, hardness

【摘 要】 Twelve La₂O₃ doped diamond-like carbon (DLC) nanofilms were deposited using unbalanced dual-magnetron sputtering. AFM, XRD, Raman spectroscopy, AES, XPS, TEM, contact surface profiler and nanoindenter were employed to investigate the structure and tribological properties of deposited films. The results show that the La₂O₃ doped DLC films are amorphous. La₂O₃ doping obviously decreases internal stress, and effectively increases the elastic modulus. This results from the dissolving and dissolution of La₂O₃ within the amorphous DLC matrix. Furthermore, the friction coefficient of the doped DLC films decreases, and adhesion strength increases. These are attributed to the lubrication function of La₂O₃ and the formation of transition layer at interface, respectively. (c) 2007 Elsevier B.V All rights reserved.

【13】 Micro-bubble phenomenon in nanoscale water-based lubricating film induced by external electric field

【作 者】 Xie GX, Luo JB, Liu SH, Zhang CH, Lu XC

【刊 名】 Tribology Letters

【年卷期】 2008, 29(3):169-176

【关键词】 gas micro-bubble, cavitation, water-based lubrication, external electric field, aqueous-solutions, friction, surface, dielectrics, intensity, breakdown, ceramics, media, oxide, pits

【摘 要】 The effect of an external electric field (EEF) on water-based thin films has been investigated. Some micro-bubbles emerging around the edge of the Hertz contact region in the films of deionized water and polyethylene glycols (PEG) aqueous solutions have been observed. A higher EEF intensity is needed at which the micro-bubbles begin to emerge after the EEF is applied on the liquid film, which is defined as the threshold EEF intensity. The threshold EEF intensity increases with the molecular weight of PEG solution at lower molecular weight. There is a maximum value when the molecular weight reaches 10,000 Da, beyond which the threshold EEF intensity tends to decrease. The threshold EEF intensity also increases with the concentration of PEG solution. Micro-bubble emerging at negative EEF is easier than at positive EEF. The micro-bubble emerging in the film of deionized water is sensitive to the variation of EEF intensity,

and disappears eventually as time progresses.

【14】 Microstructure and mechanical properties of CeO₂ doped diamond-like carbon films

【作者】 Zhang ZY, Lu XC, Guo DM, Xu J, Luo JB

【刊名】 Diamond and Related Materials

【年卷期】 2008, 17(3):396-404

【关键词】 dlc, ceo₂, unbalanced magnetron sputtering, mechanical properties, laser arc deposition, tribological properties, amorphous-carbon, in-vitro, a-c, oxide nanoparticles, cocrw coatings, dlc coatings, activation, stress

【摘要】 A kind of rare earth oxide, CeO₂, was doped into the diamond-like carbon (DLC) films with thickness of 180-200 nm, using unbalanced magnetron sputtering. All the adhesion strength of CeO₂ doped DLC films is increased, while the residual compressive stress is obviously decreased compared to pure DLC film. Specially, the residual compressive stress of the deposited films are reduced by 90%, when the CeO₂ content is in the range of 5-7%, from a value of about 4.1 GPa to 0.5 GPa. When the CeO₂ content is increased to 10%, the deposited films possess the highest adhesion strength of 85 mN, 37% higher than that of pure DLC film. The nanohardness and elastic modulus exist a transition point at 8% of CeO₂ content within the DLC film. Before this value, nanohardness and elastic modulus of CeO₂ doped DLC films are lower than those of pure DLC film, and after this value, they are higher or adjacent to those of pure DLC film. Auger electron spectroscopy shows a more widened interface of 6% CeO₂ doped DLC film compared to pure DLC film. The enhancement of adhesion strength is mainly attributed to the widening of the film-substrate interface, as well as the decrease of residual compressive stress. (C) 2008 Elsevier B.V. All rights reserved.

【15】 New SFA Techniques for Studying Surface Forces and Thin Film Patterns Induced by Electric Fields

【作者】 Hongbo Zeng, Yu Tian, Travers H. Anderson, Matthew Tirrell, and Jacob N. Israelachvili

【刊名】 Langmuir

【年卷期】 24, 1173-1182(2008)

【关键词】 multiple-beam interferometry, aqueous-electrolyte solutions, mica surfaces, polymer-films, electrohydrodynamic instability, apparatus, adhesion, microscope, contact, liquids

【摘要】 We describe two ways to measure normal and/or lateral forces between two surfaces in a surface forces apparatus (SFA) while an electric field is applied between the surfaces. The first method involves depositing thin conductive layers on the exposed substrate (usually mica) sheets; the second involves using the optically reflecting silver layers on the back surfaces of the sheets as the electrodes. Two types of experiments were performed using these new techniques: (1) measuring the effects of an electric field on the rheology of a similar to 40- μ m-thick film of zeolite particles suspended in silicone oil and (2) a dynamic study of electric field-induced pattern formation of a thin polymer film. In the first study, under an electric field of strength similar to 10⁶ V/m the shear force or effective viscosity of the colloid suspension was found to be two orders of magnitude higher than in the absence of the field, when the expected bulk value was measured. In the dynamic study, the initially uniform film transformed into a 2-D honeycombed network of depressed cells bounded by elevated ridges that grew slowly with time in a way consistent with previously derived theories. The new techniques should be applicable to studies of other systems and interactions, such as double-layer forces, micro- and nanoelectrorheology, electric field-induced ordering of particles, and the effects of electric fields on adhesion, friction, and lubrication.

【16】 Inelastic damages by stress wave on steel surface at the incubation stage of vibration cavitation erosion

【作者】 Chen H.S., Liu Shihan

【刊名】 Wear

【年卷期】 2008, 266: 69-75

【关键词】 Cavitation erosion, Stress wave, Inelastic damage, Fracture, Elastic-plastic material

【摘要】 In cavitation erosion, stress waves will be generated and propagated in the solid when a collapse impingement is acted on it. The cavitation damages on the solid surface are considered to be under the effect of the stress waves. An ultrasonic vibration cavitation erosion experiment was performed on a polished steel specimen, and not only the plastic deformations but also the brittle fractures appeared on the surface at the incubation stage of cavitation erosion. Some characteristics such as the hemispherical shape of the crater, intergranular fractures and subsurface comminution make the damages distinguishable from the common plastics deformations, and they are thought to be the results of shear waves. Thus, stress waves are proved to take part in the cavitation erosion, and they bring some special damage styles depending on the conditions of the impaction and mechanical properties of the specimen.

【17】 Formation of linear carbon chains during the initial stage of nanostructured carbon film growth

【作者】 Ma TB, Hu YZ, Wang H

【刊名】 Journal of Applied Physics

【年卷期】 104(6), 064904, 2008

【关键词】 Carbon films

【摘要】 The initial stage of nanostructured carbon film growth is investigated by molecular dynamics simulations. The carbon film exhibits amorphous structures with linear chains and cyclic rings on the surface at low incident energies. The structural transformations from linear chains to cyclic rings and to atom networks are observed during the growth process, which is explained in terms of system stability. The atomic adsorption behavior is analyzed through the calculation of the surface potential field. The formation of linear chain structure is due to the predominance of inhomogeneous adsorption of incident atoms on the surface and preferential growth at the tip of the chain. The formation of nanostructures on the surface is argued to be the initial nucleation process of amorphous carbon films.

【18】 Experimental study of cavitation damage on hydrogen-terminated and oxygen-terminated diamond film surfaces

【作者】 Chen H.S., Li J., Liu F.B., Chen D.R., and Wang J.D.

【刊名】 Wear

【年卷期】 2008, 264: 146-151

【关键词】 Cavitation

【摘要】 To investigate the effect of hydrophobic surface on cavitation damage, hydrogen-terminated diamond film and oxygen-terminated diamond film are prepared for the cavitation damage experiment. Because the film surfaces have the same roughness and hardness, the hydrophobic property effect is focused on. Obvious damage pits appear on the hydrogen-terminated surface after 4 h cavitation experiment, while no such pits are found on oxygen-terminated surface. Surface testing results also show that the surface roughness of hydrogen-terminated surface is higher than that of oxygen-terminated surface after the experiment. Such results indicate that the collapse of bubbles growing from the hydrophobic wall to be damaged plays important role in the generation of cavitation damage.

【19】 Extrusion formation mechanism on silicon surface under the silica cluster impact studied

by molecular dynamics simulation

【作者】Chen H.S., Li J., Liu F.B., Chen D.R., and Wang J.D.

【刊名】Wear

【年卷期】2008, 264: 146-151

【关键词】elemental semiconductors, extrusion, molecular dynamics method, plastic deformation, silicon, silicon compounds, slip, solid-state phase, transformations, phase-transformations, ion impacts, indentation, bombardment, emission, nanoindentation, monocrystals, deformation, microscopy, graphite

【摘要】Molecular dynamic simulation is applied in analyzing the deformation of silicon surface under the impact of large silica cluster. The mechanism of such a deformation is largely different from the cases of ion bombardment and indentation. With the impact of large silica cluster, the silicon surface is extruded due to the combinational effects of thermal spread, phase transformation, and crystallographic slip. It is found that thermal spread is the most significant one among these three effects. The extrusions on silicon surface will be in embryo during the impact unloading stage and will grow up during the cluster rebounding stage. Furthermore, the critical impact velocity to induce the formation of extrusions on silicon surface is associated with the incidence angle of the cluster, while it is independent from the size of the cluster. The findings are instructive in optimizing the process parameters for ultraprecision machining of silicon wafer.

【20】Fabrication of carbon nanotube field emission film by electrophoresis deposition and sintering

【作者】Peng Yitian, HuYuanzhong, Wang Hui

【刊名】Colloids and Surfaces A- Physicochemical and Engineering Aspects

【年卷期】329(3), 161-4, 2008

【关键词】Carbon nanotubes

【摘要】Multi-wall carbon nanotube (MWCNT) films were prepared on the stainless steel plate using electrophoresis deposition and sintering techniques in this paper. The MWCNT film adsorbed strongly onto the substrate after the sintering process in the furnace. The MWCNT film exhibits excellent field emission properties with high emission current densities, low threshold electric fields and good field mission stability. © 2008 Elsevier B.V. All rights reserved.

【21】Enhance mechanical performance of electrorheological fluid by patterning electrodes

【作者】Zhang Minliang, Tian Yu, Zhou Min, Meng Yonggang, Wen Shizhu

【刊名】Advances In Heterogeneous Material Mechanics

【年卷期】2008, 775-77

【关键词】Mechanics

【摘要】Sheared electrorheological (ER) fluid under high electric fields usually slipped on electrodes, and weakened the mechanical performance of ER actuators. This failure was usually ascribed to the detachment of particle chains of ER fluids from electrodes. Using electrodes with hole patterns, the slip at the interface of chain end and electrode can be effectively suppressed. The suppression is related with hole pattern parameters. The reduced slip at the chain end/electrode interface effectively enhanced the ER strength both in shearing and compression.

【21】Effect of external electric field on liquid film confined within nanogap

【作者】Xie GX, Luo JB, Liu SH, Zhang CH, Lu XC, Guo D

【刊名】Journal of Applied Physics

【年卷期】2008, 103(9): 094306

【关键词】Liquid films

【摘要】A strong and reproducible effect of an external electric field (EEF) on liquid films

confined within a nanogap between a highly polished steel ball and a smooth glass disk is described. Induced by the EEF, microbubbles were observed at the edge of the contact region. This phenomenon is more obvious in polar liquid films than that in nonpolar ones. A stronger EEF causes a decrease in the film thickness in the contact region initially, and then the variation becomes much smaller. When the ball is applied with a positive EEF, the emergence of microbubbles is stable over time, while it becomes much less as time progresses. Different mechanisms of these experimental phenomena have been discussed. © 2008 American Institute of Physics.

【22】 Effect of hydrodynamic pressures near solid surface in cavitation erosion

【作者】 Chen H.S., Wang J.D., Li Y.J., and Chen D.R.

【刊名】 I Mech. E., J, Journal of Engineering Tribology

【年卷期】 2008, 222: 523-531

【关键词】 Fluid mechanics

【摘要】 Ultrasonic vibration cavitation erosion experiments were performed to study the erosion on a steel specimen at different pitch angles. Experimental results show that the number and size of the erosion pits decrease as the pitch angle increases. This result is thought to be related to the hydrodynamic pressures generated near the solid surface. Numerical analyses from the Reynolds equation prove that the hydrodynamic pressures are generated in the fluid film when a bubble is moving towards the surface of the specimen. Simulation of the bubble collapse process shows that the hydrodynamic pressures shorten the collapse time of a bubble and strengthen the microjet at the moment of bubble collapse. As the pitch angle of the specimen surface increases, the squeeze pressure due to normal velocity decreases, and the increased dynamic pressure due to tangential velocity cannot compensate for the loss of the squeeze pressure. Thus, the total hydrodynamic pressure decreases, and a decrement in the number and the size of the erosion pits occurs. © IMechE 2008.

【23】 Effect of nanoparticle impact on material removal

【作者】 Xu, Xuefeng; Luo, Jianbin; Lu, Xinchun; Zhang, Chenhui; Guo, Dan

【刊名】 Tribology Transactions

【年卷期】 2008, 51(6):718-722

【关键词】 Surfaces

【摘要】 Nanoparticle impacting on a solid surface always occurs in nano-machining processes, such as the chemical mechanical planarization (CMP) of wafers. Although the material removal induced by nanoparticle impact has been observed in some simulations and tests, the contribution of nanoparticle impact to the material removal in a real CMP process is still unclear. In the present work, a cylindrical liquid jet containing SiO₂ nanoparticle impacts normally on a glass surface at speeds of 1 ms⁻¹ and 3 ms⁻¹. The desorption of the fluorescent nanoparticles adsorbed on the glass surface has been observed by a fluorescent microscope system and used to evaluate the contribution of the nanoparticle impact to the material removal. The experimental results indicate that the impact has a negligible effect on the material removal of the solid surface if the impacting speed is less than 3 ms⁻¹ and the impacting time is less than 1.5 min. It may be helpful to the understanding of the material removal mechanisms in the CMP processes.

【24】 Effect of substrate morphology on the roughness evolution of ultra thin DLC films

【作者】 Zhong, Min; Zhang, Chenhui; Luo, Jianbin

【刊名】 Applied Surface Science

【年卷期】 2008, 254(21):6742-6748

【关键词】 Substrates

【摘要】 The effect of substrate roughness on growth of ultra thin diamond-like carbon (DLC) films has been studied. The ultra thin DLC films have been deposited on silicon substrates with initial surface roughness of 0.15, 0.46 and 1.08 nm using a filtered cathodic vacuum arc (FCVA) system. The films were characterized by Raman spectroscopy, transmission electron microscope (TEM) and atomic force microscopy (AFM) to investigate the evolution of the surface roughness as a function of the film thickness. The experimental results show that the evolution of the surface morphology in an atomic scale depends on the initial surface morphology of the silicon substrate. For smooth silicon substrate (initial surface roughness of 0.15 nm), the surface roughness decreased with DLC thickness. However, for silicon substrate with initial surface roughness of 0.46 and 1.08 nm, the film surface roughness decreased first and then increased to a maximum and subsequently decreased again. The preferred growth of the valley and the island growth of DLC were employed to interpret the influence of substrate morphology on the evolution of DLC film roughness. © 2008 Elsevier B.V. All rights reserved.

【25】 Effect of surface physicochemical properties on the lubricating properties of water film

【作者】 Shuhai Liu, Jianbin Luo, Gang Li, Chenhui Zhang, Xinchun Lu

【刊名】 Applied Surface Science

【年卷期】 2008, 254:7137–7142

【关键词】 Interfacial energy

【摘要】 Effect of surface physicochemical properties on the water film confined within a nanogap was investigated. The film thickness and friction force were measured by the Relative Optical Interference Intensity (ROII) method and a UMT-2MT tribotester. It was found that the confined water film formed the thicker lubricate film than the prediction of elastic-isoviscous lubrication theory. Experimental results indicate that the higher the solid/water interfacial energy is, the thicker lubricate film the highly viscous "interphase" water layer forms and the lower the friction force is.

【26】 Double common-path heterodyne interferometer for the measurement of flying height modulation

【作者】 Dejiao Lin, Zhaoyang Yue, Nanhai Song, Yonggang Meng, Chunyong Yin

【刊名】 Measurement Science and Technology

【年卷期】 19(5): 055303 (2008)

【关键词】 Interferometers

【摘要】 A double common-path differential heterodyne interferometer is proposed to measure the flying height modulation (FHM) of a slider in a hard disk drive. A transverse Zeeman He-Ne laser is employed as the light source and high-speed phase measurement is applied for signal processing. The resolution and the sampling frequency of FH measurement are 0.1 nm and 500 kHz, respectively. According to the symmetrical optical path design, the environmental noise and Abbe error from the disk can be adaptively compensated. The experimental results show that the stability of the system is sub-nanometer in a normal laboratory without air conditioning, and the FHM of 3 nm is achieved when the pitch of the rotating disk is around 1.2 μm .

【27】 Criteria for entrapped gas under a drop on an ultrahydrophobic surface

【作者】 Wang J, Chen D

【刊名】 Langmuir

【年卷期】 24(18): 10174-10180 (2008)

【关键词】 Phase interfaces

【摘要】 Ultrahydrophobicity of a rough surface is mainly attributed to the entrapped gas under a drop. Two criteria were proposed for the entrapped gas: an intruding angle criterion and an intruding depth criterion. These two criteria are that the intruding angle must be less than the

maximum asperity slope angle and the intruding depth must be less than the height of the asperities. The intruding angle is determined by the true contact angle, the surface geometry, and the drop size. The intruding angle is directly proportional to the true contact angle, and it increases with an increase of the fractional area of the liquid-gas interface under the drop and with a decrease of the linear dimension of the three-phase contact line on the asperities. The effect of the drop size on the intruding angle is induced by Laplace and hydrostatic pressures. The intruding depth increases with an increase of the intruding angle and the distance between the asperities. The proposed criteria were evaluated using experiment data from the literature. Comparison between the experiment and calculation results showed that the experiment data supported the theory. © 2008 American Chemical Society.

【28】 Damages on steel surface at the incubation stage of the vibration cavitation erosion in water

【作者】 Chen H.S., Li J., Chen D.R., and Wang J.D.

【刊名】 Wear

【年卷期】 265: 692-698 (2008)

【关键词】 Surface analysis

【摘要】 To investigate the damage mechanism of the cavitation erosion at the incubation stage, a kind of polished 40Cr steel was used as the sample in the vibration cavitation erosion experiment. After 1-min experiment, three kinds of erosion pits were found on the sample surface, they are complete pits, incomplete pits and thermal pits in this paper. Numerical simulation of a bubble collapse process in Fluent environment explains the formations of the three kinds of erosion pits. The micro-jet with a strong radius flow around is the main reason for the complete pits and their step-like openings, the shock wave generated outside the jet function domain is the main reason for the incomplete pit, and the high temperature in the compressed bubble at the moment of collapse is considered as the reason for the formation of the thermal pits. © 2007 Elsevier B.V. All rights reserved.

【29】 A novel method of arraying permanent magnets circumferentially to generate a rotation magnetic field

【作者】 Zhang Wei, Meng Yonggang, Huang Ping

【刊名】 IEEE Transactions on Magnetics

【年卷期】 44(10): 2367-2372 (2008)

【关键词】 Magnetism

【摘要】 An outer magnetic field is extensively applied to drive the movement of a clinic micro-robot. However, how to produce a suitable magnetic field is a complicated problem. Commonly, the drive magnetic field is generated by a combination of power coils. This paper presents a novel method that circumferentially arrays identical permanent magnets to generate a rotational magnetic field in the center area of the array circle. First, we distribute permanent magnets uniformly in a circle, and adjust each of them at a corresponding initial angle. All of the magnets rotate in the same direction synchronously, generating a constant strength and reverse rotation magnetic field in the center area of the circle. The rotation speed of the generated magnetic field equals that of the permanent magnets. We used two models to analyze the magnetic field, and did some numerical analyses. We set up a test-bed and carried out some experiments to prove the feasibility of the novel method. The method seems to have wide applicability in designing magnets to drive micro-robots for diagnosis and treatment.

【30】 A PIV system for two-phase flow with nanoparticles

【作者】 Xu Xuefeng; Luo Jianbin; Yan Jing

【刊名】 International Journal of Surface Science and Engineering

【年卷期】 2008, 2(1-2):168-175

【关键词】 Two phase flow

【摘要】 The two-phase flow with nanoparticles (the solid liquid two-phase flow in which solid particles are from 1 nm to 100 nm) has been widely used in industries. A fundamental understanding of dynamics of nanoparticles in the flow is important and critical. In this study, a Particle Image Velocimetry (PIV) system has been developed to measure the movement of nanoparticles in the flow. The system utilises fluorescent core shell SiO₂ nanoparticles with a diameter around 55 nm as tracing particles. The error analysis of the system shows that the Brownian motion of particles plays a significant role in the accuracy of velocity measurements. By using the system, the velocity profile of nanoparticles in a channel flow is obtained and analysed. © 2008, Inderscience Publishers.

【31】 A revised Hilbert-Huang transformation based on the neural networks and its application in vibration signal analysis of a deployable structure

【作者】 Xun Jian, Yan Shaoze.

【刊名】 Mechanical Systems and Signal Processing

【年卷期】 2008, Vol 22/7 pp 1705-1723

【关键词】 Neural networks

【摘要】 A revised Hilbert-Huang method is proposed to deal with the non-linear and non-stationary signals generated from any kinds of the sensors, in order to overcome shortcomings of the Hilbert-Huang method, such as the end swings problem and the undesired intrinsic mode functions (IMFs) at the low-frequency range. Firstly, a radial basis function neural network is used as a pre-processor to extend the length of the signal at the both ends. Secondly, the empirical mode decomposition is applied to obtain IMFs. Thirdly, the selection process is employed to select the optimal IMFs. Finally, an energy-frequency-time distribution can be gained after the Hilbert transformation. Two simulated signals are analyzed to explain the pre- and the post-processor, respectively, by using the above two techniques. The efficiencies of the different bases are compared, and the length of signal extended is analyzed. The correlation coefficients between the analyzed signal and the IMFs are introduced to eliminate the undesired IMFs. In this paper, the revised HHT method has been applied to analyze vibration signals of a deployable structure. A simulated solar array setup is built, which contains six parts: the basal body, a locked mechanism, the synchronism mechanism, the connection joints, the driven parts, and two simulated panels. Vibration signals of the solar array setup in the deployed case that is knocked by a single impulse on the middle of the second panel are estimated, and the results show that the revised Hilbert-Huang method is efficient for non-linear and non-stationary signal analysis.

【32】 A simple method to calculate mobility with Jacobian

【作者】 Yang DC, Xiong J, Yang XD

【刊名】 Mechanism and Machine Theory

【年卷期】 2008, 43(9):1175-1185

【关键词】

【摘要】 Although many mobility formulae have been set in the last 150 years, unfortunately, some of them are not fit for many classical mechanisms and some are indigestible. This paper gives a simple method to calculate the mobility of all kinds of parallel mechanisms only with Jacobian matrixes. It can analyze composition of degrees-of-freedom and output speeds of moving platform in passing. Furthermore, this method can be used to determine the existence of inactive joints and equivalent serial chain of complicated parallel chain.

【33】 A study of the effect of model geometry and lubricant rheology upon the elastohydrodynamic lubrication performance of metal-on-metal hip joints

【作者】 Wang WZ, Jin ZM, Dowson

【刊 名】Proceedings of The Institution of Mechanical Engineers Part J-Journal of Engineering Tribology

【年卷期】222 (J3) : 493-501, 2008

【关键词】Elastohydrodynamic lubrication

【摘 要】Lubrication modelling is of great importance in the design of artificial hip joints, especially for the demand of long life expectancy of those joints employing a metal-on-metal bearing. Through lubrication analysis, the dimensions of the head/cup and the clearance between them can be reasonably determined, and thus, if fluid film lubrication can be generated in artificial hip joint replacements, the wear and related failure can be reduced. In the majority of published numerical studies of the lubrication of hip joints, the synovial fluid for the natural joint and bovine serum used for in vitro simulator testing of joint replacements have always been treated as isoviscous, incompressible Newtonian fluids because the viscosity of these lubricants is almost unchanged at high shear rate. However, all these biological lubricants generally exhibit non-Newtonian characteristics of shear thinning, particularly under relatively low shear rates, and display a second Newtonian plateau at high shear rates. In this paper, model geometry is investigated first to show that the ball-on-plane model is a reasonable approximation to a typical metal-on-metal hip joint bearing considered. Then, in order to accurately predict the film thickness and pressure, the Reynolds equation considering the shear thinning effect of biological lubricants is derived, based on the Rabinowitsch model and following Greenwood's approach. The non-Newtonian effect was considered through two effective flow factors in the sliding and leakage directions, respectively. Numerical simulations were conducted on the basis of an equivalent ball-on-plane model with an effective radius determined from the head radius and the radial clearance, showing the influence of the shear thinning effect. The general lubrication model based on the unified Reynolds equations model was solved for the film thickness and pressure distribution, and the FFT-based approach was utilized to speed up the time-consuming calculation of elastic deformation in a fully numerical lubrication analysis. The results showed that the predicted film thickness when considering the shear thinning effect was slightly larger than that from the isoviscous model. It was found, however, that if the viscosity of the lubricant is adopted as the asymptotic value at high shear rate, the isoviscous Newtonian model can also give accurate predictions of film thickness. This is due to the relatively high shear rate in the contact zone.

【34】Adaptive filtering under minimum information divergence criterion

【作 者】Ba-dong Chen, Yu Zhu, Jin-chun Hu, Zeng-qi Sun

【刊 名】International Journal of Control, Automation and Systems

【年卷期】2009,7(2), 157-164

【关键词】Probability density function

【摘 要】Traditional filtering theory is always based on optimization of the expected value of a suitably chosen function of error, such as the minimum mean-square error (MMSE) criterion, the minimum error entropy (MEE) criterion, and so on. None of those criteria could capture all the probabilistic information about the error distribution. In this work, we propose a novel approach to shape the probability density function (PDF) of the errors in adaptive filtering. As the PDF contains all the probabilistic information, the proposed approach can be used to obtain the desired variance or entropy, and is expected to be useful in the complex signal processing and learning systems. In our method, the information divergence between the actual errors and the desired errors is chosen as the cost function, which is estimated by kernel approach. Some important properties of the estimated divergence are presented. Also, for the finite impulse response (FIR) filter, a stochastic gradient algorithm is derived. Finally, simulation examples illustrate the effectiveness of this algorithm in adaptive system training.

【35】Adhesion and Friction Force Coupling of Gecko Setal Arrays: Implications for Structured Adhesive Surfaces

【作者】 Boxin Zhao, Noshir Pesika, Kenny Rosenberg, Yu Tian, Hongbo Zeng, Patricia McGuiggan, Kellar Autumn, and Jacob Israelachvili

【刊名】 Langmuir

【年卷期】 24, 1517-1524(2008)

【关键词】 Animals

【摘要】 The extraordinary climbing ability of geckos is partially attributed to the fine structure of their toe pads, which contain arrays consisting of thousands of micrometer-sized stalks (setae) that are in turn terminated by millions of fingerlike pads (spatulae) having nanoscale dimensions. Using a surface forces apparatus (SFA), we have investigated the dynamic sliding characteristics of setal arrays subjected to various loading, unloading, and shearing conditions at different angles. Setal arrays were glued onto silica substrates and, once installed into the SFA, brought toward a polymeric substrate surface and then sheared. Lateral shearing of the arrays was initiated along both the "gripping" and "releasing" directions of the setae on the foot pads. We find that the anisotropic microstructure of the setal arrays gives rise to quite different adhesive and tribological properties when sliding along these two directions, depending also on the angle that the setae subtend with respect to the surface. Thus, dragging the setal arrays along the gripping direction leads to strong adhesion and friction forces (as required during contact and attachment), whereas when shearing along the releasing direction, both forces fall to almost zero (as desired during rapid detachment). The results and analysis provide new insights into the biomechanics of adhesion and friction forces in animals, the coupling between these two forces, and the specialized structures that allow them to optimize these forces along different directions during movement. Our results also have practical implications and criteria for designing reversible and responsive adhesives and articulated robotic mechanisms.

【36】 An on-chip micro-friction tester for tribology research of silicon based MEMS devices

【作者】 Guo Zhanshe, Meng Yonggang, Wu Hao, Su Caijun

【刊名】 Microsystem Technologies

【年卷期】 14(1):109-118(2008)

【关键词】 MEMS

【摘要】 An on-chip micro-tribotester has been developed to investigate the friction and wear properties on side contacting surfaces of single crystal silicon that is most widely used in usual microelectromechanical systems actuators. The device is fabricated with standard bulk silicon process and bonding technology based on parameters that have been theoretically calculated to get the stiffness and friction forces. In this device, two comb shuttles are used. One comb shuttle is used to contact the friction surfaces under a certain normal load. The other comb shuttle moves back and forth to provide relative motion between the two friction surfaces. The tested two surfaces are the top surface of an anchor with rounded end and the lateral surface of a beam that has been connected to the two comb shuttles. Tribology experiments on the etched silicon surfaces that are side contacted have been carried out. Friction coefficients testing results suggest that dynamic friction coefficient is about 0.31-0.33 and the obtained static friction coefficient increases with the decrease of normal force. Wear experiment indicates that oxidation happens between the rubbing surfaces during the course of the testing. Wear debris is collected as agglomerates because of the function of adhesion force and water vapor and the agglomerates that are collected on top and lateral surfaces are of different shapes.

【37】 Dimensional synthesis and dynamic manipulability of a planar two-degree-of-freedom Parallel manipulator

【作者】 吴军, 汪劲松, 王立平, 绍华

【刊名】 Proceedings of The Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science

【年卷期】 222、6、1061-1069

【关键词】 Manipulators

【摘要】 This article deals with the dimensional synthesis and dynamic manipulability of a planar two-degree-of-freedom (DOF) parallel manipulator. The dimensional synthesis based on the workspace and velocity output ratio is presented. The dynamic formulation is derived by using the virtual work principle. Taking into account that the accelerating capabilities at a given point along all directions are more isotropic, the condition number of inertia matrix in the dynamic equation is presented as an index to evaluate the dynamic manipulability of a manipulator. Furthermore, two global performance indices, which consider the mean value and standard deviation of the condition number of inertia matrix, are proposed, respectively. The dynamic manipulability of the parallel manipulator is more isotropic in the centre than at the peripheries of the workspace. The parallel manipulator is incorporated into a four-DOF hybrid machine tool, which also includes a two-DOF worktable.

【38】 Dynamic dexterity of a planar 2-DOF parallel manipulator in a hybrid machine tool

【作者】 吴军, 汪劲松, 李铁民, 王立平, 关立文

【刊名】 Robotica

【年卷期】 26、1、93-98

【关键词】 Manipulators

【摘要】 This paper addresses the dynamic dexterity of a planar 2-degree of freedom (DOF) parallel manipulator with virtual constraint. Without simplification, the dynamic formulation is derived by using the virtual work principle. The condition number of the inertia matrix of the dynamic equation is presented as a criterion to evaluate the dynamic dexterity of a manipulator. In order to obtain the best isotropic configuration of the dynamic dexterity in the whole workspace, two global performance indices, which consider the mean value and standard deviation of the condition number of the inertia matrix, respectively, are proposed as the objective function. For a given set of geometrical and inertial parameters, the dynamic dexterity of the parallel manipulator is more isotropic in the center than at the boundaries of the workspace.

【39】 Efficient multi-folded Nd : YVO4 slab amplifier

【作者】 Gong ML,Wang Q,Huang L,Lu D,Liu Q

【刊名】 Optics Express

【年卷期】 2008,16(5):3349-3355

【关键词】 oscillator power-amplifier, phase-conjugate mirror, laser system

【摘要】 A high-efficiency multi-folded Nd:YVO4 slab amplifier is reported. Optimizing the mode overlapping carefully, high extraction efficiency was achieved using the wedged multi-folded configuration with two planar folding mirrors. The amplifier's performance under different seed powers and different pulse repetition frequencies (PRF) is presented. The 52 W seed at the PRF of 152 kHz was amplified to 101.75 W with the pump power of 92 W, and the corresponding extraction efficiency is 54.3%. And no remarkable deterioration of the beam quality was observed.

【40】 End-pumped 300 W continuous-wave ytterbium-doped all-fiber laser with master oscillator multi-stage power amplifiers configuration

【作者】 Yin SP,Yan P,Gong ML

【刊名】 Optics Express

【年卷期】 2008,16(22):17864-17869

【关键词】

【摘要】 An end-pumped ytterbium-doped all-fiber laser with 300 W output in continuous

regime was reported, which was based on master oscillator multi-stage power amplifiers configuration. Monolithic fiber laser system consisted of an oscillator stage and two amplifier stages. Total optical-optical efficiency of monolithic fiber laser was approximately 65%, corresponding to 462 W of pump power coupled into laser system. We proposed a new method to connect power amplifier stage, which was crucial for the application of end-pumped combiner in high power MOPAs all-fiber laser.

【41】 Experimental demonstration of isotropic negative permeability in a three-dimensional dielectric composite

【作者】 Qian Zhao, Lei Kang, B. Du, H. Zhao, Q. Xie, X. Huang, B. Li, J. Zhou, and L. Li

【刊名】 Physical Review Letters

【年卷期】 101, 027402 (2008)

【关键词】 Resonance

【摘要】 Isotropic negative permeability resulting from Mie resonance is demonstrated in a three-dimensional (3D) dielectric composite consisting of an array of dielectric cubes. A strong subwavelength magnetic resonance, corresponding to the first Mie resonance, was excited in dielectric cubes by electromagnetic wave. Negative permeability is verified in the magnetic resonance area via microwave measurement and the dispersion properties. The resonance relies on the size and permittivity of the cubes. It is promising for construction of novel isotropic 3D left-handed materials with a simple structure.

【42】 Experimental Research on Vibration Assisted EDM of Micro Structures with Non-circular Cross Section

【作者】 H. Tong, Y. Li, Y. Wang

【刊名】 Journal of Materials Processing Technology

【年卷期】 Vol 208, No. 1-3 (2008) pp. 289-298

【关键词】 Electric discharge machining

【摘要】 In micro-electrical discharge machining (EDM) of micro-structures with non-circular cross-section, the machining efficiency may be extraordinarily low due to the difficulties for dielectric liquid to flow and discharged debris to be removed out of the narrow discharge gap. To improve the machining efficiency and accuracy, the method of assisting workpiece vibration was introduced into such micro-EDM process using the tool electrodes with non-circular cross-section or array structures. The micro-amplitude vibration of workpiece was realized by applying high-frequency sine-wave voltage to drive a piezoelectric (PZT) actuator. A number of machining experiments were designed and carried out by changing the frequency and the amplitude of vibration at different discharge parameters. The experimental results showed that the effective discharge ratio increased obviously due to the assisting high-frequency vibration. Moreover, the increase of the effective discharge ratio also increased the spark explosive force, which could accelerate the dielectric liquid circulation and debris removal during the EDM process assisted with workpiece vibration. Therefore the machining stability, the machining accuracy and efficiency of the micro-EDM process are improved. The machining efficiency increased 18 times and the dimension accuracy improved by 10.5 μm when using a tungsten electrode of $\text{Ø}175 \mu\text{m}$ at the vibration frequency of 6 kHz and the amplitude of 3 μm . In this study, the emphasis is laid on the effects of assisting workpiece vibration with gap servo control on the EDM performance of micro-structures. Furthermore, the process principle of the effects is analyzed to explain our experimental results. The experimental data and the process analysis suggest that higher frequency vibration helps to acquire higher machining efficiency, and good machining effects can be obtained when the vibration amplitude is set nearly equal to the discharge gap.

【43】 Ferrite-based magnetically tunable left-handed metamaterial composed of SRRs and wires

【作者】 Lei Kang, Qian Zhao, Hongjie Zhao, and Ji Zhou

【刊名】 Optics Express

【年卷期】 16, (22) 17269 (2008)

【关键词】 Materials science

【摘要】 We experimentally demonstrate a magnetically tunable left-handed metamaterial by introducing yttrium iron garnet rods into SRRs/wires array. It shows that the left-handed passband of the metamaterial can be continuously and reversibly adjusted by external dc applied magnetic fields. Retrieved effective parameters based on simulated scattering parameters show that tunable effective refraction index can be conveniently realized in a broad frequency range by changing the applied magnetic field. Different from those tuned by controlling the capacitance of equivalent LC circuit of SRR, this metamaterial is based on a mechanism of magnetically tuning the inductance via the active ambient effective permeability.

【44】 Gait Synthesis and Sensory Control of Stair Climbing for a Humanoid Robot

【作者】 付成龙

【刊名】 Ieee Transactions On Industrial Electronics

【年卷期】 Vol.55, No.5, pp 2111-2120, 2008.

【关键词】 Anthropomorphic robots

【摘要】 Stable and robust walking in various environments is one of the most important abilities for a humanoid robot. This paper addresses walking pattern synthesis and sensory feedback control for humanoid stair climbing. The proposed stair-climbing gait is formulated to satisfy the environmental constraint, the kinematic constraint, and the stability constraint; the selection of the gait parameters is formulated as a constrained nonlinear optimization problem. The sensory feedback controller is phase dependent and consists of the torso attitude controller, zero moment point compensator, and impact reducer. The online learning scheme of the proposed feedback controller is based on a policy gradient reinforcement learning method, and the learned controller is robust against external disturbance. The effectiveness of our proposed method was confirmed by walking experiments on a 32-degree-of-freedom humanoid robot.

【45】 Homing strategy for a redundantly actuated parallel kinematic machine

【作者】 汪劲松, 吴军, 王立平, 李铁民

【刊名】 Journal of Mechanical Design

【年卷期】 130、4、0445011-0445015. 2008.

【关键词】 Kinematics

【摘要】 In the homing process of a regular parallel kinematic machine (PKM), all servoaxes are independently driven to return to their homing positions. However in a redundantly actuated PKM, the redundant limb will interfere with other servoaxes. This paper concerns the homing of a redundant four degree of freedom PKM, and an assistant homing strategy is proposed for the machine to pass the singular configuration in the homing process. After the assistant homing is finished, the other four nonredundant axes are driven to return to their home positions independently. Based on the kinematic model and the length of the redundant limb, the condition that the redundant limb performs assistant homing is determined. The homing strategy is incorporated into the numerical control system of the studied PKM. The test shows that the homing strategy is effective, and it can also be useful for other kinds of redundantly actuated PKMs.

【46】 HYDES: A Web-based hydro turbine fault diagnosis system

【作者】 Song GX, He YY, Chu FL

【刊名】 Expert Systems With Applications

【年卷期】 2008, 34(1): 764-772.

【关键词】 Turbines

【摘要】 The hydro turboset is the key equipment of the electric power system. Thus, it is very important and necessary to monitor and diagnose the running conditions and the faults of the hydro turboset for the safe and normal running of the electric power system. Fault diagnosis of the hydro turbine is a complicated process and requires a high level of expertise. In order to significantly reduce the cost consumed in the fault diagnosis, to increase the consistency of diagnosing decision-making, and to better utilize the turbine's management information resource, in this paper, an integrated Web-based expert system of the fault diagnosis has been developed for the hydro turbine of a power station. Moreover, it can be regarded as an advisory tool to those who have much technical experience and as a training tool for the less-experienced personnel who seek guidance and advice. This paper describes a research project aiming to develop a Web-based intelligent diagnosis system for the hydro turbine and discusses the process of the fault diagnosis and the difficulties involved in developing the system. The paper also includes several practical issues related to the architectures of the intelligent Web-based applications. The system is built on a three-tier architecture, including the following components: knowledge base, inference engine, knowledge administration interface, user interface, knowledge administration unit and integrated database. The expert system employs heuristic rules to diagnose the hydro turbine fault. Some issues on developing Web-based expert systems are also discussed.

【47】 Identification of dynamic parameter of a 3DOF parallel manipulator with actuation redundancy

【作者】 吴军, 汪劲松, 王立平

【刊名】 Journal of Manufacturing Science and Engineering

【年卷期】 130、4、0410121-0410127

【关键词】 Identification (control systems)

【摘要】 This paper deals with the dynamic parameter identification of a 3DOF parallel manipulator with actuation redundancy. A method for finding the parameter linear form of the dynamic equation is presented. Based on the virtual work principle, the dynamic equation for the application of dynamic parameter identification is obtained by extracting the dynamic parameters from inertial forces and moments of moving parts. Two-step identification approach is used to identify the dynamic parameters of the redundantly actuated parallel manipulator. The approach consists of two steps and utilizes simple point-to-point motions that lead to a separation of friction and rigid-body dynamics. The identified results are validated by experiments. Moreover, the experimental application of the identified model to a machine tool, which is created by combining the parallel manipulator with a 2DOF worktable, demonstrates the efficiency of dynamic parameter identification.

【48】 Investigations on Transverse-Mode Competition and Beam Quality Modeling in End-Pumped Lasers

【作者】 Gong Mali, Lu Chengqiang, Yan Ping, Wang Yunxiang

【刊名】 Ieee J. Quantum Electron

【年卷期】 2008, 44(11-12): 1009-1019

【关键词】 modeling, multimode rate equations, thermal effect, transverse-mode competition, solid-state lasers, optimization

【摘要】 The transverse-mode competition and beam quality modeling in scaling fiber-coupled laser diode (LD) end-pumped lasers to higher power and better beam quality have been investigated with the space-dependent multimode rate equations by including the thermal effect. The total photon number and threshold of the pumping rate for each mode in the cavity were

obtained by solving these equations with an iterative method, and so the threshold of the pumping power, output power, optical and slope efficiency of the single mode and laser could all be calculated. Several lasers, including one ideal laser, one multimode laser, one quasi-fundamental mode laser with folded structure, were brought forward to demonstrate the modeling process and investigate the transverse-mode competition process. The calculated results were compared with the experimental ones and the rationality of the model built in this paper was validated. The model presented here may serve as the designing guideline for a practical laser, especially one with beam quality requirement.

【49】 Magnetic control of negative permeability metamaterials based on liquid crystals

【作者】 Fuli Zhang, Qian Zhao, Lei Kang, Davy P. Gaillot, Xiaopeng Zhao, Ji Zhou, and Didier Lippens

【刊名】 Applied Physics Letters

【年卷期】 92, 193104 (2008)

【关键词】 Magnetic materials

【摘要】 We report on the tunability, by a magnetic field, of a negative permeability metamaterial consisting of stacked arrays of broadside-coupled split ring resonators infiltrated with liquid crystals (LCs). The resonant frequency shift was numerically assessed by a rigorous anisotropic analysis of the reorientation of LC molecules. Experiments were carried out with a prototype designed and fabricated for X-band operation and infiltrated with a nematic compound with optical birefringence $\Delta n=0.18$. Scattering parameters vectorial analysis shows a good agreement between the resonant frequency shifts predicted under anisotropic conditions and those measured under static magnetic control.

【50】 Magnetic tuning of electrically resonant metamaterial with inclusion of ferrite

【作者】 Lei Kang, Qian Zhao, Hongjie Zhao, and Ji Zhou

【刊名】 Applied Physics Letters

【年卷期】 93, 171909 (2008)

【关键词】 Tuning

【摘要】 We experimentally demonstrate a magnetic tuning of electrically resonant metamaterial (EMM) at microwave frequencies by introducing microwave ferrite rods into the periodic array of electrically resonant element. Different from those based on controlling the capacitance of equivalent LC circuit, this tunability arises from a mechanism of magnetically tuning the inductance of resonant element via the active ambient effective permeability. For magnetic fields from 0 to 5000 Oe, resonance frequency of the EMM can be continuously and reversibly tuned in a range of about 800 MHz. The active effective permittivity has also been investigated through the simulated scattering parameters.

【51】 Novel Q-switching method with mechanical all-fiber module

【作者】 Gong M, Peng B, Liu Q, Yan P

【刊名】 Laser Physics Letters

【年卷期】 2008,5(10):733-736

【关键词】 yb fiber laser, active q-switch, optical fiber losses, high-power

Laser, modulation

【摘要】 We propose a novel mechanical method to produce laser pulses. The laser cavity includes two pieces of fibers, and at least one of them is active fiber acting as gain medium. A piezo-electric actuator is utilized to modulate the transmitted power between the fibers, and thus changed the round-trip loss in the fiber laser cavity Q-switching pulses are successfully achieved up to the repetition rate of 10 kHz. Output pulses with 412 ns width and 10 mW average power are obtained at 200 Hz repetition rate.

【52】 Numerical investigation of metamaterials infiltrated by liquid crystal

【作者】 Fuli Zhang, Qian Zhao, Davy P. Gaillot, Xiaopeng Zhao, and Didier Lippens

【刊名】 J. Opt. Soc. Am. B

【年卷期】 25,(11): 1920-1925 (2008)

【关键词】 Metamaterials

【摘要】 We present a comprehensive analysis of the influence of liquid crystal (LC) molecules' reorientation on the electromagnetic behaviors of S-type left-handed metamaterials (LHMs) by considering an isotropic and anisotropic approach, respectively. It is shown that the frequency shift of the magnetic resonance as a function of the LC molecules' reorientation is reversed with a blue shift for the isotropic case and a red shift for the anisotropic one, the latter being in agreement with experiment. For the electric plasma frequency shift, a large quantitative difference is pointed out by the two approaches, although the frequency variation trend is similar. The fact that the scattered electric field is no longer polarized like the incident beam explains these differences, resulting in the unsuitability of an isotropic treatment of LC compounds infiltrated into metamaterials.

【53】 Optimal kinematic design and application of a redundantly actuated 3DOF planar parallel manipulator

【作者】 吴军, 汪劲松, 王立平

【刊名】 Journal of Mechanical Design

【年卷期】 130、5、0545031-0545035 (2008)

【关键词】 Manipulators

【摘要】 This paper addresses optimal kinematic design and application of a redundantly actuated parallel manipulator with 3DOFs. Based on the kinematic model, the Jacobian matrix is derived and then transferred to a uniform form such that the conditioning index has explicit physical meaning. Based on the task workspace, the width between two columns is determined. Then, a comprehensive performance index, which compromises the conflict between workspace utilization performance measure and conditioning index, is proposed for the optimum design. The parallel manipulator is incorporated into a 4DOF hybrid machine tool, which also includes a feed worktable. Furthermore, a 5DOF machine tool is created by combining the parallel manipulator with a 2DOF worktable to machine blades of gas turbines.

【54】 Orientation capability, error analysis, and dimensional optimization of two articulated tool heads with parallel kinematics

【作者】 刘辛军 and Ilian A. Bonev

【刊名】 Journal of Manufacturing Science and Engineering -Transactions of The ASME

【年卷期】 130、1、Article Number: 011015 (2008)

【关键词】 Error analysis

【摘要】 Because of the increasing demand in industry for A/B-axis tool heads, particularly in thin wall machining applications for structural aluminium aerospace components, the three-degree-of-freedom articulated tool head with parallel kinematics has become very popular. This paper addresses the dimensional optimization of two types of tool head with 3-PVP HS and 3-PVRS parallel kinematics (P, R, and S standing for prismatic, revolute, and spherical joint, respectively; the subscripts V and H indicating that the direction of the P joint is vertical or horizontal, and the joint symbol with underline means the joint is active) by considering their orientation capability and positioning accuracy. We first investigate the tilt angle of the spherical joint, the orientation capability, and the error of one point from the mobile platform caused by input errors. Optimization of the 3-PVPHS tool head is easy. For the 3-PVRS tool head, a design space is developed to illustrate how the orientation capability and error index are related to the

link lengths. An optimization process is accordingly presented. Using the optimization method introduced here, it is not difficult to find all the possible optimal solutions.

【55】 Q-switched operation with Fox-Smith-Michelson laser cavity

【作者】 Huang X, Huang L, Gong M

【刊名】 Laser Physics Letters

【年卷期】 2008,5(3): 189-192

【关键词】 fox-smith cavity, michelson cavity, q-switch, nd-yvo4 laser, coherent addition, intracavity, power, output, khz

【摘要】 A new kind of three-mirror composite cavity, Fox Smith-Michelson cavity has been configured. This laser cavity is capable of high power output, owing to the low threshold Michelson cavity. Also, thanks to the mode selection function of Fox-Smith cavity, stable pulses at high repetition rate can generated. In our experiment, 15.54 W CW output at 1064 nm has been achieved, with an optic to-optic conversion efficiency of 42.2%. At the Q- switching repetition rate of 100 kHz, the average output power si 11.92 W, with an optic-to-optic conversion efficiency of 38.2%. For Q-switching frequency from 30 Khz to100 kHz, the pulse width amplitude variation is below 4.8%.

【56】 Servo Scanning 3D Micro-EDM Based on Macro/micro-dual-feed Spindle

【作者】 H. Tong, Y. Li, Y. Wang, D. Yu

【刊名】 International Journal of Machine Tools & Manufacture

【年卷期】 48 (2008) pp.858-869

【关键词】 micro-edm, servo scanning machining, 3d micro-structure, macro/micro-dual-feed spindle, linear motor, pzt actuator

【摘要】 Using the end discharge of micro-rod-shaped electrode to scan layer by layer, micro-electrical discharge machining (EDM) can fabricate complex 3D micro-structures. During the machining process, the discharge state is broken frequently due to the wear of the tool] electrode and the relative scanning motion. To keep a favorable discharge gap, the feed spindle of the tool electrode needs the characteristics of high-frequency response and high resolution. In this study, an experimental system with a macro/micro-dual-feed spindle was designed to improve the machining performance of servo scanning 3D micro-EDM (3D SSMEDM), which integrates an ultrasonic linear motor as the macro-drive and a piezoelectric (PZT) actuator as micro-feeding mechanism. Based on LabVIEW and Visual C++ software platform, a real-time control system was developed to control coordinately the dual-feed spindle to drive the tool electrode. The micro-feed motor controls the tool electrode to keep the favorable discharge gap, and the macro-drive motor realizes long working range by a macro/micro-feed conversion. The emphasis is paid on the process control of the 3D SSMEDM based on macro/micro-dual-feed spindle for higher machining accuracy and efficiency. A number of experiments were carried out to study the machining performance. According to the numerical control (NC) code, several typical 3D micro-structures have been machined on the P-doped silicon chips. Our study results show that the machining process is stable and the regular discharge ratio is higher. Based on our fundamental machining experiments, some better-machined effects have been gained as follows. By machining a micro-rectangle cavity (960 μm x 660 μm), the machined depth error can be controlled within 2%, the XY dimensional error is within 1%, the surface roughness R-a reaches 0.37 μm , and the material removal rate is about $1.58 \times 10^4 \mu\text{m}^3/\text{s}$ by using a tool electrode of $\Phi = 100 \mu\text{m}$ in diameter. By machining multi-micro-triangle cavities (side length 700 μm), it is known that the machining repeatability error is $<0.7\%$.

【57】 Single-passed passively mode-locked Nd:YVO4 picosecond laser with SESAM

【作者】 Wushouer X, Yu H, Gong M, Yan P.

【刊 名】Laser Physics

【年卷期】2008,18(11):1164-1170

【关键词】42, 55, xi, 42, 60, da, 42, 60, pk, nd-yvo4 laser, nd-gdvo4 laser, intracavity, crystal, locking

【摘 要】We report on the LD-pumped passively mode-locked solid-state laser with SESAM (semiconductor saturable absorber mirror), in which the output beam is single passed through a flat mirror. The CW mode-locking pulse at 1064 nm, with an output power of 5 W, a pulse repetition rate of 98 MHz, and a pulse width of 25.3 ps. The beam quality is $M^2 < 1.12$ and the optical-optical efficiency is 35.7%.

【58】Study on combined influence of inter-asperity cavitation and elastic deformation of non-Gaussian surfaces on flow factors

【作 者】Meng FM , Qin DT , Chen HB , Hu YZ , Wang H

【刊 名】Proceedings of The Institution of Mechanical Engineers Part C-Journal of Mechanical Engineering Science

【年卷期】222 (6) : 1039-1048, 2008

【关键词】inter-asperity cavitation, elastic deformation, flow factors, non-gaussian surfaces, digital filter technique, rough-surface, hydrodynamic lubrication, model, simulation

【摘 要】The combined influence of inter-asperity cavitation and elastic deformation of non-Gaussian surfaces on flow factors is numerically investigated based on the equations for flow factor analyses, since some engineering surfaces are non-Gaussian. For this task, non-Gaussian surfaces are generated at first through a digital filter technique by using authors' computer code whose validity is proven. The numerical results show that the pressure flow factor increases whereas the shear flow factor decreases with low film thickness-to-roughness ratio ($h/\sigma < 3$ or so). This is due to the above-said combined influence, if the oblique flow of lubricant is not obvious. But for a high film thickness-to-roughness ratio (approximately $h/\sigma \geq 3$), the combined influence becomes weaker, hence ignored. Therefore, the above-said combined effect similar to the one from Gaussian surface circumstances ought to be considered in flow factor analyses and their applications.

【59】Theoretical and experimental study on transverse mode competition in a partial-coiled multimode fiber laser

【作 者】Yuan Y,Gong M,Li C,Yan P

【刊 名】Laser Physics

【年卷期】2008,18(1):52-57

【关键词】diffraction-limited output, doped fiber, operation, amplifiers, power

【摘 要】A model derived from propagation-rate equations with consideration of transverse-hole burning, the mode-coupling effect, and longitudinal-distributed loss for a laser signal is built up to describe the transverse mode competition in multimode fiber lasers. Based on the model, theoretical analysis on transverse mode competition in a partial-coiled multimode fiber laser, which introduced longitudinal-distributed loss, is presented. An experimental laser system applying this fiber is also demonstrated. To study the transverse mode competition, we changed the coiled length of the fiber and measured the output beam quality to compare with calculated values. The experimental results agree with the theoretical analysis.

【60】Thermal analysis of a novel compact packaged passively cooled laser diode array

【作 者】Yin C,Huang L,He FH,Gong M

【刊 名】IEEE Transactions On Components and Packaging Technologies

【年卷期】2008,31(3): 642-649

【关键词】heat transfer, laser diode array (lda), thermal analysis, industrial applications, reliability

【摘要】The temperature of a laser diode array chip must be maintained under a safe level during operation in order to achieve satisfactory performance and lifetime. In this paper, 3-D thermal analysis on diode heatsink is presented. The boundary condition at the bottom of heatsink is constant convective heat transfer coefficient. In addition, heat transfer in thermal-entry region of tubes is accounted for to calculate the convective heat transfer coefficient. Moreover, a 12 mm x 37 mm x 7 mm passively cooled laser diode array cooled by a base heatsink is demonstrated. Up to 62 W output power with an electrical-to-optical conversion efficiency of 49.2% are achieved. System thermal resistance of 0.77 K/W is obtained when the flow rate through the base heatsink with 0.8-mm-wide, 2-mm-high and 20-mm-long channels is 25 cm³/s.

【61】 Tunable negative permeability in an isotropic dielectric composite

【作者】 Zhao Qian, Du Bo, Kang Lei, Zhao Hongjie, Xie Qin, Li Bo, Zhang Xing, Zhou Ji, Li Longtu, Meng Yonggang

【刊名】 Applied Physics Letters

【年卷期】 92(5):051106(2008)

【关键词】 Ceramic materials

【摘要】A tunable isotropic negative effective permeability is experimentally demonstrated in a three-dimensional (3D) dielectric composite consisting of dielectric ceramic cube arrays by temperature changing. It shows that a strong subwavelength magnetic resonance can be excited in dielectric cubes corresponding to the first Mie resonance mode and can be continuously and reversibly adjusted from 13.65 to 19.28 GHz with the temperature changing from -15 to 35 °C. Accordingly, negative permeability can be performed in the frequency range of about 6 GHz by adjusting the temperature. It provides a convenient route to design adaptive metamaterials and 3D invisible cloak.

【62】 Vibration-assisted Servo Scanning 3D Micro EDM

【作者】 H. Tong, Y. Wang and Y. Li

【刊名】 Journal of Micromechanics and Microengineering

【年卷期】 Vol.18, No.2 (2008) pp.501-508

【关键词】 Electric discharge machining

【摘要】In scanning micro electrical discharge machining (EDM), the machining time for a 3D mould cavity is longer due to the smaller discharge area of a thin wire tool electrode. Moreover, a stable discharge area is hardly kept because of the scanning motion, resulting in a lower discharge ratio. To improve the machining process, a method of workpiece vibration-assisted servo scanning 3D micro EDM is developed. 3D micro structures are machined by tool electrode scanning layer by layer according to the numerical control (NC) code. Micro-amplitude assisting vibration is realized by adopting a piezoelectric (PZT) actuator driven by high-frequency sinewave voltage. Tool electrode wear is real-time compensated in the axial direction by keeping a discharge gap. A number of experiments were carried out to machine a micro rectangular cavity (900 μm × 600 μm), and the process model of vibration-assisted servo scanning EDM was established. In addition, several typical 3D micro structures have been machined. The process-model analysis and the experimental results show that the occurring frequency of the favorable discharge gap increases obviously during the machining process assisted with high-frequency vibration, so that the machining stability and the effective discharge ratio are improved. The machining efficiency increases to 6.5 times at the assisting vibration frequency of 5 kHz and the amplitude of 2.7 μm, and the material removal rate on red copper plate reaches about $1.4 \times 10^5 \text{ μm}^3 \text{ s}^{-1}$ with a tool electrode of 100 μm in diameter.

【63】 Unusual stress behaviour of CeO₂-doped diamond-like carbon nanofilms

【作者】Zhang, ZY, Lu, XC, Luo, JB

【刊名】PHILOSOPHICAL MAGAZINE LETTERS

【年卷期】88、145-151, 2008

【关键词】TRIBOLOGICAL PROPERTIES; DEPOSITION; FILMS; COATINGS; MICROSTRUCTURE; ACTIVATION; OXIDE

【摘要】CeO₂-doped diamond-like carbon (DLC) films with thicknesses of 180-200 nm were deposited by unbalanced magnetron sputtering. When the CeO₂ concentration is in the range 5-8%, the residual compressive stress of the deposited films is reduced by 90%, e.g. from about 4.1 GPa to 0.5 GPa, whereas their adhesion strength increases. These effects are attributed to the dissolution of CeO₂ within the DLC amorphous matrix and a widening interface between the DLC film and the Si substrate, respectively.

【64】103W high beam quality green laser with an extra-cavity second harmonic generation

【作者】Liu Q, Yan XP, Gong ML, Fu, X, Wang DS

【刊名】Optics Express

【年卷期】2008, 16(19):14335-14340

【关键词】ND-YAG LASER; HIGH-POWER; LIB3O5 CRYSTAL; AMPLIFIER

【摘要】High-power high-beam-quality 1.34 μm continuous-wave laser with twin Nd:YVO₄ crystals pumped by four fiber-coupled laser diodes, which constructed a double-end-pumping structure, is reported. With total 60 W pumping power incident, the highest 16.4 W output laser power was generated, the slope efficiency and optical efficiency were measured as better than 30.0% and 27.3%, respectively. With 12 W laser output, the beam quality was measured to be better than two times diffraction-limit and the instability of laser output was determined to be better than 1% over an hour time.

【65】16.4 W laser output at 1.34 μm with twin Nd:YVO₄ crystals and double-end-pumping structure

【作者】Lu C, Gong M, Liu Q, Huang L, He F

【刊名】Laser Physics Letters

【年卷期】2008, 5(1):21-24

【关键词】1.34 μm laser • Nd:YVO₄ • high beam quality

【摘要】High-power high-beam-quality 1.34 μm continuouswave laser with twin Nd:YVO₄ crystals pumped by four fiber-coupled laser diodes, which constructed a double-end-pumping structure, is reported. With total 60 W pumping power incident, the highest 16.4 W output laser power was generated, the slope efficiency and optical efficiency were measured as better than 30.0% and 27.3%, respectively. With 12 W laser output, the beam quality was measured to be better than two times diffraction-limit and the instability of laser output was determined to be better than 1% over an hour time.

【66】2 MHz AO Q-switched TEM₀₀ Grazing Incidence Laser With 3 at.% Neodymium Doped Nd:YVO₄

【作者】Yan Xingpeng, Huang Lei, Liu Qiang, He Fahong, Fu Xing, Wang Dongsheng, Gong Mali

【刊名】Ieee J. Quantum Electron.

【年卷期】2008, 44(12): 1164-1170.

【关键词】PUMPED ND-YVO₄ LASER; SOLID-STATE LASERS; SLAB LASER; MODE

【摘要】We present a detailed experimental and theoretical study of the ultrahigh repetition rate AO Q-switched TEM₀₀ grazing incidence laser. Up to 2.1 MHz Q-switching with TEM₀₀ output of 8.6 W and 2.2 MHz Q-switching with multimode output of 10 W were achieved by using an acousto-optics Q-switched grazing-incidence laser with optimum grazing-incidence angle and

cavity configuration. The crystal was 3 at.% neodymium doped Nd:YVO₄ slab. The pulse duration at 2 MHz repetition rate was about 31 ns. The instabilities of pulse energy at 2 MHz repetition rate were less than +/- 6.7% with TEM₀₀ operation and +/- 3.3% with multimode operation respectively. The modeling of high repetition rate Q-switched operation is presented based on the rate equation, and with the solution of the modeling, higher pump power, smaller section area of laser mode, and larger stimulated emission cross section of the gain medium are beneficial to the Q-switched operation with ultrahigh repetition rate, which is in consistent with the experimental results.

【67】 A 108 W, 500 kHz Q-switching Nd:YVO₄ laser with the MOPA configuration

【作者】 Yan XP, Liu Q, Fu X, Wang YX, Huang L, Wang DS, Gong ML

【刊名】 Optics Express

【年卷期】 2008, 16(5): 3356-3361

【关键词】 REPETITION-RATE; ND-YAG

【摘要】 high power, dual-end-pumped Nd:YVO₄ laser with a MOPA configuration was stably Q-switched at repetition rate up to 500 kHz. The thermally bonded Nd:YVO₄ crystal was used in our experiment. In acousto-optically Q-switching operation at repetition rate of 500 kHz, 35 W average power was produced by the oscillator, with optical-optical efficiency of 41.7%. 108 W average power was obtained by a master oscillator power amplifier (MOPA) configuration including two amplifier stages, corresponding to the total optical-optical efficiency of 42.2%. The pulse duration was 48 ns, with a stability of pulse peak value < 2.5%. The beam quality was better than two-times diffraction-limit ($M_x(2) = 1.99$, $M_y(2) = 1.76$).

【68】 A chamfered-edge-pumped planar waveguide laser

【作者】 Gong M, Zhang H, Kang H, Wang D, Huang L, Yan P, Liu Q

【刊名】 Laser Physics Letters

【年卷期】 2008, 5(7):518-521

【关键词】 solid-state laser; planar waveguide laser; pump scheme; chamfered-edge-pumping

【摘要】 A novel pump scheme-chamfered-edge-pumping was employed for pumping a planar waveguide laser: A 12 mm-long edge was chamfered as a 0.2 mm wide bevel, pump light from the fast-axis-collimated LID was focused and coupled into the crystal through the chamfered-edge with a pump efficiency of 82%. The single-clad YAG/Nd:YAG/YAG planar waveguide was fabricated by thermal bonding technology with the geometry of 12 mm x 5 mm x 1 mm, which Nd:YAG core was 0.2 mm thick and symmetry claddings were 0.4 mm thick. A maximum output power of 15.5 W at 1064 nm with a slop efficiency of 37%, an optical-optical conversion efficiency of 31 % and a M-2 value of 1.6 in the guided direction was achieved for a pump power of 50 W. The laser system realized a relatively high optical-optical conversion efficiency and excellent beam quality in guided direction.

【69】 A configuration of the water-jet guided pump for the fiber laser

【作者】 Gong M, Huang L, Huang Y, Zhang H, Yan X, Yan P

【刊名】 Laser Physics Letters

【年卷期】 2008, Vol.5, No.10, 584-587

【关键词】 fiber laser; water-jet guided pump; thermal effects

【摘要】 The water-jet guided pump (WJGP) is newly proposed to solve the serious thermal effects in high power end-pumped fiber lasers. In this pumping scheme, the pumping light is coupled into the water-jet similar to an optical fiber. The light is guided by the jet and pumped into a following fiber. The experiment of WJGP double-clad fiber is carried out and the maximum coupling efficiency is 71.4%.

【70】 A diode side-pumped YAG/Nd : YAG/YAG composite crystal laser

【作者】 Kang H,Zhang H,Wang D,Huang L,Yan P,Liu Q,Gong M

【刊名】 Laser Physics

【年卷期】 2008, 18(8) :947-950.

【关键词】 ND-YAG; RODS

【摘要】 A diode-bar side-pumped YAG/Nd:YAG/YAG composite crystal laser is presented. A maximum output power of 18.4 W at 1.064 μm with a slope efficiency of 57% and an optical-optical conversion efficiency of 46% was obtained for a pump power of 40 W. Compared with a side-pumped conventional crystal laser in the same experimental conditions, the side-pumped composite crystal laser improved the optical-to-optical conversion efficiency by 12%. Experimental results indicate that a composite crystal can depress the thermal effects effectively and improve the optical-to-optical conversion efficiency easily in the diode side-pumped lasers. The composite crystal has great potential in high-power diode side-pumped lasers.

【71】 A fundamental mode miniature acousto-optically Q-switched Nd : YVO₄ laser with short pulse width at high repetition rates

【作者】 Wang Y,Huang L,Zhang H,Yan X,Liu Q,Gong M

【刊名】 Laser Physics Letters

【年卷期】 2008,5(4) 286-290

【关键词】 lasers; acousto-optically Q-switched; high repetition rate; short pulse width; fundamental mode

【摘要】 A miniature, high repetition rate, short pulse width acousto-optically Q-switched Nd:YVO₄ laser in fundamental mode is presented. Miniature solid-state lasers have the characteristics of short cavity length and small mode area in the cross section, which, on the one hand, benefits high gain, high repetition rate and short pulse width, on the other hand, makes it difficult to achieve high mode-matching efficiency and causes higher order modes oscillation. The thermal lens in Nd:YVO₄ is treated as thick lens under high pump intensity. The mode-matching efficiency is analyzed with the thermal lens being equivalent to a thin lens array. In high repetition rate Q-switching operation, 3.6 ns pulses at 500 kHz repetition rate with 20 mm cavity length and 4.1 kW peak power are achieved, without active control of pump beam quality. The laser beam quality factors were measured to be $M_x(2) = 2.03$, $M_y(2) = 2.46$. By improving the pump beam quality and utilizing the optimal pump beam waist radius and location, the mode-matching efficiency and laser beam quality are improved. 4.0 ns pulses at 500 kHz with 2.5 kW peak power are produced. The beam quality factors were measured to be $M_x(2)=1.31$, $M_y(2) = 1.43$.

【72】 A high efficient one-end-pumped TEM₀₀ laser with optimal pump mode

【作者】 Yan X,Liu Q,Huang L,Wang Y,Huang X,Wang D,Gong M

【刊名】 Laser Physics Letters

【年卷期】 2008, 5(3): 185-188

【关键词】 high efficiency; one-end-pumped; mode matching; optimal pump mode

【摘要】 An one-end-pumped Nd:YVO₄ laser with fiber-coupled diode is designed. The mode matching between pump mode and laser mode is analyzed, and the optimum mode matching coefficient is obtained by optimizing the pump mode. Based on the optimal pump mode, a 14.2W TEM₀₀ mode CW laser is obtained with a optical-optical efficiency of 55.7% at 1064 nm with M² factors of $M_x(2)=1.16$, $M_y(2) = 1.15$. In Q-switching operation, 13.8W average power at a pulse repetition rate of 200 kHz is produced, with a stability of pulse peak value < 5%.

【73】 An end-pumped planar waveguide laser with an optical to optical conversion efficiency of 58%

【作者】 H.X. Kang, H. Zhang, P. Yan, D.S. Wang, and M. Gong

【刊 名】 Laser Physics Letters

【年卷期】 2008, 5(12):879-881

【关键词】 solid-state lasers • planar waveguide laser • optical to optical conversion efficiency

【摘 要】 A thermal-bonded Nd:YAG planar waveguide laser with an O-O conversion efficiency of 58% was demonstrated for the first time to our knowledge. The waveguide was end-pumped by a fiber-coupled laser diode operating at 808 nm. A maximum output power of 2.90 W at 1064 nm was achieved with an M^2 value of 2.6 in the guided direction for a pump power of 5.0 W. The results indicate that the planar waveguide laser can reach high O-O conversion efficiency and has a promising prospect for efficient and high optical quality laser sources.

【74】 Passively mode-locked Nd : YVO4 picosecond laser with oblique incidence on SESAM

【作 者】 Gong M, Yu H, Wushouer X, Yan P

【刊 名】 Laser Physics Letters

【年卷期】 2008, 5(7):514-517

【关键词】 passively mode-locked; oblique incidence; SESAM; Nd : YVO4

【摘 要】 We report an oblique incidence on semiconductor saturable absorber mirror (SESAM) method in the LID pumped passively mode-locked Nd:YVO4 picosecond laser in this article, making SESAM as the intracavity reflecting mirror, which produces maximum average output power of 1 W, pulse repetition rate of 120 MHz, and stable continuous mode-locked pulse at 1064 nm with the pulse width of 19.2 ps. To our knowledge, this was the first demonstration that got CW mode-locking in standing-wave laser with a reflected mirror SESAM in oblique incidence way.

【75】 Affected zone generated around the erosion pit on carbon steel surface at the incipient stage of vibration cavitation

【作 者】 Chen H.S., Li J., Liu S.H., Chen D.R., and Wang J.D.

【刊 名】 Chinese Science Bulletin

【年卷期】 53: 943-947

【关键词】 cavitation; cavitation erosion; thermal effect; carbon; ultrasonic vibration

【摘 要】 The characteristics of erosion pits on a carbon steel surface were investigated at the incipient stage of cavitation erosion. After a 5-minute experiment performed in an ultrasonic vibration system, needle-like erosion pits appeared on the polished steel surface, and a specially affected zone was formed around the pit. The shape of the pit and the plastic deformation of the affected zone indicate that the mechanical impaction on the surface is the main reason for the cavitation damage. On the other hand, the iridescent color, the decreased surface hardness and the precipitated carbides on the affected zone prove that the affected zone has experienced a tempering process with the temperature higher than 300 degrees C. The lack of oxygen in the affected zone also proves that it is not a chemical oxygen result. A special phenomenon that a carbon ring forms in the affected zone is explained as a result of the toroidal bubbles' heating effect at the final stage of the bubble collapse.

【76】 Effect of roughness and wettability of silicon wafer in cavitation erosion

【作 者】 Jiang N.N. Liu S.H. Chen D.R.

【刊 名】 Chinese Science Bulletin

【年卷期】 53(18): 2879-2885

【关键词】 cavitation erosion; silicon wafer; roughness; contact angle

【摘 要】 Material damage of silicon wafer with different roughness and wettability was investigated by using the self-made vibration cavitation apparatus in de-ionized water. Various roughness and wettability of silicon wafer were achieved by changing their morphology and

depositing Au, diamond-like carbon films (DLC films) on them. Surface morphology was observed with a scanning electron microscope (SEM) and a surface profilometer, and wettability was characterized by the contact angle measurement. The cavitation erosion results showed that many tiny pits and cracks appeared on the wafer surface as a result of brittle fractures; the number and size of the pits and cracks increased with experiment time, which made material flake away finally; cavitation occurred more easily on the silicon wafer surface with the augment of roughness or contact angle by changing surface morphology or depositing Au, DLC thin film on it, which consequently aggravated cavitation damage.

【77】 175-W continuous-wave master oscillator power amplifier structure ytterbium-doped all-fiber laser

【作者】 Yan P, Yin SP, Gong ML

【刊名】 CHINESE OPTICS LETTERS

【年卷期】 2008,6(8):580-582

【关键词】 Fiber lasers

【摘要】 We report on hundred watts range ytterbium-doped all-fiber laser assembly based on the master oscillator power amplifier structure. It consisted of an oscillator and an amplifier with all-fiber components. And fiber fusion splice made the laser be an integrated fiber system. It generated up to 175.5 W of continuous-wave (CW) output power at 1085 nm with more than 75% extraction efficiency in the amplifier when the total coupled pump power into the double clad fiber was 270 W.

【78】 Coupled simulative analysis for drive characteristic of micro-comb structures

【作者】 Zhu Yi; Guo Dan

【刊名】 Gongcheng Lixue/Engineering Mechanics

【年卷期】 2008, 25(7):206-211

【关键词】 Finite element method

【摘要】 The micro-comb is a common device used in micro-sensors, micro-accelerometers and micro-drivers. Its driver characteristics are significant to the precision of the sensors and drivers. The micro-comb in this paper is working under the electrostatic field. During driving process, the electrostatic field distribution between the comb's teeth will be influenced by the driving distance of the structure, then make the driving distance change again till new balance reaches. Thusly, the electrostatic-structural coupling can not be negligible when calculating the driving distance. A model of a micro-comb driver considering electrostatic-structural coupling is established to analyze the characteristic of the comb driving when the structures vary. The different base structure, sloping error and side error are considered. The Finite element method is applied to this model. The computing results show that the levitation caused by the base reduces the driving capacity, so as the sloping error, and the side error can cause the instability in horizontal direction.

【79】 Isotropic negative permeability composite based on Mie resonance of the BST-MgO dielectric medium

【作者】 Qian Zhao, Lei Kang, Bo Du, HongJie Zhao, Qin Xie Bo Li, Ji Zhou, LongTu Li, YongGang Meng

【刊名】 Chinese Science Bulletin

【年卷期】 53(21): 3272-3276 (2008)

【关键词】 left-handed metamaterials; ferroelectric ceramic; negative permeability; magnetic resonance; Mie resonance

【摘要】 Isotropic negative permeability composite, composed of BST-MgO dielectric cubes with high permittivity dispersed in the Teflon substrate with low permittivity, was designed and fabricated based on Mie resonance and the effective medium theory. Measurements and

simulations showed that the dielectric composite exhibited a strong sub-wavelength magnetic resonance at the first Mie resonance and possessed isotropic negative permeability, which resulted from the displacement current excited in the cubes. The dielectric particle was equivalent to a magnetic dipole at the magnetic resonance, which could be adjusted by the size and permittivity of the particles. It may provide a convenient method to design isotropic metamaterials and invisible cloak at infrared and visible frequencies.

【80】 Modelling of spreading process: effect from hydrogen bonds

【作者】 Li X, Hu YZ, Jiang L

【刊名】 CHINESE PHYSICS B

【年卷期】 17(8) ,3035-3039, 2008

【关键词】 Hydrogen bonds

【摘要】 Lubricant spreading on solid substrates has drawn considerable attention not only for the microscopic wetting theory but also for the dramatic application in head-disk interface of magnetic storage drive systems. Molecular dynamic simulation based on a coarse-grained bead-spring model has been used to study such a spreading process. The spreading profiles indicate that the hydrogen bonds among lubricant molecules and the hydrogen bonds between lubricant molecules and polar atoms of solid substrates will complicate the spreading process in a tremendous degree. The hydrogen bonds among lubricant molecules will strengthen the lubricant combination intensity, which may hinder most molecules from flowing down to the substrates and diffusing along the substrates. And the hydrogen bonds between lubricant molecules and polar atoms of solid substrates will confine the lubricant molecules around polar atoms, which may hinder the molecules from diffusing along the substrates and cause precursor film to vanish.

【81】 Numerical distortion and effects of thermostat in molecular dynamics simulations of single-walled carbon nanotubes

【作者】 Li Rui, HuYuanzhong, Wang Hui, Zhang Yujun

【刊名】 CHINESE PHYSICS B

【年卷期】 17(11), 4253-7, 2008

【关键词】 Carbon nanotubes

【摘要】 In this paper, single-walled carbon nanotubes (SWCNTs) are studied through molecular dynamics (MD) simulation. The simulations are performed at temperatures of 1 and 300 K separately, with atomic interactions characterized by the second Reactive Empirical Bond Order (REBO) potential, and temperature controlled by a certain thermostat, i.e. by separately using the velocity scaling, the Berendsen scheme, the Nose-Hoover scheme, and the generalized Langevin scheme. Results for a (5,5) SWCNT with a length of 24.5 nm show apparent distortions in nanotube configuration, which can further enter into periodic vibrations, except in simulations using the generalized Langevin thermostat, which is ascribed to periodic boundary conditions used in simulation. The periodic boundary conditions may implicitly be applied in the form of an inconsistent constraint along the axis of the nanotube. The combination of the inconsistent constraint with the cumulative errors in calculation causes the distortions of nanotubes. When the generalized Langevin thermostat is applied, inconsistently distributed errors are dispersed by the random forces, and so the distortions and vibrations disappear. This speculation is confirmed by simulation in the case without periodic boundary conditions, where no apparent distortion and vibration occur. It is also revealed that numerically induced distortions and vibrations occur only in simulation of nanotubes with a small diameter and a large length-to-diameter ratio. When MD simulation is applied to a system with a particular geometry, attention should be paid to avoiding the numerical distortion and the result infidelity.

【82】 Step kinematic calibration of a 3-DOF planar parallel kinematic machine tool

【作者】常鹏, 汪劲松, 李铁民, 刘辛军, 关立文

【刊名】Science in China Series E: Technological Sciences

【年卷期】51、12、2165-2177, 2008

【关键词】Machine tools

【摘要】This paper presents a novel step kinematic calibration method for a 3 degree-of-freedom (DOF) planar parallel kinematic machine tool, based on the minimal linear combinations (MLCs) of error parameters. The method using mapping of linear combinations of parameters in error transfer multi-parameters coupling system changes the modeling, identification and error compensation of geometric parameters in the general kinematic calibration into those of linear combinations of parameters. By using the four theorems of the MLCs, the sets of the MLCs that are respectively related to the relative precision and absolute precision are determined. All simple and feasible measurement methods in practice are given, and identification analysis of the set of the MLCs for each measurement is carried out. According to the identification analysis results, a step calibration including step measurement, step identification and step error compensation is determined by taking into account both measurement costs and observability. The experiment shows that the proposed method has the following merits: (1) the parameter errors that cannot influence precision are completely avoided; (2) it reflects the mapping of linear combinations of parameters more accurately and enhances the precision of identification; and (3) the method is robust, efficient and effective, so that the errors in position and orientation are kept at the same order of the measurement noise. Due to these merits, the present method is attractive for the 3-DOF planar parallel kinematic machine tool and can be also applied to other parallel kinematic machine tools with weakly nonlinear kinematics.

【83】 The spreading behaviour of perfluoropolyether droplets on solid surfaces

【作者】GuoXiaoyan, li Xin, Hu Yuanzhong, Wang Hui

【刊名】Chinese Physics B

【年卷期】17(3):1094-1100, 2008

【关键词】perfluoropolyether spreading thin lubricant films hard disk driver

【摘要】The spread of perfluoropolyether (PFPE) droplets on solid surfaces has been measured from the top-down view through a microscope system. Effects of substrates, molecular weight and end-group functionality on spreading of the PFPE droplets have been studied experimentally and the results were compared with those by molecular dynamics (MD) simulations. Silicon wafer and diamond-like carbon (DLC) substrates were used to study the effect of substrates on spreading. Two types of PFPE, Z-dol and Z-tetraol, with the same chain structure and various molecular weights (2000 and 4000\,g/mol) were employed in experiments. Effect of molecular weight has been investigated through comparing the spreading of Z-dol 2000 and Z-dol 4000, and it is found that the increase of molecular weight will decrease the mobility of PFPE. Comparison between spreading of Z-dol and Z-tetraol of the same molecular weight proved that functional end group plays a significant role on the spreading of PFPE, which confirmed the MD simulation results.

附录一

摩擦学国家重点实验室 第四届学术委员会暨第一届咨询专家委员会 第五次会议参会委员名单

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学术委员会副主任：张嗣伟 教授，石油大学

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附录二

摩擦学国家重点实验室 成立二十周年庆典来宾名单

出席庆典的摩擦学届前辈有（前排左起）：



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张嗣伟教授 石油大学

出席庆典的来宾还有（按姓氏拼音字母为序）：

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范守善院士 清华大学
高润生处长 教育部科技司综合处

葛世荣教授 中国矿业大学
顾卡丽所长 武汉材料保护研究所
郭万林教授 南京航空航天大学
黄 平教授 华南理工大学
稽世山副院长 清华大学科研院
雷源忠教授 自然科学基金委
李家强处长 清华大学实验室设备处
李 曙教授 中国科学院金属研究所
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王海斗副教授 装甲兵工程学院
吴志申教授 河南大学
谢焕瑛处长 自然科学基金委综合计划局
严新平教授 武汉理工大学
杨沛然教授 青岛理工大学
尤 政教授 清华大学精仪系
郁鼎文教授 清华大学精仪系
张平余教授 河南大学
张治军教授 河南大学
周仲荣教授 西南交通大学
朱 东博士 美国 Eaton 公司

附录三

会议记录

讨论会由学术委员会主任钟掘院士主持，各位委员对实验室的发展提出了许多很好的建议，发言记录如下：

张嗣伟教授：

听了雒建斌主任的报告感觉很振奋，近 5 年实验室进步很大，在科研成果、学术水平方面均得到国际上的承认。实验室的几个方向是比较稳定可行的。但是在国内工程应用领域尚未有重大的突破，需要考虑如何把研究方向和国家重大需求结合起来。另外，把学术作风提到实验室发展日程上来，是个非常好的开头，希望坚持下去。

林忠钦教授：

实验室的研究能否围绕节能减排方面做些工作。国家增加了对重点实验室的投入后，需要考虑如何加大开放力度。建议将科研经费拿出一部分，将国内其它搞摩擦学的单位团结起来，形成合作。

周仲荣教授：

实验室在如下 5 方面作的非常出色：①管理有序；②学术上的民主，自主课题设置评审管理，非常规范；③领域的不断扩展；④国际化程度高；⑤和谐的环境。

建议：带动全国的摩擦学单位做一个大的项目，通过自主课题，强化与其它单位的合作。

郭万林教授：

在开放课题方面，能否通过开放课题和其它大项目在其它单位组织起来，集全国的优势力量。

桂长林教授：

建议加强开放课题的资助强度，将开放课题的研究作为重点实验室科研工作的一块。

钟掘院士：

重点实验室评估排名第一，作为公认的第一就要起带头作用。一方面服务于国内，一方面在国际上确立地位。

葛世荣教授：

近几年实验室的国际影响力大大提升是非常的突出。在人才培养以及青年领军人才培养方面做的非常出色。同时在汇聚人才和培养人才方面做的很好。

建议：谋求进一步提高开放度。国内开放已经达到一定水平，要开始谋划国际开放，吸引世界各地的学者来实验室。将研究方向更加贴进国家重大需求。实验室的自主研究课题都是在已有的基础上的锦上添花，应设立新的研究方向。

能否针对《摩擦学科学与工程应用现状与发展战略研究》提出对策研究。需要加强对创新目标的指向性，创新也包括实验方法上的创新和实验装置的创新。另外，可以通过开放基金和通过自主研究课题加强在国内同行中的引领作用。

罗继伟教授：

实验室的特点是作风扎实，在学风培养方面，摒弃了社会上浮躁的风气。思想上更加开放，思路更具有开拓性，并与国民经济紧密结合，比原来有较大的发展。另外，在滚动轴承方面能否与相关的企业或科研机构做些重大的合作。

赵源教授：

自主研究课题、与国家需求、行业具体产品背景怎么结合？比如水润滑能否结合具体产品；

关于开放课题的设置，能否拉进来一部分人到实验室做课题。

李曙教授：

实验室的国际化最好有具体的措施和考核指标。比如中科院金属所的作法是招收一定数量的留学生，并和国外著名的实验室达成合作协议，同时建立海外团队。

关于开放课题的设置，是自由申请还是指向性申请？应该通过开放课题来集中实验室所缺乏专业方向的人才，弥补实验室的不足。

史铁林教授：

实验室非常重视基础研究，其实很多基础问题是从工程中来的，实验室应该关注这方面的研究。通过开放，与做工程的人结合起来，解决工程中的难题。

王成焘教授：

在国际上取得的地位，与研究领域位于国际前沿有很大关系。比如弹流研究，得到了国际上的认可。重点实验室是代表国家的，作为国家队在国际前沿领域作工作。但是，实验室在解决国家重大需求方面尚未达到应有的地位，跟重大需求的结

合应该瞄准一个固定方向投入力量，解决重大需求中的摩擦学问题，需要瞄准一个重大产业，深入研究，保持稳定性。比如兰化在这方面做的就很出色。

李玉卓教授：

科学研究与工程应用结合关键是怎么找到一个结合点，投入力量。在 CMP 方面，就是摩擦学与工程的结合点。

实验室怎样国际化？国际交流方式已发生变化，在很多领域，已经有许多网络交流空间，比如 CMP 就有一个空间。应该加入这种交流空间，甚至可以自己建立一个空间，将国内外的力量加入进来。

严新平教授：

在实验室运行机制方面能否有些创新，从而吸引国外的高水平人才加入实验室。

雷源忠教授：

摩擦学国家重点实验室的国际影响力在国内同类实验室里是最高的。

目前经费很充足，如何出更高水平的成果？在基础理论研究方面，需要抓住不放。表面织构研究能否在生物摩擦学方面做些工作。另外，运行机制方面需要进行一些新的探索。

在自主研究课题方面能否有外面的专家参与其中。

齐毓霖教授：

摩擦学是应用科学，必须接合实际。如何进行摩擦学研究，不在于经费多少。科研设备必须自己做，必须接合实际。千万不要有设备是一流的，水平就是一流的，必须要把工作做成一流的。

摩擦学研究必须要做任务，而且是难啃的硬骨头。

熊有伦院士：

实验室的学术风气很好。

现在的科研条件很好，青年人也很辛苦，但很多时间都没用在业务上。关于实验室的定位，需要提出理论以及关键技术突破。总体上五个研究方向定位是正确的，但如何细化需要考虑。

刘家浚教授：

实验室研究方向明确，学术成果丰富

如何解决实际问题，能否选择一个方向，拿出经费，组织人力，解决一项实际

问题。

孙立宁教授：

在基础方面比较突出，在国家重大工程方面的突破需求加强考虑。比如可以在节能和健康方面结合实验室的研究作出突破。

杨沛然教授：

实验室的五个研究方向比较合理。

担心：拿这么多钱做不出事来怎么办？

瞄准一个方向坚持下去，持续十几年才能出成果。另外，科研工作需要积累，不能每个人都从头做起。

黄平教授：

摩擦本质问题解决的不太好，摩擦机理尚有很多科学问题未解决，如果解决会在重大工程上形成突破。

钟掘院士：

不要把基础研究和工程研究分开，工程上很多问题潜藏着很深的基础问题，如果不发现，会造成工程研究的盲目进行和基础研究的丢失。

附录四

2008 年度摩擦学国家重点实验室开放课题批准结果

资助号	课题名称	申请人	单位	批准资助额度
SKLTKF 08A01	CoCr 合金人工髋关节的生物摩擦学行为研究	王庆良	中国矿业大学材料科学与工程	10 万
SKLTKF 08A02	电站水工建筑抗冲蚀保护技术与理论基础研究	李健	武汉材料保护研究所	10 万
SKLTKF 08A03	先进电子制造中超纯纳米 SiO ₂ 粒子研制及其抛光性能研究	顾忠华	清华大学摩擦学国家重点实验室深圳微纳工程研究室	10 万
SKLTKF 08A04	混合润滑机理及其在齿轮与轴承中的应用	朱东	Tri-Tech Solutions, USA	14 万
SKLTKF 08B01	规则微纹理密封端面摩擦失效机理研究	白少先	浙江工业大学	5 万
SKLTKF 08B02	超低摩阻磨耗 DLC 梯度厚膜制备技术及其特种应用研究	王成彪	中国地质大学（北京）	3 万
SKLTKF 08B03	SAM/氧化物双层膜的纳米摩擦学行为	万 勇	青岛理工大学机械工程学院	3 万
SKLTKF 08B04	界面摩擦过程热力耦合行为研究	龚中良	华南理工大学	3 万
SKLTKF 08B05	多缸内燃机曲轴轴承三维轴心轨迹的实测研究	孙军	合肥工业大学	3 万
SKLTKF 08B06	正畸低摩擦矫治器的综合模拟实验研究	林久祥	北京大学口腔医院正畸科	3 万
SKLTKF 08B07	PTFE 复合材料高温摩擦学研究	黄兴	广州机械科学研究院	2 万
	钛硼碳氮薄膜的摩擦性能及对结构的依赖性	陆永浩	北京科技大学	不资助
	基于磨损机理的失效时间预测技术研究	常秋英	北京交通大学	不资助

附录五

摩擦学国家重点实验室成立二十周年专家报告会

时间：2008年10月25日，8：30~12：00

地点：精仪系大会议室

题 目：大型复杂曲面零件数字化设计、加工、测量一体化研究
报告人：熊有伦 院士，华中科技大学

题 目：Novel Functionalized Nanoparticles in CMP
报告人：Prof. Li Yuzhuo, Clarkson University, USA

题 目：Introduction of Today's bearing Technology
报告人：町田尚 博士，日本精工株式会社执行董事代表，副总裁

题 目：微纳操作关键技术
报告人：孙立宁 教授，哈尔滨工业大学

题 目：基于非晶合金的微小零件三维制造工艺
报告人：史铁林 教授，华中科技大学

题 目：空蚀中微颗粒的作用
报告人：汪家道 副教授，清华大学摩擦学国家重点实验室