目录(Contents)

复旦大学光科学与工程系
上海市邯郸路 220 号
邮政编码：200433
电话：86-21-65643791/65649001
传真：86-21-65641344

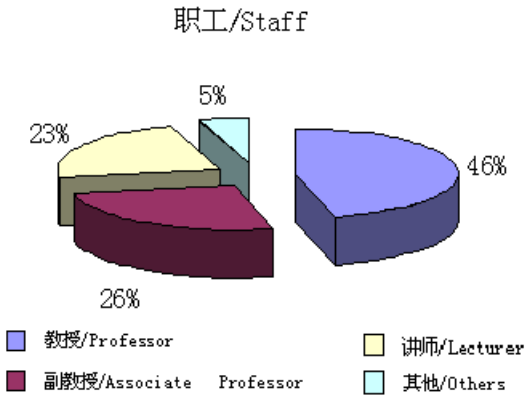
Department of Optical Science & Engineering
Fudan University
Shanghai 200433, China
Tel.：86-21-65643791/65649001
Fax：86-21-65641344

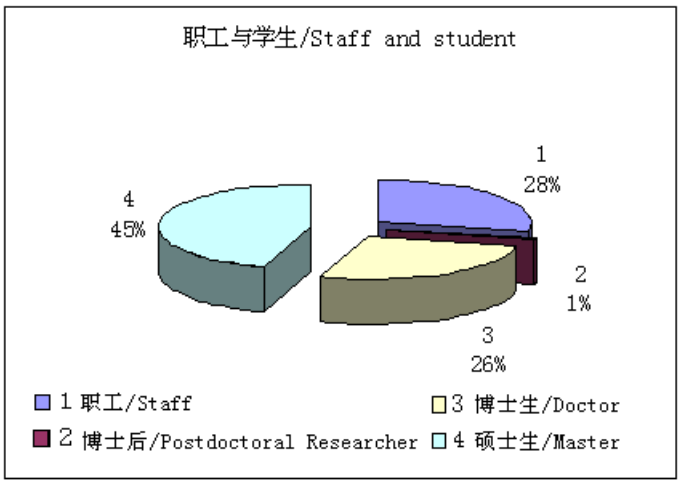
实验室概况/Overview of the Department of Optical Science& Engineering

光科学与工程系有教授 18 名，副教授 10 名。教授中包括 2 名院士、1 名长江特聘教授及国家杰出青年基金获得者、3 名国家杰出青年基金获得者、4 名跨世纪和新世纪人才基金获得者。我系拥有光学国家重点学科，在“211”、“985”等高校重点学科建设中获得近 2000 万元的建设经费。在科研方面，以信息光子学领域具有重要意义和应用价值的新型光子学材料与器件作为主攻方向，侧重于基础光子学以及微光子学与纳米光子学材料和器件的研究，并适当重视光子学在交叉学科中的应用。近 5 年来，获得各类科研经费总额达 3000 多万元。我系拥有多台进口激光器、光子学器件制备系统、薄膜制备系统以及分析测试系统等设备，研究条件优越。

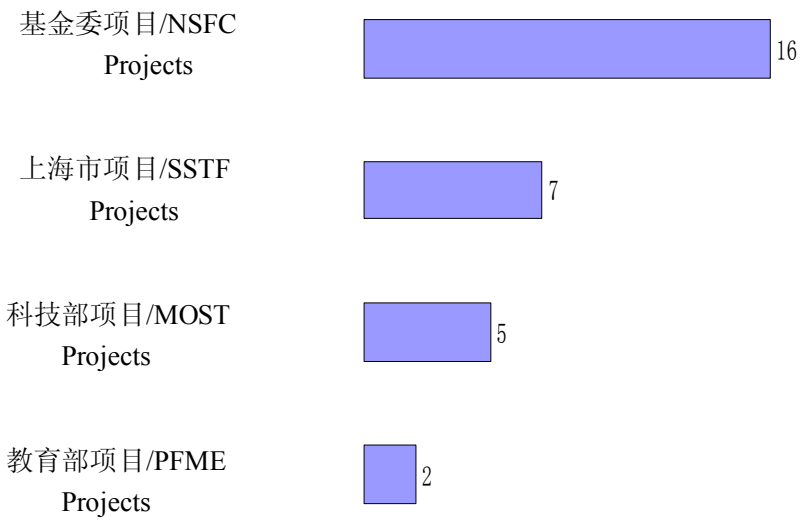
The Department of Optical Science & Engineering has 34 highly qualified faculty members, including 18 professors and 10 associate professors. Among the professors, there are one academician of the Chinese Academy of Sciences, one academician of the Chinese Academy of Engineering, one professor of “Cheungkong Scholars Program” of the ministry of education and the winner of the national distinguished youth science fund, two winners of the national distinguished youth science fund, three winners of “cross-century talent cultivation plan fund” of the ministry of education. The department boasts one national key discipline of optics, which is included in the “211 Plan” and “985 Plan” of the ministry of education and has acquired finance allocation of about 20 million yuan for constructing the discipline in the past years. The research in the department focuses on the novel photonic materials and devices of great importance and promising application in the field of information photonics, emphasizing particularly on the study for fundamental photonics, new materials and devices of micro-photonics and nano-photonics, and also paying attention to the interdisciplinary studies concerning photonics. In the past 5 years, the research fund from various programs added up to 30 million yuan. The department has a very good research environment，and is in possession of many lasers of high performance, fabricating system for photonic devices, thin film deposition system and testing and analyzing system, etc.

人事概况/General View of Personnel





在研项目概况/General View on Projects under Researching



人员结构/Organization

光科系主任/ Director

钱列加 教 授 Qian Liejia, Professor

光科系副主任/ Deputy Directors

吴嘉达 教 授，Wu Jiada, Professor

郑玉祥 教 授，Zheng Yuxiang, Professor

我系聘请的名誉教授和顾问教授/Honorary and advisory professors

N. Bloembergen Professor (美国哈佛大学，诺贝尔物理学奖获得者， Harvard University, USA)

沈元壤 院士 Y. R.Shen Academician (美国加州大学, University of California, Berkerley USA)

张国鼐 教授 R. K. Chang Professor (美国耶鲁大学, Yale University, USA)

厉鼎毅 教授 T. Y. Li Professor (美国 AT&T 公司及 Bell 实验室, AT&T Bell Lab, USA)

唐孝威 院士 Xiaowei Tang Academician (北京高能所， Institute of High Energy Physics, CAS)

徐至展 院士 Zhizhan Xu Academician (上海光机所, Shanghai Institute of Optics & Fine Mechanics, CAS)

杨国桢 院士 Guozhen Yang Academician (北京物理所, Institute of Physics, CAS)

侯 洵 院士 Xun Hou Academician (西安光机所，Xian Institute of Optics & Fine Mechanics, CAS)

钟业华 教授 Yip-Wah Chung Professor (美国西北大学, North-West University, USA)

杰出人才/ Intelligent Staff

中国科学院院士/ Academician, CAS

1980　干福熹　Gan Fuxi

中国工程院院士/ Academician, CAE

1995　范滇元　Fan Dianyuan

国家杰出青年基金获得者/National Science Fund for Distinguished Young Scholars

1994　陈良尧　Chen Liangyao

2000　金庆原　Jin Qingyuan

2007　钱列加　Qian Liejia

国家教育部“长江学者”荣誉称号获得者

1999　陈良尧　Chen Liangyao

国家教委跨世纪（新世纪）优秀人才基金获得者

1997　徐　雷　Xu Lei

2000　吴嘉达　Wu Jiada

2006　郑玉祥　Zheng Yuxiang

2009　张文献　Zhang Wenxian

光科学与工程系人员名录/Name List

研究人员/Scientific

陈良尧	Chen Liangyao	王松有	Wang Songyou
戴海涛	Dai Haitao	韦　玮	Wei Wei
范滇元	Fan Dianyuan	吴嘉达	Wu Jiada
干福熹	Gan Fuxi	吴　翔	Wu Xiang
金庆原	Jin Qingyuan	徐　雷	Xu Lei
李　晶	Li Jing	徐　敏	Xu Min
刘建华	Liu Jianhua	许　宁	Xu Ning
刘丽英	Liu Liying	应质峰	Ying Zhifeng
陆　明	Lu Ming	袁　鹏	Yuan Peng
马　斌	Ma Bin	张　浩	Zhang Hao
糜　岚	Mi Lan	张荣君	Zhang Rongjun
倪　刚	Ni Gang	张文献	Zhang Wenxian
彭　波	Peng Bo	张宗芝	Zhang Zongzhi
钱列加	Qian Liejia	赵海斌	Zhao Haibin
沈德元	Shen Deyuan	郑玉祥	Zheng Yuxiang
孙　剑	Sun Jian	朱鹤元	Zhu Heyuan
王培南	Wang Peinan	庄　军	Zhuang Jun

技术人员/Technical Staff

戴祝萍	Dai Zhuping	杨月梅	Yang Yuemei
胡谊梅	Hu Yimei	姚明远	Yao Mingyuan
徐新民	Xu Xinmin	张敏毅	Zhang Minyi

博士后/Postdoctoral fellows

高洪跃	Gao Hongyue

博士生/ Ph.D Students

廖嘉霖	Liao Jialin	张启明	Zhang Qiming
李晓凡	Li Xiaofan	胡婧婷	Hu Jngting
张艳武	Zhang Yanwu	李　皓	Li Hao
周薇溪	Zhou Weixi	赵　源	Zhao Yuan
周　靖	Zhou Jing	邱　娉	Qiu Ping
张　尉	Zhang Wei	李颖峰	Li Yingfeng
毛鹏辉	Mao Penghui	陈　英	Chen Ying
魏慎金	Wei Shenjin	涂　鑫	Tu Xin
邱静燕	Qiu Jingyan	单　炯	Shan Jiong
任红艳	Ren Hongyan	蔡清元	Cai Qingyuan
张　弛	Zhang Chi	赵　坤	Zhao Kun
刘明辉	Liu Minghui	周恩宇	Zhou Enyu
钟亥哲	Zhong Haizhe	干　洁	Gan Jie
李　征	Li Zheng	吴　松	Wu Song
李　明	Li Ming	马金贵	Ma Jingui
宁博元	Ning Boyuan	王永志	Wang Yongzhi
张兴旺	Zhang Xingwang		

硕士生/ Master Students

张　淼	Zhang Miao	朱　江	Zhu Jiang
冯　亮	Feng Liang	冯　慧	Feng Hui
王骁栋	Wang Xiaodong	唐　佳	Tang Jia
滕雪雷	Teng Xuelei	张　岩	Zhang Yan
马鎏学	Ma Liuxue	黄丽媛	Huang Liyuan
唐文涛	Tang Wentao	王　刚	Wang Gang
张旭辉	Zhang Xuhui	周信传	Zhou Xinchuan
沈　彦	Shen Yan	陈舒拉	Chen Shula
熊蓉玲	Xiong Rongling	陈永彬	Chen Yongbin
耿昭华	Geng Zhaohua	高　昆	Gao Kun
徐吉鹏	Xu Jipeng	贺　赫	He He

陆卫杰	Lu Weijie	任　勇	Ren Yong
徐　岫	Xu Xiu	陈珊珊	Chen Shanshan
陈剑波	Chen Jianbo	朱焕锋	Zhu Huanfeng
李　倩	Li Qian	王绍军	Wang Shaojun
崔伯寅	Cui Boyin	曹兴鑫	Cao Xingxin
陈　坤	Chen Kun	陈　立	Chen Li
崔　勇	Cui Yong	付小牛	Fu Xiaoniu
李　丁	Li Ding	梁　旭	Liang Xu
刘文明	Liu Wenming	骆志远	Luo Zhiyuan
徐　达	Xu Da	许宏淮	Xu Honghuai
张冬旭	Zhang Dongxu	朱艳燕	Zhu Yanyan
丁大宇	Ding Dayu	曲韶华	Qu Shaohua
沙剑剑	Sha Jianjian	许　妮	Xu Ni

光学工程/Optical Engineering

邱永成	Qiu Yongcheng	李振亚	Li Zhenya
蒲海辉	Pu Haihui	李双柱	Li Shuangzhu
王治国	Wang Zhiguo	赖菊水	Lai Jushui
高　斌	Gao Bin	伍经纬	Wu Jingwei
孙　涛	Sun Tao		

承担课题/Projects under Researching

序号	项目来源	课题名称（编号）	负责人	起止时间
1	973 子项目	光参量放大过程中位相传递及其控制 2007CB815104-1	钱列加	2007.1-2009.12
2	973 子项目	磁性多层结构中磁各向异性的量子调控方法和机理-3 2009CB929201-3	金庆原	2009.7-2012.12
3	973 子项目	磁性多层结构中磁各向异性的量子调控方法和机理-2 2009CB929201-2	李晶	2009.7-2012.12
4	863 项目	高增益低噪声放大技术研究 2007AAXXX507	钱列加	2007.1-2010.12
5	863 项目	纳秒级激光脉冲的高分辨单次测量及实验研究 2008AAXXX0011	袁　鹏	2008.7-2009.6
6	国家杰出青年基金	基于光学二阶非线性的超快激光技术研究 60725418	钱列加	2008.1-2011.12
7	国家自然科学基金重大项目的课题	高峰功率可调谐中红外激光技术的基础问题研究 60890202	钱列加	2009.1-2012.12
8	国家自然科学基金重点项目	新型纳米微结构光电子材料及微腔光子器件特性研究 60638010	徐　雷	2007.1-2010.12
9	国家自然科学基金重点项目	1μm 波段全系列宽带激光技术研究 60538010	范滇元	2006.1-2009.12
10	国家自然科学基金重点项目	无机基有机杂化非线性光学材料的基础研究（分课题）50532030	刘丽英	2006.1-2009.12
11	国家自然科学基金面上项目	垂直高矫顽力记录介质的自旋超快过程研究 60678008	金庆原	2007.1-2009.12
12	国家自然科学基金面上项目	巨磁电阻器件中极化电流激发的自旋波效应研究 10604016	张宗芝	2007.1-2009.12
13	国家自然科学基金面上项目	易轴垂直取向巨磁电阻器件中电流驱动的磁矩翻转效应 50771033	张宗芝	2008.1-2010.12
14	国家自然科学基金面上项目	纳米模板辅助 FePt 有序合金阵列的制备研究 50771032	金庆原	2008.1-2010.12
15	国家自然科学基金面上项目	基于分层部分氘化 KDP 晶体的宽带激光三倍频技术研究 10776005	钱列加	2008.1-2010.12

16	国家自然科学基金面上项目	纳米信息功能薄膜的变温快速椭圆偏振特性分析和研究 60778028	郑玉祥	2008.1-2010.12
17	国家自然科学基金面上项目	ECR-PLA 等离子体的时空运动、激发增强和气相反应 10875029	吴嘉达	2009.1-2011.12
18	国家自然科学基金面上项目	直流等离子体反应沉积法合成氮碳纳米锥阵列及其场致发射特性研究 10875030	许 宁	2009.1-2011.12
19	国家自然科学基金面上项目	硅纳米晶光频转换增强及晶体硅电池光电转换效率的提高 60878044	陆 明	2009.1-2011.12
20	国家自然科学基金面上项目	中红外光纤激光器用材料及其光纤的研究 10876009	彭 波	2009.1-2011.12
21	国家自然科学基金面上项目	高光学非线性介质微腔中的光学参量过程与实时调控技术研究 10874033	徐 雷	2009.1-2011.12
22	上海市重点（子项目）	人工微纳结构中的红外光电转换过程 07JC14058	徐 雷 陈良尧	2007.12-2009.11
23	上海市优秀学科带头人	微控光子学材料与器件（A 类） 08XD14006	徐 雷	2008.1-2009.12
24	教育部新世纪优秀人才	快速光谱获取技术及其在环境科学中的应用 NCET-06-0365	郑玉祥	2007.1-2009.12
25	博士点基金	发光增强型多层硅纳米晶的制备及其发光特性 20060246028	陆 明	2007.1-2009.12
26	上海市晨光计划	搀杂氧化钛在可见光诱导杀伤癌细胞中的应用 2008CG03	糜 岚	2008.11-2010.12
27	上海市 AM 基金	硅表面高 K 金属氧化	吴嘉达	2007.12-2009.6
28	上海市科委浦江计划	眼安全波长高功率光纤激光器及相关技术的研究 09PJ1402200	沈德元	2009.7-2011.7
29	上海市科委基金	回音壁模式耦合微腔激光器的光学性能及其在生物传感上应用研究 09ZR1402800	吴翔	2009.7-2012.7
30	上海市教委人才基金	垂直磁化自旋阀中巨磁电阻力和自旋转矩效应研究 09ZZ03	张宗芝	2009.1-2011.12
31	973 课题	多带隙和纳米结构材料在太阳光全光谱光电转换中的应用 2010CB933703	陆明	2010.1-2011.12
32	国家自然科学基金重点项目	光在金属介质界面传播特性及其在信息和能源器件领域的应用研究 60938004	陈良尧	2010.1-2013.12
33	国家自然科学基金青年	铁磁性薄膜的超快自旋磁矩进动研究 60908005	赵海斌	2010.1-2012.12

	项目			
34	国家自然科学基金青年项目	回音壁模式耦合微腔激光器光学性能及其用于生物传感的基础研究 60907011	吴翔	2010.1-2012.12
35	国家自然科学基金青年项目	量子调控旋量波色超冷原子气体中的自旋交换和偶极相互作用 10904017	张文献	2010.1-2012.12
36	国家自然科学基金面上项目	高功率铒、镱共掺光纤激光器中寄生振荡产生机理及抑制方法的研究 60978033	沈德元	2010.1-2012.12
37	国家自然科学基金面上项目	新型亚微米高度大纵横比玻璃光波导的光传输特性与制备技术研究 60977047	刘丽英	2010.1-2012.12
38	国家自然科学基金面上项目	金属氧化物的新型带隙调制及广谱光分解效应研究 10974034	陆明	2010.1-2012.12
39	国家自然科学基金面上项目	液态和非晶态铝-半导体合金微观结构的多层次、多尺度分子动力学研究 10974029	王松有	2010.1-2012.12
40	上海市教委创新项目	原子纵向操纵的新方法及其在纳米结构修饰构造中的应用 10ZZ02	庄军	2010.1-2012.12
41	博士点基金	半导体量子点中电子自旋的退相干过程及相干时间的延长 20090071120013	张文献	2010.1-2012.12

仪器设备/Facilities

序号	设备名称	型号	性能	用途
1	分子束外延设备(超高真空系统)	定制	极限真空: 1.5E-11 mbar	磁性超薄膜生长和性能测试
2	光刻机	SUSS MJB3 UV400	光刻基板最大尺寸：3 英寸。样品台移动范围：X 轴±3mm, Y 轴 3mm 转角±3 度。光刻分辨率 0.6 微米，套刻精度 0.5 微米，光强均匀性 5%。汞灯 350W。	用于各种器件图形的制备
3	扫描干涉显微镜（表面轮廓仪）	NV200HR	横向分辨率最大为 0.22 微米，纵向测量精度为 0.1nm。	测表面粗糙度
4	掺钛蓝宝石飞秒激光器	MIRA BASIC	脉宽: 100fs； 输出功率: 振荡级 490mW 放大级 800mW OPA 30uj @ 606nm 调谐性:振荡级 750-850nm OPA 450-750nm	测量磁性薄膜材料的自旋超快动力学过程
5	锁模 Nd:YAG 激光器（皮秒）	PY61C-10	能量（with #9740Dye) 30mJ@1064nm, 15mJ@532nm, 5mJ@355nm, 3mJ@266nm; 脉宽 40ps@1064 nm; 稳定性 5%@1064nm;7%@532 nm	皮秒脉冲光源
6	微波 ECR 实验装置+YAG 激光器	自制	极限真空: 2 10-4Pa 工作气体: N2,O2, Ar, He, etc. 工作气压: 9 10-3Pa ~ 110-1Pa 微波频率: 2.45GHz 微波功率: 300-1000W 激光系统: 调 Q-Nd: YAG (Continuum 公司) 波 长: 266nm, 355nm, 532nm, 1064nm 激光脉宽: 5ns 激光能量: 600 mJ/ pulse pu 重复频率：1Hz ~10Hz	可以产生 ECR 等离子体、PLA 等离子体 ECR-PLA 等离子体，用于 ECR 微波放电和脉冲激光烧蚀联合作用过程和 ECR-PLA 等离子体特性研究以及等离子体和激光束联合材料处理和制备技术探索和应用。

7	皮秒宽光谱扫描激光器	PL2143A	波长：220-2000nm, 脉宽：30ps, 重复频率 10Hz, 单脉冲能量 0.01-1mJ	材料的物性研究，微光学器件性能研究
8	多光子/共焦荧光显微镜	FV300-1X71/81	分辨率：1 微米；激发波长：405 和 514nm;荧光探测波长：可见光	三维高分辨荧光图像和光谱分析
9	多功能扫描探针显微镜	XE-100	扫描范围 100x100 微米，精度 0.1nm	测量固体表面形貌
10	高真空多靶磁控溅射仪	KJLC CMS-18	极限真空: 2E-8 mbar；6 靶；共溅射；附带传样室。	磁性薄膜和器件的生长
11	ND:YFL 激 光器	EVOLUTLONXX	脉宽: 200ns 中心波长:527nm 输出功率: 5w	纳秒光源
12	飞秒激光器系统	SPIT FIRE 速率 70	脉宽: 50fs 中心波长:800nm 输出功率: 振荡级 350mW 放大级 500mW	飞秒光源

获奖情况/Award

获奖研究生/Award for excellent graduate students

2009 年全国优秀博士学位论文提名奖　宋清海
2009 年上海市优秀博士学位论文奖　张　豫
2009 年复旦大学优秀硕士学位论文奖　徐　明
2009 年复旦大学优秀硕士学位论文奖　魏　崠
2009 年复旦大学优秀硕士学位论文奖　李政皓
2009 年复旦大学优秀硕士学位论文奖　赵　慧

研究工作报告/Scientific Report

超快非线性光学的应用研究 / Applications of Ultrafast Quadratic Nonlinear Optics

成员：钱列加 朱鹤元 范滇元 Group members: Qian Liejia, Zhu Heyuan, Fan Dianyuan

课题组以发展超高功率短脉冲(PW)等大型激光装置为牵引目标，从事高功率激光技术和二阶非线性光学的研究工作。在基础性研究方面，着重开展超快非线性光学的科学研究工作，探索新的时空非线性光学现象和效应，拓展非线性光学的新应用，并发展形成新的光学技术和测量方法。在工程性激光技术研究方面，将超快非线性光学的科学研究结果作为基础和创新源泉，驱动高功率激光技术的发展，解决大型激光工程中的关键技术难题。本年度取得的主要进展包括：

1. 开展了中红外 OPCPA 的理论分析，探索并明确了三种影响输出脉冲光谱位相的新机制，为产生更短脉宽的中红外脉冲奠定了物理基础。 Spectral phase shifts in femtosec ond parametric down-conversion with media dispersion

现有的飞秒 OPA 是在沿续传统的长脉冲 OPA 技术基础上发展的，没有很好地利用和研究飞秒脉冲群速度色散的特征，而是简单地努力避免非线性晶体的群速度走离 GVM 和群速度色散。这种简单情况只是对应着可见光与近红外波段。我们在理论上研究了色散介质中，中红外飞秒光参量下转换过程中的频域相移。我们主要研究了材料群速度色散（GVD）对频域相移的影响，目的是对中红外飞秒脉冲的压缩给出理论指导。我们的研究结果表明：光参量产生的中红外飞秒脉冲的频域相移与线性传输得到的结果有显著差别。通过研究和总结，我们探索并明确了三种影响输出脉冲光谱位相的新机制，为产生更短脉宽的中红外脉冲奠定了物理基础。

We theoretically study the spectral phase shift of a mid-infrared (MIR) femtosecond pulse generated through parametric frequency down-conversion in dispersive media, with an emphasis on the effect of group-velocity dispersion (GVD), in the aim of obtaining guidelines for dispersion compensation and pulse compression in such systems. It is found that the spectral phase of the generated MIR pulse is significantly different from that of due to its linear propagation. We consider two common ways of MIR femtosecond pulse generation- difference frequency generation (DFG) and optical parametric amplification (OPA). The resultant spectral phase is determined by the initial injection condition, and the transfer of the spectral phase accumulated by the higher frequency fields. Our results show that in DFG, pump depletion has little effect on the spectral phase, while in OPA, the combined effect of linear GVD and high parametric gain leads to a notable dependence of spectral phase on gain- the higher the gain, the less the spectral phase. Quantitatively, under conditions where the MIR pulse is generated through injection of two higher-frequency fields, its spectral phase is close to only half of that accumulated through linear propagation in DFG, while it is even smaller in OPA. To obtain the shortest MIR femtosecond pulse, these results determine the amount of dispersion that needs compensation.

2. 宽范围调谐中红外飞秒 OPA。Generation of broadly tunable mid-infrared femotosecond pulses by a $LiNbO_3$ optical parametric amplifier

针对中红外飞秒 OPA，提出并实现了一种创新性的宽范围调谐技术。利用铌酸锂晶体

特殊的 OPA 相匹配特性，采用共线和小角度非共线相位匹配相结合的联合调谐方式，设计出一种有特色的中红外飞秒 OPA 系统。对闲频光实现了 2.0-4.5 μm 左右大范围调谐，超过了目前国外文献报道的数据。

A mid-infrared (MIR) femtosecond optical parametric amplifier (OPA) with extended tunability is proposed and demonstrated, which combines the configurations of collinear and small-angle noncollinear phase-matching. A tuning range from 2.0 μm to 4.7 μm is demonstrated by a two-stage $LiNbO_3$-based femtosecond OPA, which well exceed the typical tuning range reported so far. MIR femtosecond pulses with energy up to 30 μJ are obtained.

3. 提出了“宽带/窄带基频激光组合”的三倍频方案，并开展了其实验考核工作，论证了技术可行性。Broadband frequency-tripling scheme for Nd:glass laser-based CPA system: an approach to efficiently generate ultraviolet petawatt pulses

我们提出了“宽带/窄带基频激光组合”的新方案，论证了该方案在 1μm 波段具有 6 nm 三倍频接受带宽的能力。同时，该方案所涉及的晶体材料与激光技术都是常规和成熟的。特别地，该新方案与分层部分氘化 KDP 晶体方案是兼容的，如果与分层部分氘化 KDP 晶体相结合的话，将进一步增大三倍频接受带宽。“宽带/窄带基频激光组合”的新方案，是针对常规晶体材料（KDP）设计的，所需的激光技术也是成熟的。因此，“宽带/窄带基频激光组合”方案集成了现有技术，但原理创新。同时，其 6 nm 的三倍频接受带宽能力，完全满足了目前钕玻璃激光所能支持的最大带宽的三倍频需求，该方案的形成将彻底解决 1μm 波段带宽激光三倍频问题，突破建造宽带型激光驱动器的这一关键技术难关。

We propose and numerically demonstrate a broadband frequency-tripling scheme for Nd:glass laser-based chirped-pulse amplification (CPA) system at 1053 nm. Based on the frequency-mixing of broadband chirped-pulse with a narrowband laser, the tripling scheme can support a bandwidth as large as 6 nm by alleviating the involved effects of group-velocity mismatch, which can be applied to generate ultraviolet petawatt pulses from a sub-picosecond Nd:glass petawatt laser system. Both the energy of ultraviolet pulse and tripling efficiency (>80%) are boosted by an additional narrowband fundamental laser. The generated ultraviolet pulse can be compressed to a duration shorter than that of the initial Nd:glass petawatt laser pulse and its peak power can be increased by 2.5 times as high as that of the Nd:glass petawatt laser. The sensitivities of conversion efficiency on both the intensity and crystal orientation are also discussed for practical applications.

本年度共发表 SCIE 文章 2 篇，被授权发明专利 3 项。
2 papers were published in SCIE journals and three patents were approved in 2009.

微光子学材料与器件 / Micro-Photonic Materials and Devices

成员：徐雷 刘丽英 吴翔 Group members：Xu Lei，Liu Liying，Wu Xiang

微光子学以光波导、光学微腔等具有一定功能的微小光学光路为研究对象，不同功能的微小光学光路的集成（称为集成光学，或集成光子学）是取代体光学光路的必由之路，也是人们所追求的终极目标。本课题组的工作集中于探索功能玻璃材料作为光子芯片应用的可能性，研究涉及材料的性能、微结构和微图形及光子学器件。

Micro-photonic chips are miniature optical circuits of waveguides and microcavities. Integration of circuits that have different functions will eventually replace bulk optical components, just like integrated circuits of microelectronics replaced discrete electronic components and changed our normal life. Our group focused on functional glassy materials, exploring the possibility of using these materials as part of photonic chips. Our research covers material characterization, micro-patterning technique and prototype photonic chip devices.

1. 提出并实现了一种全新的超高灵敏度耦合腔微腔激光器生物传感机理。Coupling variation induced ultrasensitive label-free biosensing by using single mode coupled microcavity laser

将本课题上年度发展的耦合腔单频微腔激光器用于生物传感，当痕量传感物质进入耦合区改变耦合比后，会异常灵敏地改变单频激光的输出波长，引起单频激光的跳频。跳频前后单频激光输出强度比与待测物质的浓度有很强的依赖关系。据此发展出一种全新的传感模式。实验上得到对牛血清蛋白和其它数种生物蛋白高达 80 pg/ml 的检测灵敏度，相当于采用超高 Q 无源微腔精密测量结果。而我们提出的新模式探测过程和要求远低于超高 Q 无源微腔。该项工作发表于 J. Am. Chem. Soc., 131, 16612-16613 (2009)。相关的耦合腔单频激光器的工作被邀请在国际系列会议国际激光光谱会议(ICOLS, International Conference on Laser Spectroscopy 2009)上做邀请报告。

A novel label-free optical bio-sensing scheme by using single mode coupled microcavity laser is experimentally realized. We demonstrated that slight change of coupling coefficient due to the existence of bio samples leads to sensitive single mode laser hopping to a new frequency that is several nm away from the original mode wavelength. By monitoring the emergence of the hopped laser mode intensity, we obtain a detection limit of bovine serum albumin (BSA) at 5ng/mL, which is comparable to that of a passive microcavity sensor with Q~107, but with much simplified experimental setup. Our results show the possibility of using a coupled optical microcavity to achieve ultra-sensitive optical sensing.

2. 液晶中主客体相互作用及光学非线性增强效应研究。Guest-host interaction in liquid crystal and the enhancement of optical nonlinearity

在向列相液晶中，当使用液晶有吸收的共振波长激发时，观察到了液晶光学重新取向的增强，测量得到这个增强高达 700 倍，这就发现了至今为止液晶分子转动所引起的最强的光学非线性之一。通过与染料掺杂液晶体系非线性增强效应的对比，证实了是由于激发态液晶和基态液晶之间的相互作用力大于基态液晶之间的相互作用力而引起了液晶取向的增强。论文发表于 Opt. Lett., 34(15), 2252-2254 (2009)。

通过施加辅助光激励，连续增大偶氮掺杂液晶中顺态（*cis* 态）染料对液晶取向的贡献，观察到由 *cis* 态染料对液晶的作用而导致的液晶取向的翻转。并进而计算得到该偶氮染料的两种异构态（*trans* 和 *cis* 态）与液晶之间相互作用力的比值为 1.18: 1。利用了两能级的平均场理论成功地解释了液晶取向增强系数和泵浦光强之间的关系。并揭示了在偶氮掺杂液晶中，由于和 *cis* 态相比 *trans* 态染料的取向有序度可以保持较长的时间，所以 *trans* 态对液晶取向的贡献要远远大于 *cis* 态染料。论文发表于 J. Phys. D, 42, 085116 (2009)。

Giant enhancement of optical reorientation in pure nematic liquid crystal was observed with a near-resonant input beam, the enhancement factor was almost 700 times and this is one of the strongest optical nonlinearity by optical-field induced molecular reorientation ever observed in liquid crystal. Compared with the enhancement in the dye-doped liquid crystal, we confirmed that this enhancement happened if the interaction between excited liquid crystals and ground-state liquid crystals is stronger than the interaction between ground-state liquid crystals.

By using an additional pump beam, the contribution of *cis* state dye to the reorientation of liquid crystal was increased in the azo-dye doped liquid crystal, and we observed the reorientation in liquid crystal changes sign from negative to positive when the reorientation contribution from *cis* isomers is increasing. We deduced that the interaction strength ratio of *trans*/*cis* with the liquid crystal is 1.18: 1. A two-level mean-field theory was derived to reveal the intensity dependence of orientation enhancement factor. And found that *trans* isomer can reorient the liquid crystal molecules more effectively than *cis* isomers because *cis* isomer easily lose its angular anisotropy.

3. 偶氮染料顺式异构体二阶光学超极化率的测量。The second order hyperpolarizability of cis azobenzene isomer

偶氮染料在常温下以 *trans* 形态存在，在光泵浦条件下会转变为 *cis* 分子。之前许多与偶氮染料相关的工作中都将 *cis* 分子的二阶光学超极化率近似地处理为 0，由此不可避免地引入了误差。我们通过理论和实验结合获得 *cis* 分子的二阶光学超极化率。最后得到 *trans* 和 *cis* 分子二阶光学超极化率分别为$g_{t}=1.1\times10^{-32}$esu，$\gamma_{c}=5.6\times10^{-33}$esu。论文发表于 Chem. Phys., 362, 109-113 (2009)。

The second order hyperpolarizability of *cis* azobenzene isomer (γ_{c}) was obtained by measuring the third harmonic generation (THG) variation of an azobenzene doped polymer film

when the film was optically pumped to create a large amount of *cis* isomers via photoisomerization. A steady state theory was developed to treat the THG intensity variation by considering the optical pump induced redistribution and reorientation of azobenzene in the polymer film and the contribution of *cis* isomer to the THG signal. g_t and γ_c were deduced to be 1.1×10^{-32} esu and 5.6×10^{-33} esu, respectively. The result shows that the optical nonlinearity of *cis* isomer is clearly not negligible.

2009 年度本课题组完成国家自然科学基金重点项目子课题 1 项。2009 年申请到国家自然科学基金面上项目 1 项和青年基金项目 1 项，上海市项目 1 项。2009 年度课题组发表文章 10 篇，其中 SCI 文章 9 篇，发表在包括 J. Am. Chem. Soc., Opt. Lett.和 IEEE J. Lightwave Technol.等期刊上，与其他课题组合作发表文章 4 篇，发表在 Appl. Phys. Lett.和 Chem.-A European J. 等期刊上；在国际会议上报告 1 次，为会议邀请报告；在国内会议上报告 6 次。

硅纳米晶的制备、发光及其在太阳电池中的应用/ Si Nanocrystals: Preparation, Light Emission and Application in Solar Cell

成员：陆明 赵有源　　Group Members: Lu Ming，Zhao Youyuan

本年度在 2 个方向上开展了工作，分别是：1）结合溶胶凝胶法和电化学腐蚀方法，发展了室温下制备含硅纳米晶的二氧化硅薄膜的方法，并将其应用在晶体硅太阳电池效率的提高。发现了薄膜光致发光强度和电池短路电流在一定范围内存在正的关联关系，紫外光照射下短路电流可增加~20%；2）基于高温相分离法，发展了一种新的增强硅纳米晶光致发光和电致发光的方法，即通过在起始一氧化硅薄膜中引入额外的成核点，来提高硅纳米晶的密度。利用 CO2 激光预退火后，发现光致发光和电致发光强度均增加了一倍以上；3）研究了硅纳米晶的光放大现象。另外，我们还研究了 SrTiO3 (001) 晶体高温还原后的紫外光催化增强，以及 BR 薄膜的光学非线性效应。

Research work covers two subjects. 1) By combining sol-gel method with that of electric chemical etching, we developed a method of preparing Si nanocrystals embedded in SiO2, and then applied this material to the improvement of Si solar cell performance. We found that the short circuit current of the Si cell increases with the increasing PL intensity of this material within a Si nanocrystal concentration range, and under the UV light irradiation, the short circuit current increases by ~20%; 2) Based on the method of high temperature phase separation, we developed a method of enhancing the light emission from Si nanocrystals by introducing extra nucleation sites into the SiO thin film so as to increase the density of Si nanocrystals. It is found that after CO2 laser pre-annealing, both the PL and EL intensities have a twofold increase; 3) The light amplification of Si nanocrystals was investigated. In addition, we have studied the enhancement of UV photocatalysis in SrTiO3 (001) after high temperature reduction treatment and the non-linear optical effect of BR thin film.

本年度发表 SCI 论文 1 篇，将发表 SCI 论文 1 篇，投稿 3 篇。授权发明专利 1 项。获得国家基金委面上项目 1 项，973 项目子课题 1 项。

量子调控 / Quantum Control

成员：庄军 张文献 Group member：Zhuang Jun, Zhang Wenxian

1. 通过数值计算，我们研究了在多个周期性的理想π相位调制脉冲的作用下，二能级量子体系退相干过程的相干调控。针对三种谱密度形式（高斯型、洛伦兹型、和指数型），我们发现二能级体系的退相干过程可能被减缓或者加速，这依赖于环境能谱的峰对应的位置和二能级体系的本征频率之间的差别。有趣的是，如果调控脉冲的间隔较短，那么二能级体系将不再衰减（退相干冻结效应）。退相干冻结的数值同体系在半个脉冲间隔内的衰减一致。

We investigate with exact numerical calculation coherent control of a two-level quantum system's decay by subjecting the two-level system to many periodic ideal π phase modulation pulses. For three spectrum intensities (Gaussian, Lorentzian, and exponential), we find both suppression and acceleration of the decay of the two-level system, depending on difference between the spectrum peak position and the eigen frequency of the two-level system. Most interestingly, the decay of the two-level system freezes after many control pulses if the pulse delay is short. The decay freezing value is half of the decay in the first pulse delay.

2. 氟磷灰石晶体中 ^{19}F 的核自旋经常在实验中用来近似一维的自旋系统。在相应的多脉冲调控下，这个核自旋系统的动力学可以用一维的两量子哈密顿模型近似描述，而一维的两量子哈密顿模型在最近临的条件下是严格解析可解的。我们利用核磁共振的方法，研究了氟磷灰石体系的多量子相干性的动力学，重点研究可解模型成立的实验条件区间。结合实验、数值近似、和解析求解的方法，我们探讨了自旋链内的长程相互作用、不同自旋链之间的相互作用、以及其它的环境自旋的效应，这些效应在较长的时间范围内都会使多量子相干震荡的信号衰减。我们的研究给出了氟磷灰石系统能够较好地模拟一维量子线体系的时间尺度。

The ^{19}F spins in a crystal of fluorapatite have often been used to experimentally approximate a one-dimensional spin system. Under suitable multipulse control, the nuclear-spin dynamics may be modeled to first approximation by a double-quantum one-dimensional Hamiltonian, which is analytically solvable for nearest neighbor couplings. Here, we use solid-state nuclear magnetic resonance techniques to investigate the multiple quantum coherence dynamics of fluorapatite, with an emphasis on understanding the region of validity for such a simplified picture. Using experimental, numerical, and analytical methods, we explore the effects of long range intrachain couplings, cross-chain couplings, as well as couplings to a spin environment, all of which tend to damp the oscillations of the multiple quantum coherence signal at sufficiently long times. Our analysis characterizes the extent to which fluorapatite can faithfully simulate a one-dimensional quantum wire.

3. 基于第一原理计算,我们提出了一种以原子精度可逆修饰表面纳米团簇的简单机制以及具体可行的控制方法. 在 Al(111)表面吸附的 Al 纳米团簇边界上, 原子可通过一个 Al 三原子针尖探针被提取以及重新释放. 利用这一可逆的操纵过程,我们把一个由十个原子组成的六角

形纳米团簇重排或修饰成了一个三角形的纳米团簇, 而且这种重排或修饰是完全可逆的. 这种操纵机制是基于探针与表面的相互作用, 它与探针移动方向的依赖关系在操纵过程中起了关键的作用.

Using first-principles simulations, we propose a simple mechanism and an easy-controlled method for reversible modification of supported nanoclusters on surfaces with atomic precision. As illustrated, individual atoms at edges of a Al nanocluster on a Al(111) surface can be extracted vertically and repositioned with a Al trimer-apex tip, which allows to rearrange a ten-atom hexagonal nanocluster to a triangular one in a reversible way. The governing mechanism is the atomic tip-surface interaction whose distinct dependence on directions plays a key role in manipulations.

4. 用金原子修饰幻数团簇(SiO2)4O2H4, 我们得到了两类类壳团簇 Aun(SiO2)4O2H4-n (n=1-4) 和 Aun(SiO2)4O2 (n= 5-8), 并研究了它们的光吸收性质. 团簇的结构优化基于密度泛涵理论, 结果表明尽管吸附 Au 原子的数目和类型不同，核(SiO2)4O2 的 Td 对称性保持不变。吸收光谱是基于含时的密度泛涵理论获得的。 从一种类型 Aun(SiO2)4O2H4-n (n=1-4) 到另外一种类型 Aun(SiO2)4O2 (n= 5-8)，吸收从紫外-可见光扩展到了近红外，在每一种类型中吸收强度与 Au 原子个数成线性关系。这些特点有利于获得特定光学性质的，并易于调控的新型团簇材料。 并且 Au8(SiO2)4O2 的类壳团簇在 900～1200 nm 的强吸收，就象 Au 包裹 SiO2 纳米壳那样，在肿瘤热治疗方面具有潜在应用。

By bonding gold atoms to the magic number cluster (SiO2)4O2H4, two groups of Au-adsorbed shell-like clusters Aun(SiO2)4O2H4-n (n=1-4) and Aun(SiO2)4O2 (n= 5-8) were obtained, and their spectral properties were studied. The ground-state structures of these clusters were optimized by density functional theory, and the results show that in despite of the different numbers and types of the adsorbed Au atoms, the cluster core (SiO2)4O2 of Td point-group symmetry keeps almost unchanged. The absorption spectra were obtained by time-dependent density functional theory. From one group to the other, an extension of absorption wavelength from the UV-visible to the NIR region was observed, and in each group the absorption strengths vary linearly with the number of Au atoms. These features indicate their advantages for exploring novel materials with easily controlled tunable optical properties. Furthermore, due to the weak electronic charge transfer between the Au atoms, the clusters containing Au2 dimers, especially Au8(SiO2)4O2, absorb strongly NIR light at 900～1200 nm. Such strong absorption suggests potential applications of these shell-like clusters in tumor cells thermal therapy, like the gold-coated silica nanoshells with larger sizes.

半导体量子点在活细胞中和细胞间的输运研究 / Intracellular and Intercellular Transport of Semiconductor Quantum Dots

成员：王培南 糜岚 Group members: Wang Peinan, Mi Lan

纳米材料在细胞内和细胞间的输运和分布对于了解纳米材料的细胞毒性以及药物传递具有重要意义。近年来又发现动物细胞之间可以通过细胞膜隧道纳米管（tunneling-nanotube，TNT）相互连通。这些TNT的长度甚至可以达到几个细胞直径，远超出人们以前的想象。TNT可以传输多种生物物质和信息，已经发现的输运物质包括细菌、钙信号、病毒和细胞器等等。但是关于无机纳米颗粒在TNT中的传输至今未见报道。

由于光学方法可以对活细胞进行无损伤的长时间跟踪研究，因此，我们利用共焦显微技术，通过时间分辨的快速图像扫描方法，研究了水溶性 CdTe 量子点在亚细胞微区（如线粒体、溶酶体、高尔基体等细胞器内）中的动态分布以及纳米颗粒在细胞间经由细胞膜隧道纳米管的输运过程，并通过对输运轨迹和速度的分析来了解输运模式和机理。

在我们的实验中，首次发现除了溶酶体以外量子点还会逐渐分布到高尔基体和线粒体等细胞器内，其中溶酶体和高尔基体是量子点的主要目的地，而线粒体中的分布相对较少。我们还首次发现半导体量子点也可以通过 TNT 在细胞间传输，既可以通过微丝以单向运动模式输运，也可以通过微管以双向运动模式输运，而双向运动模式大大降低了量子点的输运速度。我们也观察到了聚集于溶酶体中的量子点沿 TNT 的输运。通过对输运速度的分析发现，所有的输运都是主动输运。

It is of great importance for the potential applications of drug delivery and the understanding of cytotoxicity of nanoparticles to learn their behavior and mechanism of intracellular and intercellular transportations. In recent years, it was found that the animal cells could be connected by membrane or tunneling-nanotubes (TNTs). The lengths of TNTs can reach several cell diameters. The communication of bio-information and the transport of bio-objects mediated by the long-range physical connections among living cells are more widespread than previously thought. A multitude of cargos, including calcium fluxes,5 bacteria,7 virus,8,11 endosomal vesicles,1,7 lysosomes,3,7 mitochondria,7,15 were observed to be transported through TNTs. However, the transport of inorganic nanoparticles has not yet been reported.

Since optical approaches can be used for long-term tracking of living cells, we studied the subcellular dynamic distributions and TNT-mediated intercellular transportations of water-soluble CdTe quantum dots (QDs) by time-resolved images using a laser scanning confocal microscope. The transport mode and mechanisms were studied by analyzing the transport trajectory and speed. In our experiments, the QDs were found to distribute gradually into lysosomes, Golgi complexes

and mitochondria. Among them, lysosomes and Golgi complexes were the mail destinations of QDs, while mitochondrion is not the main site of the QD distribution. We also found for the first time that QDs could be transported through TNTs between living cells. There are two transport modes for QDs through the TNTs: the microtubule-based bidirectional and the actin-dependent unidirectional manners. The bidirectional motion greatly reduced the transport speed. The transport of QDs within lysosomes was also found in our experiment. The analyses of the transport speeds revealed that all the internalized QDs were transported actively through TNTs.

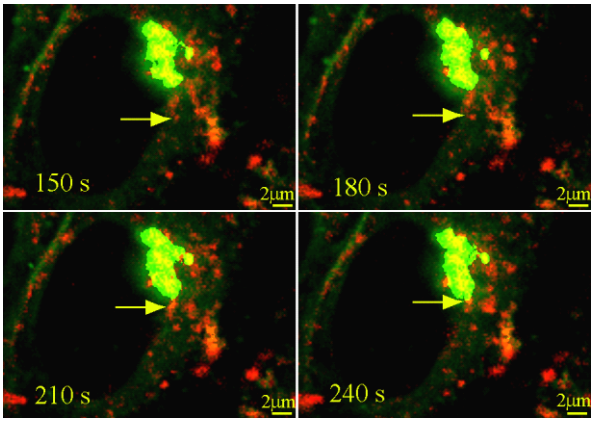


图 1. QGY 细胞内的量子点（红色）向高尔基体（绿色）的输运过程。黄色表示已经进入高尔基体的量子点。

Figure 1. Active transportation of the endocytosed QDs (red) towards a Golgi complex (green) in a QGY cell. The yellow color denotes the colocalization of QDs and Golgi complexes.

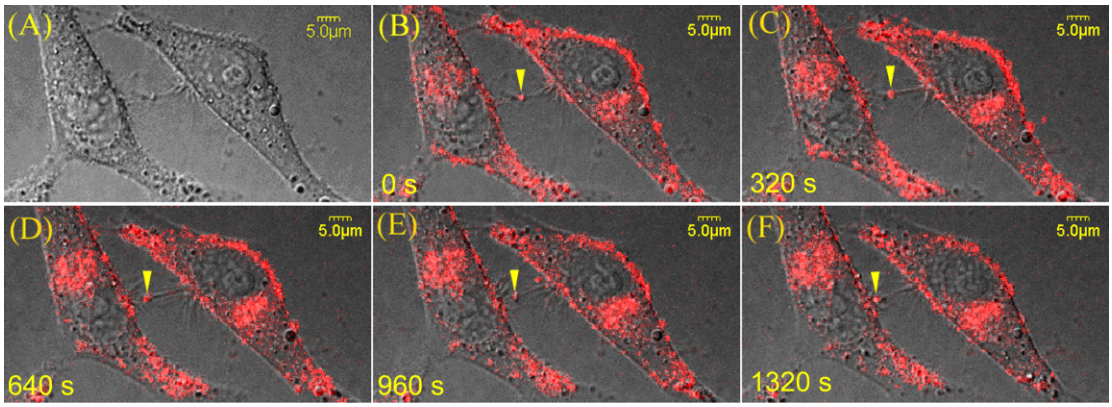


图 2. 量子点（红色）在连接 QGY 细胞的 TNT 内（箭头标示）的输运过程。

Figure 2. Transportation of the endocytosed QDs (arrowhead) through a TNT between a QGY cells.

等离子体特性和应用、功能材料的制备和性质研究 / Characteristics and applications of plasmas, preparation and properties of functional materials

成员：吴嘉达 许宁 应质峰 孙剑

Group members: Wu Jiada, Xu Ning, Ying Zhifeng,Sun Jian

氮碳纳米锥的合成工作进一步深入，摸索和优化了控制氮碳纳米锥生长的实验条件，研究了工作气体种类（不同比例 N_2 和 CH_4 混合气体）、放电参数（放电电流和放电电压）、制备时间、衬底条件（催化剂颗粒的尺寸和分布密度）对合成的氮碳纳米锥的成份、晶格结构、化学键态、形态形貌、分布密度和均匀度的影响，并研究了氮碳纳米锥的导电特性。结果表明在一定实验条件下在硅衬底上可以制备具有较高氮含量（氮碳原子比可达到 4:3 左右）、高尖锐度（锥尖曲率半径可达 5 纳米以下）、竖直生长、排列整齐的单晶形态氮碳纳米锥阵列。

The work on the synthesis of CN_x nanocones was extended to search and optimize the experimental conditions to control the growth of CN_x nanocones. The influences of working gases (mainly the ratio of N_2/CH_4), discharge parameters (discharge current and voltage), synthesis time, substrate conditions (the size and density of catalyst) on the composition, crystallinity, chemical bonding, morphology, distribution and uniformity of nanocones were studied, together with the examination of the conductivity of CN_x nanocones. We have succeeded in the synthesis of vertically aligned and single-crystalline CN_x nanocone arrays on silicon substrates with high N content (N/C atomic ratio near 4:3) and sharp cone end (radius less than 5 nm).

采用等离子体辅助反应脉冲激光沉积方法以金属锌为原材料合成制备了晶粒尺寸 20 纳米左右的纳米晶 ZnO 薄膜，室温下获得强烈的波长为 380 纳米的紫外光致荧光，特别考察了 7K 至室温度条件下纳米晶 ZnO 薄膜光致荧光谱特性和机制。在低温光致荧光谱中分辨出 ZnO 激子峰的精细结构，包括自由激子、施主束缚激子等，并且随着温度的提高，由于纵向光学声子散射和激子热电离等束缚激子紫外发光峰蓝移、展宽，束缚激子发光减弱，而自由激子发光增强，150K 以上光致荧光转变为以自由激子发光为主。

Nanocrystalline ZnO Films with crystal size of about 20 nm were synthesized by plasma assisted reactive pulsed laser deposition from metallic zinc. At room temperature, the synthesized nanocrystalline ZnO Films emit strong UV photoluminescence of about 380 nm. The photoluminescence features and the mechanisms responsible for photoluminescence were examined in the temperature range from 7 K to room temperature. Fine structures associated with ZnO exciton emission were identified in the low-temperature photoluminescence including those associated with free excitons and neutral donor bound excitons. With the increase of temperature, the UV emission peaks move toward lower energies and gradually get broadened together with the decrease of the bound exciton emission due to the LO phonon scattering and increased exciton thermal ionization, while the free-exciton related emission gets stronger. At temperatures above 150 K, the photoluminescence turns to be dominated by the free-exciton related emission.

我们还在 ZnSe 纳米线、ZnO 纳米棒等 II-VI 族半导体纳米结构材料的生长制备和性质研究方面开展了较深入的工作，采用脉冲激光沉积方法可以制备出较理想的竖直密集生长的单晶形态 ZnSe 纳米线薄膜和 ZnO 纳米棒薄膜，并探索制备基于以氮碳纳米锥阵列和 II-VI 族半导体纳米线作为电子传输层的聚合物/无机复合薄膜太阳能电池。

The preparation and properties of nanostructured II-VI semiconductors including ZnSe

nanowires and ZnO nanotubes were furthered in this group. We have succeeded in the preparation of vertically grown and single-crystalline ZnSe nanowires and ZnO nanotubes. Some attempts have been made to explore and develop polymer/organic solar cells using CN_x nanocones and nanostructured II-VI semiconductors as the transport layer for electrons.

较深入地研究了 ECR 等离子体特性和 PLA 等离子体特性，空间均匀、时间稳定的 ECR 等离子体和高速膨胀的瞬变 PLA 等离子体相互作用形成兼具 ECR 等离子体特性和 PLA 等离子体特性的复杂的 ECR-PLA 等离子体，特别是 PLA 等离子体对 ECR 等离子体的瞬时激发增强和 ECR 等离子体对 PLA 等离子体的激发延续导致 ECR-PLA 等离子体具有更高的活性，我们在实验上发现 PLA 铝等离子体可以使 ECR 氮等离子体瞬时激发增强了二十余倍，而 PLA 硼/碳等离子体使 ECR 氮等离子体瞬时激发增强了近六十倍。我们还研究了发生在高活性的 ECR-PLA 等离子体中的气相反应，并在实验上探测到反应产物。

Study on the characteristics of ECR plasma and PLA plasma was furthered in this group. The interactions between the spatially uniform and temporally steady ECR plasma and the fast-expanding and transient PLA plasma results in the formation of complicated ECR-PLA plasma which possesses both the characteristics of ECR plasma and those of PLA plasma. In particular, the enhanced excitation of the ECR plasma by the PLA plasma and the extended excitation of the PLA plasma by the ECR plasma make the ECR-PLA plasma more reactive. Experimentally, we have found that the excitation of the ECR nitrogen plasma was enhanced by the PLA aluminum plasma more than twenty times, and moreover, the ECR nitrogen plasma was enhanced by the PLA boron/carbon plasma about sixty times. The gas phase reactions occurred in the highly reactive ECR-PLA plasma were studied and we succeeded in the detection of the products of the reactions.

本年度执行国家自然科学基金面上项目 2 项，结题上海市科委国际合作基金项目 1 项，获得授权国家发明专利 1 项，发表学术论文 7 篇，另有 4 篇被接受。

In this year, two NSFC projects were carrying out and one Shanghai International Cooperation (AM) project was accomplished. One invention patent was granted. Seven papers were published and another four were accepted for publication.

凝聚态光学性质与光谱学研究进展 / The Progresses on the Study of Optical Properties of Condensed Matters and Spectroscopy

成员：陈良尧 郑玉祥 王松有 李 晶 张荣君

Group Members: Chen Liangyao，Zheng Yuxiang, Wang Songyou, Li Jing, Zhang Rongjun

一、主要研究进展 Progress on research

本年度在凝聚态光谱学和材料性质方面的研究进展包括：The research progress on spectroscopy of condensed matter and properties of solid state materials includes:

1． 十光栅及二维InGaAs探测器阵列折叠光路结构红外光谱仪． Path-folded infrared spectrometer consisting of 10 sub-gratings and a two-dimensional InGaAs detector

设计和研制了一种新型折叠光路、结构紧凑的红外光谱仪，该光谱仪中包括 10 个子光栅及一个 2 维 InGaAs 探测器阵列，无机械运动部件。由于采用双重折叠光路，整个系统结构紧凑。光谱仪的分辨率达 0.07nm，光谱范围 1450 到 1650 nm，光谱获取时间约 2ms，可应用于光通讯等领域实时光谱分析或光谱监控。

A new compact infrared spectrometer without any mechanical moving elements has been designed and constructed using a two-dimensional InGaAs array detector and 10 sub-gratings. The instrument is compact, with a double-folded optical path configuration. The spectra are densely 10-folded to achieve 0.07-nm spectral resolution and a 2-ms data acquisition time in the 1450- to 1650-nm wavelength region, making the instrument useful for real-time spectroscopic data analyses in optical communication and many other fields.

2． 微量掺杂对$Ge_2Sb_2Te_5$相变复合薄膜性能的改善研究. Phase change characteristics improvement of micro-elements doped $Ge_2Sb_2Te_5$ films

利用磁控溅射系统、采用共溅射方式制备微量掺杂的$Ge_2Sb_2Te_5$相变薄膜样品$M_x(Ge_2Sb_2Te_5)_{100-x}$，其中M为微量掺杂元素（如金属Al、Ti、或半导体Si、ZrO_2、TiO_2等）。利用在位温控椭偏光谱仪对掺杂样品进行变温椭偏光谱测量；还搭建Pump-probe时间分辨超快激光系统对样品的超快动力学过程进行实验研究；同时，运用第一性原理对此类样品微结构转变的分子动力学过程进行相应的理论研究。探索并阐明此类样品晶态-非晶态间的快速转变的分子动力学机制，为$Ge_2Sb_2Te_5$相变薄膜材料的性能改善及应用研究提供参考，为此类相变材料通过微量掺杂改善性能，并通过理论研究其分子动力学过程预测改性样品的微结构变化机制寻找新途径。

Micro-elements doped $Ge_2Sb_2Te_5$ Phase change films [$M_x(Ge_2Sb_2Te_5)_{100-x}$] were prepared by co-magnetron sputtering system. The “M” stands for different elements or molecules such as Al, Ti, Si, ZrO_2 or TiO_2, etc. The influence of M doping upon phase change characteristics of these $M_x(Ge_2Sb_2Te_5)_{100-x}$ films has been investigated by a temperature-regulable UVISEL™ typed spectroscopic ellipsometry (TRSE). Experimental study on the ultrufast dynamic process of these phase change films has been made by a pump-probe time resolution response test system. In the meatime, the molecular dynamic processes of mirco-strucural transformation of these doped films have been simulated by ab initio.

3． ZnO薄膜的椭圆偏振光谱研究. Optical Properties of Zinc-oxide Films Determined Using Spectroscopic Ellipsometry with Various Dispersion Models

使用ECR等离子体辅助脉冲激光沉积装置制备了ZnO薄膜，通过椭圆偏振测量和不同的色散模型，研究了金属氧化物ZnO薄膜的光学性质。在透明区，Cauchy和F-B模型均很好得给出了拟合结果。同时F-B模型也适用于吸收区。通过仔细的研究以及与其他工作的对比分析，我们发现F-B模型对(100)晶向占主导的样品II，其导出的光学常数更加合理可信。在透明区，Cauchy模型得出的RMSE最小，得出的光学常数更加准确。实验表明，对于不同微观结构的ZnO薄膜来说，应该选用不同的色散模型进行椭偏光谱的拟合，以得到最接近真实的光学性质。将F-B模型的光学常数拟合结果与文献数据进行了对比：Yoshikawa等人通过蒸镀的方法对ZnO晶体光学性质进行了研究；Dumont等人研究的是射频溅射制得的ZnO薄膜。对比结果如图1所示。可以看到，在透明区，本实验样品的光学常数n和k与文献数据几乎一致，但在吸收区可以观察到数值上的差别。在两块样品中，样品II通过F-B模型得到的光学常数更为合理。而在透明区，两块样品Cauchy模型都给出了最小的RMSE值，表明拟合得到的光学常数最为可信。

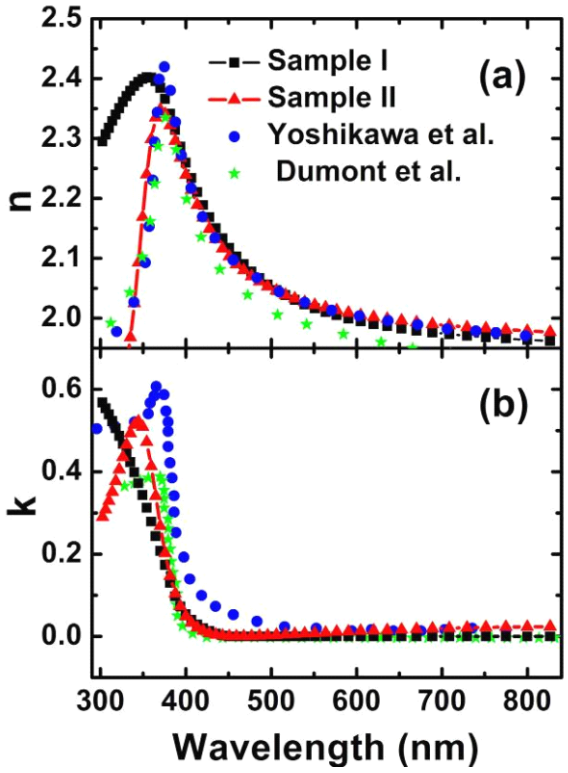


图 1　F-B 模型导出的光学常数与文献数据对比图

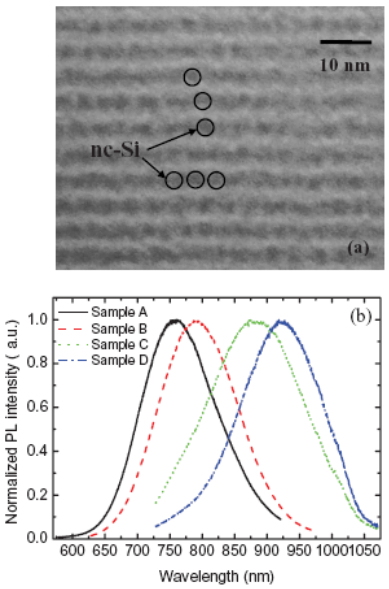
In this work, we have studied the optical properties of wurtizite zinc-oxide films grown on silicon (100) substrates by means of pulsed laser deposition (PLD). Spectroscopic ellipsometry and three dispersion models, namely, the Sellmeier, Cauchy, and Forouhi-Bloomer models, were applied for determining the optical constants of the ZnO thin films. A comparison was made between two samples that were deposited for 30 minutes (sample I) and 60 minutes (sample II), respectively. X-ray diffraction analysis indicates that there are two types of preferred-orientation, i.e., (101) and (100) orientations for sample I and II, respectively. Results show that the Cauchy model gives the best fit for the samples with least root mean square error (RMSE) whereas the Forouhi-Bloomer model is most suitable for the data analysis in both the transparent and the absorption regions. The optical properties extracted from different dispersion models have been compared with the data reported in the literature. The results given in this work show that different

dispersion models should be applied to obtain the optical constants for ZnO film samples grown under conditions to have different types of preferred-orientations.

4. SiO_2基质中纳单晶Si的尺寸对其光学常数的影响研究. Influence of nanocrystal size on dielectric functions of Si nanocrystals embedded in SiO2 matrix

在样品的制备过程中，首先用热蒸发的方法制备一系列SiO_x/SiO_2超晶格，其中SiO_x层的厚度分别为2nm（样品A）、3nm（样品B）、5nm（样品C）、6nm（样品D），SiO_2层的厚度固定为4nm，生长周期为40；然后生长一层厚度大约为20nm的SiO_2，在蒸发之前，腔体内的气压为1×10^{-7}mbar，衬底的温度为100℃；最后在1100℃的高温下，氮气环境中退火一个小时，得到二氧化硅（SiO_2）与硅纳米晶（nc－Si）的复合薄膜。对样品的测量是在室温下完成的。在1.5eV～4.5eV的入射能量范围内，以65°、70°，75°三个不同的入射角，0.05eV的步长进行测量。采用了Maxwell- Garnett有效介质模型和洛仑兹振子模型来模拟硅纳米晶的色散关系，并计算出复合薄膜及硅纳米晶的光学常数，再利用F-B模型来表征硅纳米晶的色散关系。实验还对硅纳米晶的结构和PL特性进行了测量，如图2所示[图中各样品的尺寸为A（~2nm nc-Si），B（~3nm nc-Si），C（~5nm nc-Si），D（~6nm nc-Si）]。实验观察到纳晶Si的介电函数与其纳米尺寸的依赖关系，以及与体Si相比，纳晶Si的E_1、E_2特征峰显著降低，如图3所示[图中各样品的尺寸为A（~2nm nc-Si），B（~3nm nc-Si），C（~5nm nc-Si），D（~6nm nc-Si）]。

The complex dielectric functions of Si-nanocrystals (nc-Si) with different sizes embedded in SiO_2 matrix synthesized by SiOx / SiO_2 superlattice approach is obtained by spectroscopic ellipsometry. The Maxwell–Garnett effective medium approximation and the Lorentz oscillator model are employed in the spectra fitting. The dependence of the dielectric functions on the nc-Si size is observed. A significant suppression in amplitude of the dielectric functions with respect to bulk crystalline silicon, and a large influence of the nc-Si size on the $E1$ and $E2$ critical points are observed and discussed.



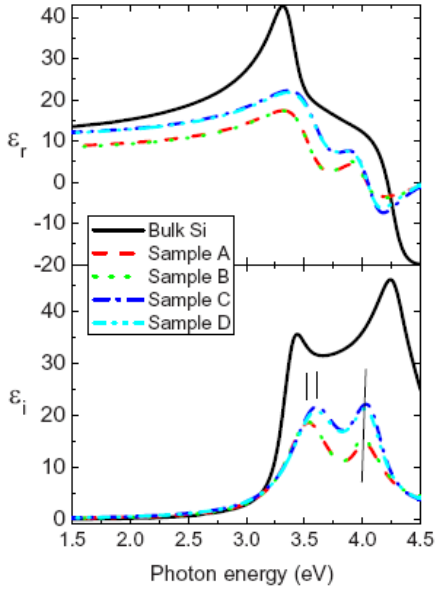


图2 （a）纳晶Si样品的TEM照片；（b）不同尺寸纳晶Si的PL谱。 图3 纳晶Si样品的介电常数谱。

5. ZrO_2 薄膜样品缺陷电平的椭圆偏振光谱研究. Electrical levels of defect investigation of

ZrO2 thin film by spectroscopic ellipsometry

在不同氧流量下制备 ZrO_2 薄膜样品，并用 X 射线衍射技术，X 射线光电子能谱技术及椭圆偏振光谱技术研究其缺陷电平。ZrO_2 薄膜的结构属于单斜晶系，其中存在氧空位，氧间隙等各种缺陷。这种薄膜的光学性质与其缺陷结构的变化密切相关。利用洛仑兹振子模型拟合椭圆偏振参数获得不同带电氧间隙缺陷和空位缺陷的转变能和概率。结果与密度泛函理论给出的电子亲和势相符，并标识了被不同带电缺陷俘获的电子能量。本项工作为探测高 k 薄膜缺陷态和能级提供一种非破坏和非接触测量方法。

The electrical levels of defects of of high-*k* dielectric ZrO_2 films deposited with different oxygen fluxes have been investigated using x-ray diffraction, x-ray photoelectron spectroscopy, and spectroscopic ellipsometry. Various defects with the formation of interstitial oxygen and oxygen vacancies existed in monoclinic ZrO_2 films. The optical properties of the films are strongly influenced by configuration changes in defects. Parameters were extracted from spectroscopic ellipsometry raw data by Lorentz oscillator model fitting that indicate the probabilities and transition energies for different charged oxygen interstitial and vacancy defects. These correspond to the electron affinity energies calculated by density functional theory and assigned to electrons trapped at different charged defects from the bottom of the conduction band. A nondestructive and noncontact solution is suggested for detecting the defect states and energy level of high-*k* film.

6． 液态和过冷液态锆的第一性原理分子动力学模拟.Ab initio Molecular Dynamics Simulation on Liquid and undercooled Zirconium

液态和过冷液态金属短程有序结构是影响金属非晶态形成过程中晶核的形成及玻璃态形成的决定因素，因此引起了材料领域的广泛关注。Schenk 等人报道了用利用电磁浮置装置结合中子衍射首次测量到在过冷液态纯金属元素中存在二十面体短程有序（ISRO）结构，而且在金属的熔点温度之上也观察到了二十面体短程有序结构，随着温度的降低短程有序度越显著。Waseda 等人在锆的熔点附近（2173K），利用 X 射线衍射方法，首次测量了液体锆的结构。Hattori 等人利用更先进的测量方法和测量技术对纯金属锆是否能够形成玻璃态进行了细致的研究，发现纯金属锆的玻璃态是不能形成的的。另外，理论上实验工作通常采用的逆蒙特卡罗模拟方法由于得到的原子结构与所加约束条件相关，因此得到的结果和第一性原理分子动力学方法得到的结果也存在一定的差距。因此，本工作对液体和过冷液态锆利用第一性原理分子动力学的方法进行系统研究，分析了从 2500K 到 1830K 的液体锆在不同的温度下的短程有序结构。在液态和过冷状态都发现了短程有序，并且随着温度的降低，在过冷液体中更是占有支配地位。运用结构队列分析方法，发现体心立方和二十面体结构同时存在于液态锆中。但在 1830 K 过冷液态锆中，体心立方结构有序占主要成分，同时也发现体心立方有向六角密堆积结构转化的趋势。

The short range order of liquid and supercooled metals is widely studied because the local structure of supercooled liquid is believed to affect the nucleation and glass formation mechanism remarkably. Schenk *et al.* reported the direct experimental proof of Icosahedral short range order(ISRO) in stable and deeply supercooled liquid of pure metallic elements using the combination of electromagnetic levitation with neutron scattering, and ISRO was observed above the melting temperatures and became more pronounced in the supercooled state with decreasing temperature. The first experiment on liquid zirconium was done by Waseda *et al.*, using X-ray diffraction, near the melting point (2173 K). Hattori *et al.* found out that the amorphous zirconium glass can’t be formed but their grain size become lager by the newly developed *in situ*

angle-dispersive x-ray diffraction using a two-dimensional detector and x-ray transparent anvils. Besides, theoretically, the reverse Monte Carlo (RMC) method and *ab initio* molecular dynamics were adapted to explore the local structure of zirconium liquid. But the results didn't agree very well with each other. In present work, *Ab initio* molecular dynamics study on liquid and undercooled zirconium is performed together with several kinds of analysis. The short range order (SRO) of liquid Zr at temperature from 2500 K to 1830 K is discussed. ISRO appears in both equilibrium and supercooled state and with the decrease of temperature it turns to be more dominant in the supercooled liquid. By structure alignment analysis, it is found that BCC as well as icosahedral both exist in the high temperature states. Besides, at 1830 K, a real structure evidence for the existence of BCC in supercooled liquid is shown. At last, there is a trend of phase change from BCC structure to HCP.

7. 液态 $Cu_{100-x}Si_x$ 的局域结构和动力学性质的第一性原理研究. Local Structures and dynamic properties of Liquid $Cu_{100-x}Si_x$ Alloys by ab initio Molecular Dynamics Simulations

随着合金应用范围地不断拓展，新型材料的需求随之不断增加。最近，金属玻璃因其独特的性质引起材料领域的广泛关注。因为晶态和非晶态源于液态，最近邻原子的排列对液态和非晶态的材料的性质起了决定性的作用。因此，对液体的局域原子结构随温度的变化规律的研究对于制备晶态和非晶态材料，均具有重大意义。

本工作利用第一性原理的分子动力学方法研究了液态 $Cu_{100-x}Si_x$ (x=20, 30)合金的局域结构和动力学性质。研究的温度分别是 1573, 1473, 1373, 1253, 1153, 1103, 与 1053 K。在每个温度点，100 个原子运行 4000 动力学步(3 飞秒/步)。通过原子的三维坐标得到了它们的对关联函数及结构因子。结果发现在退火过程中，配位数随着温度的降低而增大。$Cu_{80}Si_{20}$ (11.90~12.60)体系的平均配位数比 $Cu_{70}Si_{30}$ (11.55~11.95)的高。通过分析合金的键角分布，发现相邻两个原子主要处于 55.5 度和 106.5 度，表明体系中存在二十面体短程有序结构。Honeycutt-Andersen 指数分析也说明在 $Cu_{70}Si_{30}$ 和 $Cu_{80}Si_{20}$ 中二十面体短程有序占据统治地位。另外，代表二十面体短程有序的 HA 指数随着温度的增加而降低。同时，代表六角密堆积及面心立方短程有序结构的 142 指数超过了 10%，并且随着温度的降低而降低。在同一温度铜离子的扩散常数比硅的要大，$Cu_{70}Si_{30}$ 的中两种离子的平均扩散系数几乎是 $Cu_{80}Si_{20}$ 的两倍。

Due to the wide application of the alloys, the requirements on advanced materials are phenomenally increasing. Recently, the metallic glass has attracted global interest for their superior characteristics. Because the amorphous state is normally generated from the liquid, the local atomic arrangement of the nearest neighbors is expected to play an important role in the properties of liquid and amorphous materials. Thus it is valuable to begin with an accurate description of the local atomic structure of the liquid and further describe how it changes as a function of temperature.

The local structures and dynamic properties of liquid $Cu_{100-x}Si_x$ (x=20, 30) alloys have been studied by means of ab initio molecular dynamics (MD) simulations using the VASP code. The simulation temperatures are 1573, 1473, 1373, 1253, 1153, 1103, and 1053 K, respectively. At each temperature, 100 atoms run for 4000 MD steps (3 fs/step). The pair correlation functions and the structure factors were derived from the three dimensional coordination of the result. With the quenching process, the coordination number (CN) increases with the decrease of temperature. The CN of $Cu_{80}Si_{20}$ (11.90~12.60) is larger than that of $Cu_{70}Si_{30}$ (11.55~11.95). The bond angle distribution analysis was done and the result shows that peaks positions are about 55.5 and 106.5,

indicating the feature of icosahedral short range order (ISRO). The Honeycutt-Andersen index analysis also gave the result that the icosahedral short range order is dominant in both $Cu_{70}Si_{30}$ and $Cu_{80}Si_{20}$. In addition, the indexes representing the ISRO increase dramatically with the decrease of temperature. Meanwhile, the 142 index representing hcp/fcc short range order also takes more than ten percent and decreases with the decrease of temperature. The diffusion constant of Cu is bigger than that of Si at the same temperature, and the average diffusion constant of $Cu_{70}Si_{30}$ is almost twice that of $Cu_{80}Si_{20}$.

二、研究项目与成果 Research Projects and Results

2009 年度，本组承担了 8 项科研项目，包括国家自然科学基金重点项目 1 项、国家自然科学基金面上项目 2 项、上海市基础研究重点项目各 1 项、上海市自然科学基金项目各 1 项、教育部新世纪优秀人才计划 1 项、973 项目子课题 2 项。新增国家自然科学基金 2 项。发表期刊论文 21 篇，其中 SCI 论文 18 篇，EI 论文 3 篇。发表会议论文 22 篇，其中国内会议论文 9 篇，国际会议论文 13 篇。授权国家发明专利 1 项。

In 2009, our group has been carrying out 8 research projects, including 1 NSFC key project, 2 NSFC regular projects, 1 key project from Shanghai committee of science and technology, 1 project from Shanghai natural science foundation, 1 new century excellent talent program of education ministry, 2 sub-projects from national 973 program. In addition, two new projects have been approved by NSFC. We have published 18 research papers in SCI Journals, 3 papers in EI Journals, 13 papers in international conferences and 9 papers in domestic conferences. 1 national invention patent has been licensed.

纳米混合存储及其相关物理问题研究 / Nano Hybrid Magnetic Recording and Related Physics

成员：金庆原 张宗芝 马斌 Group Members: Jin Qingyuan Zhang Zongzhi, Ma Bin

进入 21 世纪，信息产业已经成为支柱产业之一，信息量的爆炸式增长要求信息存储密度迅速提高。为了适应记录密度的不断提高，磁记录的方式也从过去的纵向磁记录转向垂直磁记录，垂直磁记录技术将并且正在成为新一代数据存储的方式。磁记录密度的进一步提高，导致每一个位的尺寸以及晶粒尺寸迅速收缩，在室温下出现超顺磁。为了克服超顺磁瓶颈，必须提高介质的垂直磁各向异性，这使得磁记录写入头遇到前所未有的困难，因为传统写入磁头不能提供足够大的磁场来克服介质非常高的矫顽力。为此，人们提出了激光辅助磁写入、磁读出型光-磁混合存储的技术。该技术是一种新型的存储方式，它集光存储和磁存储的诸多优点于一身，能大大提高写入密度和读出分辨率，从而使存储密度大大提高，理论上可实现 10 Tbit/in^2 的超高记录密度，这使得激光辅助混合磁存储将成为更新一代信息存储的手段之一。我们主要围绕激光辅助混合磁记录的材料制备、记录的动态过程和实现、读出头性能和物理机制等方面进行了研究。

Information industry is one of the most important pillar industries. With the explosive increase of the information, recording density is required to be increased rapidly. In order to increase the magnetic recording density, the traditional longitudinal recording has been replaced by perpendicular recording, and perpendicular recording will and is becoming a new method of data storage. However, both the recording bits and grains shrink greatly in size with further increasing recording density, resulting in the superparamagnetic effect. In order to overcome the superparamagnetic limit, high anisotropy media materials should be used. The problem of using highly anisotropy materials is that the strength of the field produced by the traditional write head is not high enough to overcome the very large coercivity. One possibility to overcome the writing problem is to employ heat assisted magnetic recording (HAMR) technique. This new kind of hybrid optical-magnetic storage technique, which combines the advantages of both optical storage and magnetic storage, can greatly enhance the recording density and is expected to reach the density up to 10 Tbit/in^2. Our work mainly focuses on the HAMR-related meida materials fabrication, dynamic recording process, read head materials performance and their physical mechanism.

1. 超高密度纳米混合磁存储材料(ultrahigh density nano hybrid magnetic recording materials)：

采用基板加热（450 °C）的方法，在氧化镁基板上制备了矫顽力达到 30 kOe 的 $L1_0$ 相 FePt 岛状颗粒薄膜，理论上的磁晶各向异性达到 4.0×10^7 erg/cc。通过在其表面覆盖一薄层软磁的 Fe 膜，发展了可以称为核-壳结构的交换耦合复合结构（如图 1），可以将矫顽力大幅度降低，在 t_{Fe}=3 nm 时，复合结构的矫顽力降到 7.8 kOe（如图 2），在现有磁头场的允许范围内。与此同时，复合薄膜的势垒没有显著变化。因此，在相同的热稳定要求下，能够将记录密度提高近两倍。

通过增加薄的 MnAl 缓冲层，抑制了非磁性相的生长，较好地改善了 MnAl 薄膜的磁性能。在楔形膜的研究中，我们确定形成τ-MnAl 的最佳成分是 $Mn_{58.8}Al_{41.2}$，饱和磁化强度达到 192 emu/cc。对ΔM 曲线的研究发现，薄膜以非一致转动的球链模型实现发磁化过程。这

是因为我们采用多层膜的方法，利用 Mn、Al 原子的扩散制备τ-MnAl 薄膜。由于原子扩散随距离增加而减小，容易形成分层排列的结构；而这种结构的磁化翻转机理，可以用球链模型来解释。

By using substrate heating with the temperature 450 °C, $L1_0$ FePt granular film is prepared on MgO single crystal substrate, which coercivity is as high as 30 kOe. The estimated magneto-crystalline anisotropy is about 4.0×10^7 erg/cc。When the FePt grains are covered by a soft magnetic Fe film, the core-shell type exchange coupled composite is developed as shown in Fig. 1. Coercivity then decreases greatly with the increase of Fe layer thickness (Fig. 2). When t_{Fe}=3 nm, the coercivity of the core-shell composite reduces to 7.8 kOe which is below the current writing field of the induced magnetic head. At the same time, there is no obvious change of the energy barrier which stands against the thermal disturbance. Therefore, the recording density can be nearly doubled under the same requirement of thermal stability.

The added thin MnAl buffer layer can suppress the growth of non-ferromagnetic Mn-Al phases, and then better magnetic properties are obtained. By using the MnAl wedge, we find that the optimum composition for τ phase is $Mn_{58.8}Al_{41.2}$ which saturation magnetization is 192 emu/cc. According to the measurement of ΔM curve, the chain-of-spheres, an incoherent magnetization reversal, is assumed. This is due to the layered MnAl structure formed in the method of multilayers deposition followed by annealing.

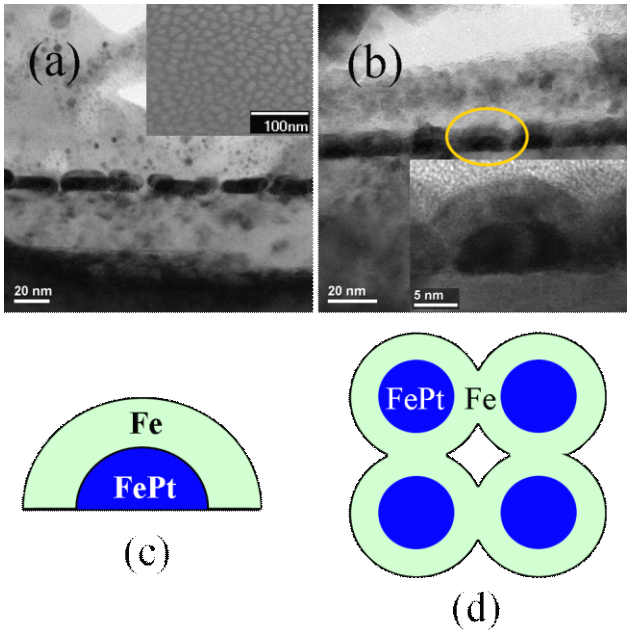


图 1：L10 FePt 和 FePt/Fe 薄膜的透射电子显微镜截面图：(a) $L1_0$ FePt(3.2 nm)；(b) FePt(3.2 nm)/Fe (5 nm)。(a)中的小图是扫描电子显微镜图，显示了薄膜的颗粒状结构。(b)图中的高分辨电镜图清晰地揭示了核-壳结构。(c)和(d) 分别是核-壳复合结构单元和微纳图案。

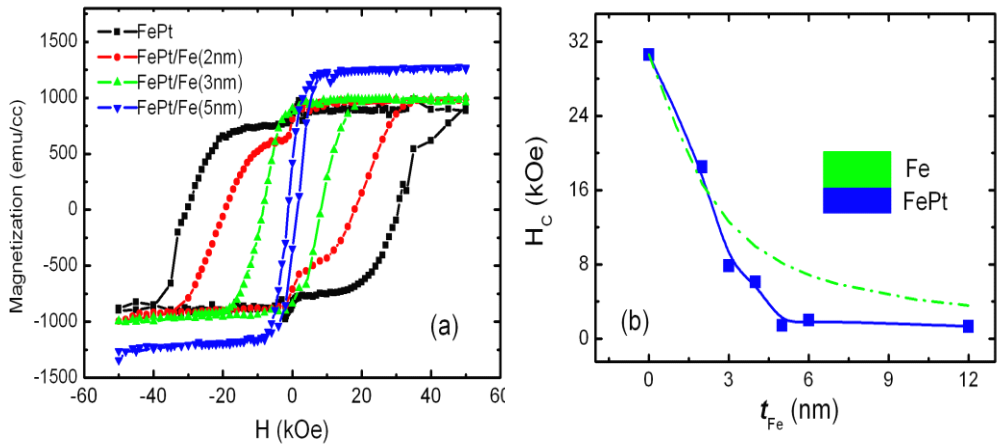


图 2：核-壳型 FePt(3.2nm)/Fe 复合结构的磁性能随 Fe 层厚度的变化：(a)磁滞回线；(b)矫顽力随 Fe 层厚度的变化。虚线表示根据 Ledge 型交换耦合介质得出的矫顽力随厚度的变化。

2. 纳米自旋体系超快动力学(ultrafast spin dynamics of nano systems)

在激光辅助混合磁记录中，了解激光的热效应对垂直磁记录介质材料磁性能--磁化强度和矫顽力的影响及其动态变化特征，对于激光辅助下磁信息是否能够有效写入以及写入速度都起到关键的作用，有助于探获实现激光辅助混合磁记录的最佳激光功率和薄膜材料结构参数。

我们采用磁控溅射方法在不同温度下制备了一系列 $L1_0$ 相 FePt 薄膜。利用基于磁光克尔效应（MOKE）的时间分辨 Pump-Probe 测量技术，研究了衬底温度对由激光激发的 FePt 膜的最大退磁量及磁性恢复速度的影响。图 3 给出了在 500， 530 和 550 度温度下制备的完全有序 FePt 8nm 薄膜的 XRD 图。可以看出，三个样品都具有很好的（001）织构，有序度和磁晶各向异性常数基本相同。但较高的衬底温度会使得 FePt 晶粒尺寸长大，根据 Scherrer 公式估算的晶粒尺寸分别是 9.7 nm, 12.9 nm, 和 16.0 nm。高温下制备的样品因为其单畴晶粒尺寸大而表现出较大的矫顽力，如图 4 的 Kerr 回线所示。对这些磁晶各向异性相似而晶粒大小不同的样品，我们测量了其飞秒激光激发的自旋动力学过程。从图 5(a)可以看出，衬底温度对退磁过程几乎没有影响，同样的泵浦功率下，最大退磁量和达到最大退磁时间都相同。但是，磁性恢复的快慢却与制备温度有关。高温下制备的 FePt 薄膜具有较快的恢复速度。这是由于对于过渡金属磁性薄膜来说，磁性恢复的快慢主要依赖于自旋-晶格驰豫速率，而自旋-晶格驰豫速率又与磁晶各向异性能 KuV 有关。既然 Ku 的大小基本相等，那么晶粒体积 V 大的样品磁化强度恢复较快，如图 5(b)所示。这些工作部分已经发表在 Thin Solid Films，部分投到 Journal of Korea Physical Society 杂志。

It is of cruicial importance to understand and detect the laser heating effect on the magnetic properties of magnetization and coercivity and their dynamic behaviors for the perpendicular media materials, which play a key role on the efficient and fast writing in heat-assisted magnetic recording (HAMR), and is helpful to acquire proper laser power and media structure parameters.

We have deposited a series of ordered $L1_0$-FePt thin films at various substrate temperatures by magnetron sputtering. The substrate temperature effects on the maximum demagnetization percentage and magnetization recovery speed excited by fs laser pulse have been studied by

employing the time-resolved pump-probe technique. Three fully ordered FePt samples with a fixed FePt thickness of 8 nm were obtained at different Ts of 500 °C, 530 °C, and 550 °C. The XRD patterns shown in Fig. 3 indicates the well oriented (001) texture. Although the ordering degree and the magneto-crystalline anisotropy constant Ku are very alike for the three samples deposited at different Ts, the average grain size D estimated by Scherrer equation are different, they are around 9.7 nm, 12.9 nm, and 16.0 nm for the Ts of 500 °C, 530 °C, and 550 °C, respectively. The increase of the single domain grain size with T_s would lead to an increase in magnetic coercivity, which can be seen from the static polar MOKE loops presented in Figure 4. Figure 5(a) and (b) shows the short and long range curve of the temporal magnetization evolution. For the same excitation intensity, substrate temperature does not play any effect on the demagnetization percentage. All the curves reach the same maximum demagnetization percentage at almost the same delay time of 0.9 ps after pumping. However, the magnetization relaxation rate is related to the substrate temperature, the FePt film prepared at higher T_s has a higher recovery speed. It is because for the itinerant ferromagnet, the recovery process is dominated by the spin-lattice relaxation rate which is mainly related to the magneto-crystalline anisotropy energy $K_u V$. The grains with bigger size (V) formed at higher T_s owns larger anisotropy energy. As a result, we attribute the observed faster magnetization recovery process of the higher T_s sample to the increased magneto-crystalline anisotropy energy.

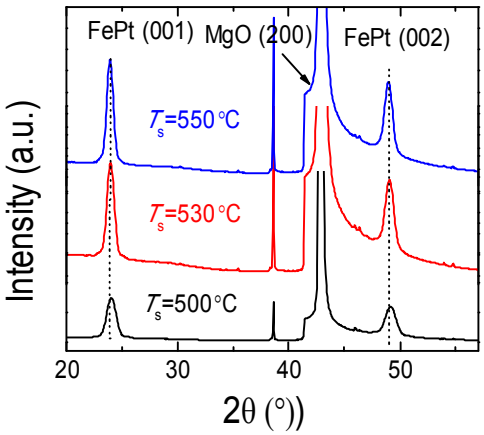


Fig.3 XRD patterns of MgO /FePt(8 nm) /Ta samples deposited at various substrate temperatures of 500, 530 , and 550 C.

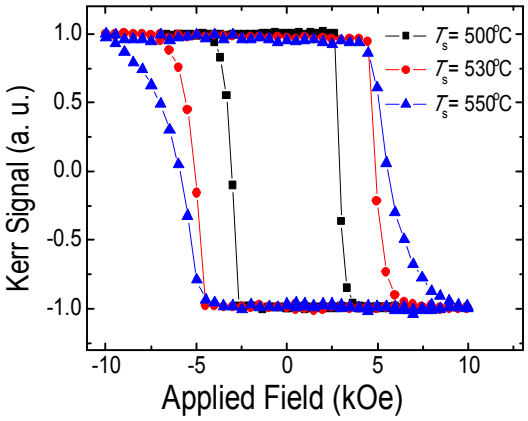


Fig.4 The corresponding static polar Kerr loops

3． 自旋电子学材料和微磁学模拟 (spintronics materials and micromagnetic simulation)

采用磁控溅射法制备了 Corning Glass /Ta/Cu/ $[Ni/Co]_3$/Ru 0.4-1.2nm/ $[Co/Ni]_5$ /Ta 多层膜。磁性测量表明 Ru 层厚度为 0.5-0.9nm 时，表现为反铁磁耦合，0.7nm 时反铁磁耦合达到最强，耦合场大小为 4640 Oe。当 Ru 的厚度小于 0.4nm 或大于 1.2nm 时，反铁磁耦合消失，变为铁磁耦合。选取 Ru 厚 0.7nm，制备了一系列的自旋阀薄膜，其结构为 glass/Ta(3.0)/Cu(1.4)/$[Ni(0.59)/Co(0.33)]_3$/Cu(2.3)/$[Co(0.33)/Ni(0.59)]_4$/Ru(0.7)/ $[Co(0.25)/Ni(0.59)]_3$. 制备态的样品不仅有很好的垂直各向异性，而且自由层和参考层的翻转场有高达 800 Oe 的差异，因此具有比较好的热稳定性。室温巨磁电阻信号可达 6.0%，经过

180 度磁场热处理后，尽管信号开始下降，但下降速度很缓慢，温度升到 300 度时仍有 4.0 % 的信号。

Samples of Ta(3.0)/Cu(1.4)/[Ni(0.59)/Co(0.25)]$_3$/Ru(t_{Ru}0.4-1.2)/[Co(0.25) /Ni(0.59)]$_5$ /Ta(3.0) (unit: nm) were prepared by magnetron sputtering. The antiferromagnetic coupling (AF) occurs at t_{Ru}= 0.5-0.9 nm. It reaches maximum value of 4640 Oe at t_{Ru}=0.7 nm.The AF coupling changes to be FM coupling when the Ru layer is thinner than 0.4 nm or thicker than 1.2 nm. Based on the above experimental results, we have fabricated pseudo spin valves including the perpendicularly magnetized SAF reference layer. The optimized sample has a stack of glass/Ta(3.0)/Cu(1.4)/[Ni(0.59)/Co(0.33)]$_3$/Cu(2.3)/[Co(0.33)/Ni(0.59)]$_4$/Ru(0.7)/ [Co(0.25) /Ni(0.59)]$_3$. The spin valve in the as-deposited exhibits well-defined perpendicular anisotropy. The switching field difference between the free and reference layer is as high as 800 Oe. The GMR signal is 6.0 % before anneal, it decreases very gradually with the increase of annealing temperature, as shown in Fig. 6.

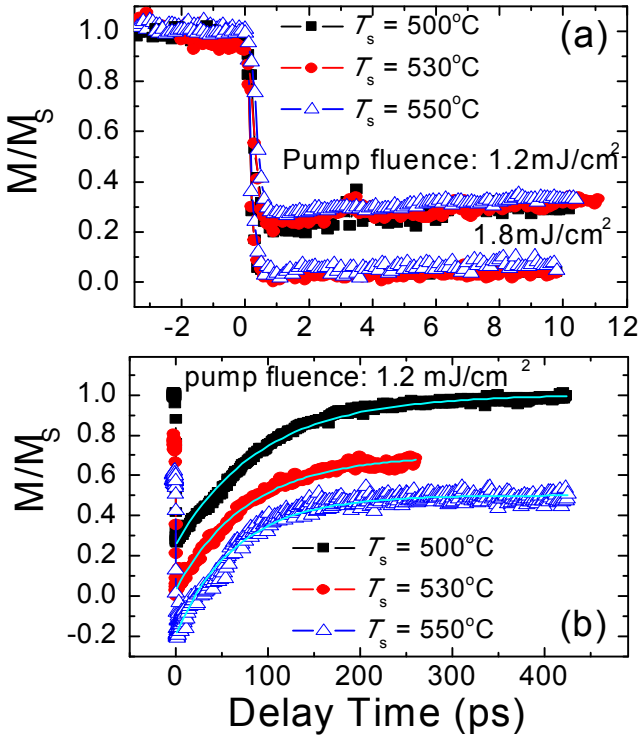


Fig. 5. Short range (a) and long range (b) transient normalized magnetization as a function of delay time for MgO /FePt (8 nm) /Ta (3 nm) sample deposited at various substrate temperatures. The photoexcitation pump fluences are 1.2 and 1.8 mJ/cm^2 for (a) and 1.2 mJ/cm^2 for (b).

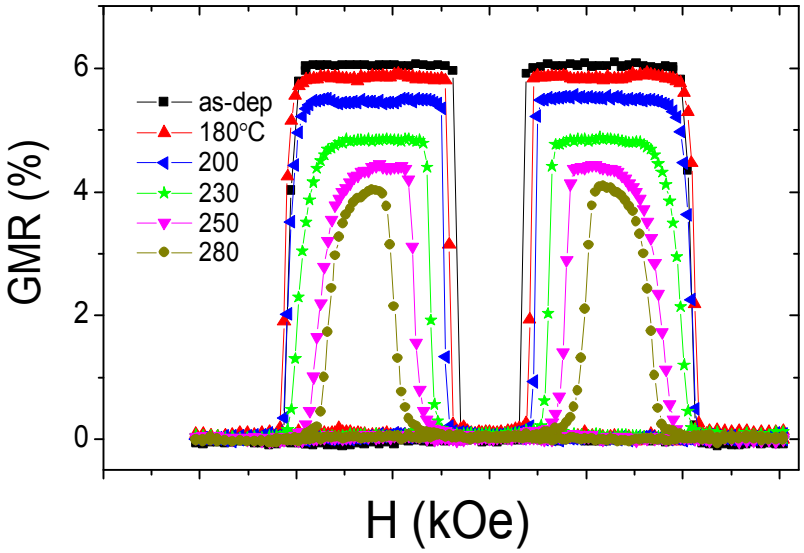


Fig. 6. The GMR curves of SAF pseudo spin-valve

我们模拟计算了垂直磁化 MRAM 阵列中近邻单元散磁场对目标单元自旋转矩诱导的磁化翻转行为的影响；我们设计了具有不同磁化方向配置的 3x3 的 MRAM 阵列，研究结果表明随着近邻存储单元间距的减小，中心目标单元的磁化强度翻转动态行为与目标单元和近邻存储单元的磁偶极相互作用密切相关。与共振进动效应相比，散磁场的影响起决定作用。而且，我们观察到的 Bloch 壁调节的磁化强度翻转动态过程与最近的实验报道非常符合。

Micromagnetic simulation is employed to study the influence of neighboring cells on spin torque switching in a 3x3 matrix of nanopillars with perpendicular magnetic anisotropy. The dynamic magnetization switching behaviors of the central target cell depend on the dipolar interactions between the target and its surrounding neighbor cells. The stray fields, rather than the resonant precession effect, play a dominant role in the critical switching current. Moreover, the Bloch wall mediated switching process is evidenced by the magnetization snapshots and agrees with the recent experimental results.

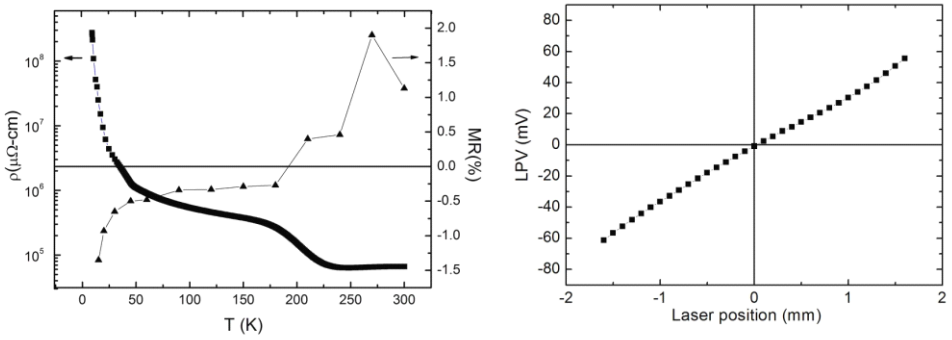
有机半导体的自旋电子学研究 / Spintronics in organic semiconductors

成员：倪刚 Group Member: Ni Gang

◆ Si 衬底磁性有机半导体复合薄膜的输运性质和横向光伏效应/Transport properties and lateral optical voltaic effects in magnetic organic semiconductor hybrid films on Si substrates

我们采用真空共蒸镀膜的方法，在硅衬底上沉积了 Co/Alq_3等磁性有机半导体颗粒膜。我们对其进行了输运性质的研究，观察到正负磁电阻的转换，认为这和衬底与薄膜界面形成的 MOS 反型层相关，并发现 Si 衬底的自然氧化层起着非常重要的作用；在此基础上，系统研究了不同掺杂浓度的 Si 衬底和不同组分的磁性有机半导体层对输运性质的影响机制。

此外，我们还对上述样品进行了横向光伏效应的研究，在其中观察到较大的横向光伏效应，并研究了相关的物理机制。



A series of Co-Alq_3 granular film samples were prepared on silicon substrates using co-evaporating technique. The microstructures, magnetic and magneto-transport properties in these samples were investigated systemically. A crossover of magnetoresistance (MR) from positive to negative was observed. The transition of resistance and MR results from the channel switching of electron transport between upper Co-Alq_3 granular film and inversion layer underneath. The transport properties of samples were greatly influenced by HF acid pretreatment, positive MR decrease drastically and the temperature dependence of resistance changes a lot near room temperature. It indicates that the native oxide layer plays an important role in the transport mechanism. Moreover, high-sensitivity lateral photovoltaic effect was observed in the samples, the possible mechanism in the samples was discussed.

液晶光电子器件 / Liquid crystal electro-optical devices

成员：刘建华 戴海涛 徐克璹　　Group Members: Liu Jianhua, Dai Haitao, Xu Keshu

1．全息光致聚合过程扩散及反应系数的解析表达反应的动态表征.

提出了一种确定全息光聚合反应及扩散系数的解析表达方法. 上述参数可以根据实验中 Bragg 光栅形成初期的一阶光栅衍射效率的增长率得到. 然后再根据一维反应-扩散理论对实验测量的一阶衍射效率的演变过程进行数值模拟, 调节上述参数的衰减系数可以使实验测量结果与数值模拟很好地吻合. 另外, 已获得的光栅最佳一阶衍射效率已达 96%, 并对光栅的动态形成机制进行了讨论, 发现后聚合效应在光栅最终结构的形成中具有重要的作用.

An analytical method is proposed to determine the initial diffusion and reaction coefficients for monomer molecules in holographic photopolymerization processes. Those parameters can be obtained directly from the measured first order diffraction efficiency at the onset stage in the formation of volume Bragg gratings. Simulations, according to these parameters, on the evolution of the diffraction efficiency, based on one-dimensional reaction-diffusion model, were well consistent with experimental data in our trimethylolpropane triacrylate based monomer and liquid crystal composite material. It is shown that diffusion and reaction both play important roles in postcuring process.

Volume Bragg grating with 96% diffraction efficiency _DE_ was efficiently formed by holographic hotopolymerization in blend syrup of photocurable trimethylolpropane triacrylate monomer and nematic liquid crystal. The formation dynamics of the composite gratings was quantitatively characterized under the frame of one-dimensional reaction-diffusion model with a revision of individual decay constants for monomer diffusion and reaction. Initial parameters of diffusion and reaction were analytically determined from the measured first order DE at the beginning stage. evolutions of the DE, both in curing and post curing periods, were excellently simulated, especially with post curing reaction been taken into account.

2. 可电调谐的多重光栅记录

研究了多重光栅在聚合物分散液晶中的存储, 在一个小于 0.8mm^2 的区域内, 记录了 10 幅体全息图, 其衍射效率分别在 6%-15% 之间. 分析了角度复用全息图对材料折射率的调制. 这种调制在全息多重存储及二维光子晶体应用, 及对存储容量及密度的理论和实验研究具有重要的作用.

We investigate multiple hologram recording in TMPTA based polymer-dispersed liquid-crystal thin film. By a new method of peristrophic multiplexing, ten volume holograms are stored at a single location of less than 0.8 mm^2 area with the relatively high diffraction efficiencies, 6%-15%. We also report two refraction index structures of peristrophic multiplexed holograms, which are important for the investigation of multiple hologram storage and two-dimentional photonic crystals in the material, and study, both experimentally and theoretically, the relation between the optical recording density and the diffraction efficiencies of multiplexed gratings for the estimation of holographic storage capacity.

3. Airy 光束的生成和传播动力学研究

根据 Airy 光束傅里叶变换的三次位相特征,提出了二元相位原件生成 Airy 光束的原理. 并基于 DMD 无模版曝光系统制备了 PDLC 二元相位光学器件.通过该器件调制后的入射平面波在其后傅立叶平面上将形成 Airy 函数的复振幅分布,从而产生了 Airy 光束. 在传播过程中,由于二元光学元件的本身的特征,Airy 光束将具有对称的两个主瓣,并分别沿相背离的抛物线轨迹传播.该光束可用于微粒操控,弯曲等离子体通道的生成等领域. 该工作被 OpticsInfoBase 网站选摘为每周图片展示.

Based on the cubic profile phase of the Fourier transform of Airy function, one novel method was proposed to generate the Airy beam by means of binary phase optical element. And then the desired element was prepared by utilizing DMD maskless lithographic system in PDLC materials. The Airy-type complex filed would be formed in the Fourier transform plane after the incident plane wave was modulated by aforementioned BPOE and that is Airy beam. In comparison with conventional Airy beam, there are two main lobes of this kind Airy beam generated by BPOE, which is due to the intrinsic property of binary optical elements. The two main lobes will propagate along repelled parabolic trajectories respectively. The Airy beam can be employed in the particle manipulation, curved plasma channel generation etc. Our research work was digested as week image by OpticsInfoBase website.

专利/Patents

申请专利/Patents Applied

[1] 200910045520.3；应用于数字 X 光诊断系统的光学成像系统；发明；徐敏，程珂，王军华，於崇真

[2] 200910046113.4；超薄背投光学系统；发明；徐敏，郝沛明，王军华，程珂

[3] 200910046920.6；一种常温制备 AlxGa1-xN 三元合金半导体薄膜的方法；发明；吴嘉达，孙剑，方芳，干洁

[4] 200910051232.9；电控开关式全息聚合物分散液晶衍射分束器；发明；高洪跃，刘建华，戴海涛，尹德金，浦海辉，高斌

[5] 200910055233.0；一种高效率产生紫外飞秒脉冲激光的方法；发明；赵坤，袁鹏，钟亥哲，张东方，朱鹤元，钱列加

[6] 200910197211.8；易轴垂直取向的人工合成反铁磁体和赝自旋阀薄膜结构；发明；张宗芝，贺赫，马斌，金庆原

[7] 200910199050.6；一种在硅衬底上制备高介电常数金属氧化物薄膜的方法；发明；吴嘉达，孙剑，高昆，干洁

[8] 200910045496.3；一种硒化锌纳米线薄膜的脉冲激光烧蚀沉积制备方法；发明；许宁，赖菊水，沈轶群，吴嘉达，应质峰

[9] 200910045717.7；高效全息聚合物分散液晶 Bragg 体光栅制备材料及其制备方法；蒲海辉，尹德金，高洪跃，戴海涛，刘建华

[10] 200910045718.1；电调谐全息聚合物分散液晶 Bragg 体光栅单色仪；发明；刘建华等

[11] 200910047118.9；一种聚合物-液晶复合光栅及其制备方法；发明；刘建华，蒲海辉，尹德金，高洪跃，戴海涛

[12] 200910047119.3；一种高效聚合物-液晶复合光栅及其制备方法；发明；刘建华，蒲海辉，尹德金，高洪跃，戴海涛

[13] 200910048872.4；在硅衬底上制备无过渡层的金属氧化物薄膜的方法；发明；吴嘉达，孙剑，唐文涛，干洁

[14] 200920067440.3；全息 Bragg 体光栅光谱仪；实用新型；刘建华，尹德金，蒲海辉，高洪跃，戴海涛

授权专利/Patents Approved

[1] ZL 200610148157.4；一种直流放电活性原子束喷射制备氮化碳纳米薄膜的方法；发明；许宁，胡巍，沈轶群，张廷卫

[2] ZL 200710040491.2；一种直径可调的硅量子线阵列的制备方法；发明；孙海彤，李政皓，陆明

[3] ZL 200610027438.4；聚焦高斯光束相速度分布的测量方法及其装置；发明；钱列加，陆大全，李永忠，范滇元

[4] ZL 200610118107.1；一种利用皮秒脉冲泵浦的飞秒光参量放大的方法；发明；钱列加，杨华，袁鹏，罗航，朱鹤元

[5] ZL 200610118917.7；c 轴垂直取向的 L10 相 FePt 磁记录薄膜的制备方法；发明；马斌，查超麟，金庆原

[6] ZL 200610118916.2；一种新型硅纳米晶的制备方法；发明；张荣君，陈良尧，郑玉祥，李晶，王松有，陆明

[7] ZL 200510025958.7；混合注入式飞秒激光光学参量放大器装置；发明；钱列加，罗航，袁鹏，朱鹤元

[8] ZL 2004 1 0067344.0；一种多模干涉热光开关；发明；吴翔，徐雷，刘丽英，王文澄

（注：去年未报 2008 年授权）

发表论文/ Journal papers

[1] Hao Li, Lei Shang, Xin Tu, Liying Liu, Lei Xu; Coupling variation induced ultrasensitive label-free biosensing by using single mode coupled microcavity laser; **J. Am. Chem. Soc.**, **131**(2009)16612.

[2] Qinghai Song, Liying Liu, Lei Xu, Yonggang Wu, Zhanshan Wang; Electrical tunable random laser emission from a liquid-crystals infiltrated disordered planar microcavity; **Opt. Lett.**, **34**(2009) 298.

[3] Qinghai Song, Liying Liu, Lei Xu; Directional random-laser emission from Bragg gratings with irregular perturbation; **Opt. Lett.**, **34**(2009) 344.

[4] Pei Yang, Liying Liu, Lei Xu, YR Shen; Excitation-enhanced optical reorientation in nematic liquid crystals; **Opt. Lett.**, **34**(2009) 2252.

[5] Yiqun Xie, Liuxue Ma, Peng Zhang, Xiulong Cai, Wenxian Zhang, Fuxi Gan, Xijing Ning, Jun Zhuang; Reversible atomic modification of nanostructures on surfaces using direction-depended tip-surface interaction with a trimer-apex tip; **Appl. Phys. Lett.**,**95** (2009) 073105.

[6] Hongyue Gao, Haihui Pu, Bin Gao, Dejin Yin, Jianhua Liu,and Fuxi Gan; Electrically switchable multiple volume hologram recording in polymer-dispersed liquid-crystal films; **Appl. Phys. Lett.**, **95** (2009) 201105.

[7] Dejin Yin, Haihui Pu, Bin Gao, Hongyue Gao, Haitao Dai, and Jianhua Liu; Analytical rates determinations and simulations on diffusion and reaction processes in holographic photopolymerization; **Appl. Phys. Lett.**, **94** (2009)211108.

[8] Yongcheng Qiu, Zongzhi Zhang, Qinyuan Jin, and Yaowen Liu; Dynamic dipolar interaction effect on spin-transfer switching with perpendicular anisotropy; **Appl. Phys. Lett.**, **95**(2009) 052507.

[9] RJ Zhang, YM Chen, WJ Lu, QY Cai, YX Zheng, LY Chen; Influence of nanocrystal size on dielectric functions of Si nanocrystals embedded in SiO2 matrix; **Appl. Phys. Lett.**, **95**(2009)161109.

[10] Cong Yin, Xijing Ning, Jun Zhuang,Yiqun Xie, Xiufang Gong, Xiangxi Ye,Chen Ming，and Yunfei Jin; Shape prediction of two-dimensional adatom islands on crystal surfaces during homoepitaxial growth; **Appl. Phys. Lett.**, **94** (2009) 183107.

[11] Xiaoqian Wang, Jiyao Chen, Lan Mi, Peinan Wang; A comparison of tissue penetrations

between single and two-photon-excitations; **Appl. Phys. Lett.**, **95** (2009) 143705.

[12] Xiang Wu, Yuze Sun, Jonathan D Suter, and Xudong Fan; Single mode coupled optofluidic ring resonator dye lasers; **Appl. Phys. Lett.**, **94**(2009)241109.

[13] Z Liu, L Shi, Z Shi, XH Liu, J Zi, SM Zhou, SJ Wei, J Li, X Zhang, and YJ Xia; Magneto-optical Kerr effect in perpendicularly magnetized Co/Pt films on two-dimensional colloidal crystals; **Appl. Phys. Lett.**, **95** (2009).

[14] PH Mao, YX Zheng, YR Chen, QY Cai, RJ Zhang, LY Chen; Study of the new ellipsometric measurement method using integrated analyzer in parallel mode; **Optics Express**，**17** (2009) 8641.

[15] MH Liu, SX Pan, YR Chen, YF Wu, QY Cai, PH Mao, YX Zheng, LY Chen; Path-folded infrared spectrometer consisting of 10 sub-gratings and a two-dimensional InGaAs detector; **Optics Express**，**17** (2009) 14956.

[16] HT Dai, YJ Liu, XW Sun, D Luo; A negative–positive tunable liquid-crystal microlens array by printing; **Optics Express**, **17**(2009) 4317.

[17] HT Dai, XW Sun, D Luo, YJ Liu; Airy beams generated by a binary phase element made of polymer-dispersed liquid crystals; **Optics Express**, **17**(2009) 19365.

[18] Yin Wang, Zhengzhe Lin,Wenxian Zhang, Jun Zhuang, Xijing Ning; Pulling long linear atomic chains from graphene: Molecular dynamics simulations; **Physical Review B**, **80** (2009) 233403.

[19] SY Wang, MJ Kramer, M Xu, S Wu, SG Hao, DJ Sordelet, KM Ho, CZ Wang; Experimental and ab initio molecular dynamics simulation studies of liquid Al60Cu40 alloy; **Physical Review B**, **79** (2009) 144205.

[20] W Zhang, J Zhuang; Dynamical control of two-level quantum system's decay; **Phys. Rev. A**, **79** (2009) 012310.

[21] W Zhang, P Cappellaro, N Antler, B Pepper, DG Cory, VV Dobrovitski, C Ramanathan, and L Viola; NMR multiple quantum coherences in quasi-one-dimensional spin systems: Comparison with ideal spin-chain dynamics; **Phys. Rev. A**, **80** (2009)052323.

[22] Xuan Li, Zongzhi Zhang, QY Jin, and Yaowen Liu; Spin-torque-induced switching in a perpendicular GMR nanopillar with a soft core inside the free layer; **New Journal of Physics**, **11** (2009) 023027.

[23] Hongyue Gao, Jianhua Liu, Fuxi Gan, B Ma; Investigation of multiple holographic recording in azo-dye-doped nematic liquid-crystal film; **Applied Optics**,**48**(2009) 3014.

[24] Haihui Pu, Dejin Yin, Bin Gao, Hongyue Gao, Haitao Dai, and Jianhua Liu; Dynamic characterizations of high diffraction efficiency in volume Bragg grating formed by holographic photopolymerization; **J. Appl. Phys.**, **106**(2009) 083111.

[25] Zhenya Li, Zongzhi Zhang, Hui Zhao, Bin Ma, and QY Jin; High giant magnetoresistance and thermal annealing effects in perpendicular magnetic [Co/Ni](N)-based spin valves; **J. Appl. Phys.**, **106** (2009)013907.

[26] TR Gao, Z Shi, SM Zhou, R Chantrell, P Asselin, XJ Bai, J Du, and ZZ Zhang; Exchange bias, training effect, hysteretic behavior of angular dependence, and rotational hysteresis loss in NiFe/FeMn bilayer: Effect of antiferromagnet layer thickness; **J. Appl. Phys.**, **105** (2009) 053913.

[27] C Li, WG Chen, F Wang, SF Li, Q Sun, SY Wang, and Y Jia; First-principles investigation of mechanical and electronic properties of MNNi3 (M=Zn, Mg, or Cd); **J. Appl. Phys.**, **105** (2009).

[28] Seyoung Seo, Rongjun Zhang, Wolfgang Löffler, Heinz Kalt, Kyung Joong Kim, and Margit Zacharias; Far-field observation of the radial profile of visible whispering-gallery modes in a single microdisk based on Si-nanocrystal/SiO2 superlattices; **J. Appl. Phys.**,**106** (2009) 123102.

[29] Qinghai Song, Liying Liu, and Lei Xu; Lasing action in dye doped polymer nanofiber knot resonator; **J. Lightwave Technol.**, **27**(2009) 4374.

[30] Jiong Shan, Pei Yang, Liying Liu, Lei Xu; The second order hyperpolarizability of cis azobenzene isomer; **Chem. Phys.**, **362**(2009) 109.

[31] Pei Yang, Jiong Shan, Liying Liu, Lei Xu; Photo-induced reorientation inversion in cis-enriched azo-dye doped liquid crystals in the isotropic phase; **J. Phys. D**, **42**(2009) 085116.

[32] Yanwu Zhang, Xiang Wu, Zian He, Liying Liu, Lei Xu; Compact asymmetric 1×2 multimode interference optical switch; **Journal of Optics A: Pure and Applied Optics**, **11**(2009)105401.

[33] Wei Liu, Qiming Zhang, Liying Liu, Lei Xu, Yinsheng Xu, Guorong Chen; Enhancement of second-order optical nonlinearity in photo-darkened Ge25Sb10S65 chalcogenide glass by femtosecond laser light; **Opt. Commun.**, **282**(2009) 2081.

[34] ZQ Xie, J Zhu, M Zhang, YY Zhao, M Lu; A combined approach to fabricating Si

nanocrystals with high photoluminescence intensity; **Applied Surface Science**, **255** (2009) 3833.

[35] Xiulong Cai, Peng Zhang, Liuxue Ma, Wenxian Zhang, Xijing Ning, Li Zhao, and Jun Zhuang; Tuning optical properties of magic number cluster (sio2)4o2h4 by substitutional bonding with gold atoms; **J. Phys. Chem. A**, **113** (2009) 4889.

[36] Xiufang Gong, Gongxian Yang, Youheng Fu, Chen Ming, Yiqun Xie, Jun Zhuang, Xijing Ning; Solute diffusion in the c0 phase of Ni based alloys;**Computational Materials Science**, **47** (2009) 232.

[37] Xiufang Gong, Gongxian Yang, Youheng Fu, Yiqun Xie, Jun Zhuang, Xijing Ning; First-principles study of Ni/Ni3Al interface strengthening by alloying elements; **Computational Materials Science**, **47** (2009) 320.

[38] CY Duan, XP Qiu, B Ma, ZZ Zhang, QY Jin; The structural and magnetic properties of tau-MnAl films prepared by Mn/Al multilayers deposition plus annealing; **Materials Science and Engineering B**, **162** (2009)185.

[39] PP Gu, CL Zha, B Ma, JP Wang, ZZ Zhang, QY Jin; Formation of (001) Texture in Fe-O Underlayered L1(0) FePt Films; **IEEE Trans. Magn.**, **45** (2009) 3594.

[40] P Sheng, G Ni, JF Yin, Y Zhang, ZY Tang, SM Zhou, QY Jin; Tunneling magnetoresistance effect in Co/TPD granular films; **Journal of Alloys and Compounds**, **477**(2009) 32.

[41] XM Zhao, G Ni, Q Shu, P Sheng, JQ Wu, JF Yin, B Ma, QY Jin; Magnetic properties, microstructures and magnetoresistance effect in Co/Alq(3) granular films; **Journal of Magnetism and Magnetic Materials**, **321**(2009) 418.

[42] K Yin, H Xu, GY Zhong, G Ni, W Huang; Highly improved electroluminescence from double-layer devices based on a carbazole-functionalized europium(3+) complex; **Applied Physics A**, **95** (2009) 595.

[43] GM Tao, HT Guo, L Feng, M Lu, W Wei, B Peng; Formation and Properties of a Novel Heavy-Metal Chalcogenide Glass Doped with a High Dysprosium Concentration; **Journal of the American Ceramic Society**, **92**(2009) 2226.

[44] L Feng, HT Guo, GM Tao, M Lu, W Wei, B Peng; Dy3+-doped Ge-In-S-CsI chalcohalide glasses for 1.3 mu m optical fiber amplifier; **Journal of Optoelectronics and Advanced Materials**, **11**(2009) 924.

[45] EY Zhou，ZY Lv，ZB Deng, HY Wang, DH Xu, Z Chen, W Wei, B Peng, Y Zhang;

Electroluminescence performance of organic light-emitting devices with KCl inside hole transport layer; **Journal of Luminescence**, **129**(2009)1390.

[46] F Liu, C Tang, QQ Chen, SZ Li, HB Wu, LH Xie, B Peng, W Wei, Y Cao, W Huang; Pyrene functioned diarylfluorenes as efficient solution processable light emitting molecular glass; **Organic Electronics**,**10** (2009) 256.

[47] HY Wang, KY Pu, S Huang, F Liu, B Peng, W Wei; Alternating copolymers based on perylene bisimide and oligo(p-phenylene ethynylene) units: Synthesis, characterization, and photoinduced energy and electron transfer processes of a new class of donor-acceptor systems; **Reactive & Functional Polymers**,**69**(2009).

[48] K Gao, W Zhang, J Sun, N Xu, ZF Ying, Q Li, J Gan, and JD Wu; Influences of substrate and annealing on the structural and optical properties and photoluminescence of nanocrystalline ZnO films prepared by plasma assisted pulsed laser deposition; **J. Phys. Chem. C**, **113**(2009) 19139.

[49] XF Xu, JD Wu, YQ Shen, and ZF Ying; Synthesis of crystalline carbon nitride nanocone arrays by direct-current discharge plasma-assisted CVD; **Chem. Vap. Deposition**,**15** (2009) 306.

[50] F Fang, W Zhang, J Sun, N Xu, J Zhu, ZF Ying, and JD Wu; Evolution of photoluminescence from Si nanocrystals embedded in a SiO2 matrix prepared by reactive pulsed laser deposition; **J. Mater. Res.**, **24** (2009) 2259.

[51] XF Xu, N Xu, W Hu, JD Wu, YQ Shen, ZF Ying; Self-assembled growth of carbon nitride nanocones using abnormal glow discharge; **Appl. Phys. A**, **96** (2009) 415.

[52] YQ Shen, N Xu, JS Lai, J Sun, JD Wu, ZF Ying, and T Okada; Fabrication of ZnO nanorods by pulsed Nd:YAG laser ablation deposition; **J. Vac. Sci. Technol. B**, **27**(2009) 1856.

[53] WW Li, ZG Hu, JD Wu, J Sun, M Zhu, FY Yue, ZQ Zhu, and JH Chu;Concentration dependence of optical properties in arsenic-doped ZnO nanocrystalline films grown on silicon (100) substrates by pulsed laser deposition; **J. Phys. Chem. C**, **113** (2009) 18347.

[54] QW Shu, XX Zhong, JD Wu, J Sun, and Kostya (Ken) Ostrikov; Investigation on bioactivity of titanium dioxide thin films fabricated by electron cyclotron resonance plasma aided pulsed laser deposition;**Plasma Sci. Technol.**, **11** (2009) 447.

[55] YH Sun, B Zhang, N Dai, JX Si, HZ Wu, RJ Zhang, LY Chen; Temperature-dependent optical properties of Pb1-xMnxSe films epitaxially grown on Zn0.04Cd0.96Te substrates; **Journal**

of Alloys And Compounds,**468**(2009) 34.

[56] W Gu, YH Wu, YR Chen, ZH Dai, WX Zhou, YX Zheng, LY Chen; Study on the properties of light propagation at the metal interface; **Journal of Infrared And Millimeter Waves**, **28**(2009) 31.

[57] W Gu, SY Wang, M Xu, YR Chen, LY Chen, Y Jia; Studies of the electronic and optical properties of BaMxO1-x (M = S, Se, Te) using first-principle calculations; **Optics Communications**, **282**(2009) 48.

[58] YR Chen, P Zhou, J Li, LY Chen; Electrical levels of defect investigation of ZrO2 thin film by spectroscopic ellipsometry; **Journal of Vacuum Science & Technology B**, **27** (2009) 1030.

[59] F Pei, S Wu, G Wang, M Xu, SY Wang, LY Chen, Y Jia; Electronic and optical properties of noble metal oxides M2O (M = Cu, Ag and Au): First-principles study;**Journal of The Korean Physical Society**,**55** (2009)1243.

[60] ZH Dai, RJ Zhang, J Shao, YM Chen , YX Zheng , JD Wu , LY Chen; Optical properties of zinc-oxide films determined using spectroscopic ellipsometry with various dispersion models; **Journal of The Korean Physical Society**,**55** (2009)1227.

[61] Yu Zhang, Lan Mi, Rongling Xiong, Wuli Yang, Changchun Wang, Qian Peng, Jiyao Chen, and Peinan Wang; Subcellular Localization of Thiol-Capped CdTe Quantum Dots in living Cells; **Nanoscale Research Letters**, **4** (2009) 606.

[62] Yu Zhang, Lan Mi, Jiyao Chen, and Peinan Wang; Environmental Influence on the Photoluminescence Behavior of Thiol-Capped CdTe Quantum Dots in Living Cells (topical review); **Biomedical Materials**, **4** (2009) 012001.

[63] Fan Zhang, Jing Li, Jiong Shan, Lei Xu, Dongyuan Zhao; Shape, Size, and Phase-Controlled Rare-Earth Fluoride Nanocrystals with Optical Up-Conversion Properties; **Chemistry-A European Journal**, **15** (2009)11010.

[64] Jiancan Yu, Jingyan Qiu, Yuanjing Cui, Jingting Hu, Liying Liu, Lei Xu, Guodong Qian; Preparation and electro-optic properties of hybrid sol-gel films containing imidazole chromophore; **Mater. Lett.**, **63** (2009) 2594.

[65] Guanghui Chen, Yigang Li, Yaoji He, Liying Liu, Lei Xu, Wencheng Wang; Photosensitivity and photoluminescence of Sn/Yb codoped silica optical fiber preform; **Chin. Opt. Lett.**, **7** (2009) 348.

[66] Tao Wang, Jiyao Chen, Shen Zhen, Peinan Wang, Changchun Wang, Wuli Yang and Qian Peng; Thiol-Capped CdTe Quantum Dots with Two-Photon Excitation for Imaging High Autofluorescence Background Living Cells; **J. Fluoresc.**, **19** (2009) 615.

[67] SY Wang, CZ Wang, CX Zheng, and KM Ho; Structure and dynamics of liquid Al1-xSix alloys by ab initio molecular dynamics simulations; **Journal of Non-Crystalline Solids**, **355** (2009) 340.

[68] Xiali Li， Guangqian Yang, Jian Chen，Ronguun Zhang，Weimin Zhou,Yanbo Liu，Jing Zhang and Qingkang Wang;Enhanced light extraction from colloida ZnO QD film by adding on photonic crystals using uv-nanoimprint lithography; **Surface Review and Letters**, **16**(2009) 367.

[69] JF Yin, G Ni, JQ Wu, MY Yuan, P Sheng, SY Wang, QY Jin; Magneto-optical Kerr Effect in Co/Alq(3) Granular Films; **Chinese Physics Letters**,**26** (2009) 017804.

[70] Q Shu, XM Zhao, Y Zhang, P Sheng, ZY Tang, G Ni;Transition of Magnetoresistance in Co/Alq(3) Granular Film on Silicon Substrate; **Chinese Physics Letters**,**26** (2009) 077505.

[71] Chaoyang Duan, Bin Ma, Fulin Wei, Zongzhi Zhang, and Qinyuan Jin; Influence of an Fe cap layer on the structural and magnetic properties of Fe49Pt51/Fe bi-layers; **Chinese Physics B**, **18** (2009) 2565.

[72] H Yang, LJ Qian, P Yuan, H Luo, HY Zhu;Generation of broadly tunable mid-infrared femtosecond pulses by a LiNbO3 optical parametric amplifier; **Chinese Science Bulletin**,**54** (2009) 3623.

[73] DQ Lu, W Hu, LJ Qian, DY Fan; Propagation and spatiotemporal coupling of iso-diffraction ultra-short pulsed Hermite Gaussian beams in free space;**Acta Physica Sinica**,**58**(2009)1655.

[74] XF Li, R Winfield, S O'Brien, LY Chen; Fabrication of 3d templates using a large depth of focus femtosecond laser; **Chinese Physics Letters**,**26**(2009) 094203.

[75] Y Sun, X Chen, Y Yue, RJ Zhang, and N Dai; Flexible Aluminum Nanobowls for Alternative Preparation of Individual or a Small Number of Nanoparticles; **Chemical Research in Chinese Universities**, **25** (2009) 143.

[76] 殷聪, 谢逸群, 巩秀芳, 庄军, 宁西京; 理论预测晶体表面吸附二维原子岛的形状; **物理学报**, **58** (2009) 5291.

[77] 吴翔, 尚磊, 李皓, 刘丽英, 徐雷;单频单方向回音壁模式微腔激光器; **激光与光电子学进展**, **46**(2009) 15.

[78] 陆卫杰, 张荣君, 陈一鸣, 郑玉祥, 程序, 李传文, 陈良尧;可扩展光学薄膜 Mapping 测量平台的设计与实现;**中国激光，36**（2009）1555.

[79] 张荣君，陈一鸣，郑玉祥，陈良尧; 硅发光研究与进展; **中国激光，36**（2009）269.

[80] 张荣君，郑玉祥，李晶，陈良尧，葛春风; 单模光纤的色散和损耗特性测量系统; **实验室研究与探索，28**（2009）29.

国际、国内会议/ Conference and symposium presentations

[1] Lei Xu, Xiang Wu, Lei Shang, Hao Li, Liying Liu； Single frequency microcavity lasers and applications；19th International Conference on Laser Spectroscopy (ICOLS 2009), Kusshiaro, Hokkaido, Japan, June 7-13, 2009 (invited talk)

[2] Liejia Qian； The principle, function and design of hybrid seeded optical parametric amplifiers； CLEO/Pacific Rim 2009, Shanghai, China, Aug.30-Sep.3, 2009 (invited)

[3] YH Wu，W Gu, YR Chen, XS Zhu, P Zhou, ZH Dai, YX Zheng, L Xu and LY Chen；Study of the light transmission properties at the metal/dielectric interface in the visible region； Applications of Optical Metamaterials(AOM), Nankai University, Tianjing, China，June 2009 (invited)

[4] Minghui Liu and Liangyao Chen；Study of the new spectrometer with densely-folded spectral images to work in both visible and infrared wavelength ranges with high resolution and high speed；The 10th Chitose International Forum on Photonics Science and Technology， CIST，Nov. 13-14, 2009 (invited)。

[5] Jianbo Chen, Yurui Chen, Yan Shen, Jiuchun Ren, Liangyao Chen； Comparison study of the photonics crystal and structure by different numerical approaches； The 8th Pacific Rim Conference on Lasers and Electro-Optics, Shanghai, China, 2009.8.30-9.3 (invited).

[6] Weixi Zhou, Zhonghong Dai, Yan Shen, Jing Li and Liangyao Chen； Experimental study of light refraction at the pure metal/air interface； 2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[7] Jianbo Chen, Yuerui Chen, Yan Shen, Jiuchun Ren,Yuxiang Zheng and Liangyao Chen； Difference arising from the band-gap structure calculations of the 1D-photonic crystal by TMM and PWM approaches； 2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[8] Minghui Liu, Suxing Pan, Yuerui Chen, Yunfei Wu, Qingyuan Cai, Penghui Mao, Liangyao Chen；Path-folded infrared spectrometer consisting of 10 sub-gratings and a two-dimensional InGaAs detector；2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[9] Qingyuan Cai, Penghui Mao, Yuxiang Zheng* , Rongjun Zhang, Dongxu Zhang, Minghui Liu, and Liangyao Chen, “The evolution of optical constants of Silicon dioxide from ultra thin films to thicker films”, 2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[10] Weixi Zhou, Xiaofan Li, Jing Li, Liangyao Chen； Study of high absorption film of spectral selectivity with dielectric/metal structure； 2009 中韩双边光电子会议，浙江绍兴，

2009.7.26-31

[11] Weijie Lu, Hui Zhou, Rongjun Zhang, Qingyuan Cai, Weixi Zhou, Yuxiang Zheng, Shixiong Qian, Liangyao Chen；Nonlinear optical properties of silicon nanocrystals grown by thermal evaporation；2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[12] Zhaohua Geng, Gang Wang, Song Wu, Songyou Wang, Langyao Chen and Yu Jia；Study of the electronic and optical properties of the ordered ternary alloys of X0.5Y0.5O2 (X,Y=Si, Ge, Sn) using first-principle calculations； 2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[13] Yan Shen, Weixi Zhou, Penghui Mao, Yuchao Wang, Jing Li, Yuxiang Zheng and Liangyao Chen；Experimental measurement and discussion of surface plasmons in the noble metals；2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[14] Gang Wang, Song Wu, Zhaohua Geng, Songyou Wang, Liangyao Chen and Yu Jia； The first-principles study on the electronic structures and optical properties of Hg1-xCdxTe；2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[15] S Wu, SY Wang, XW Fang, CZ Wang,KM Ho；Ab initio molecular dynamics simulations on liquid and undercooled Zirconium；The 12th Asian Workshop on First-Principles Electronic Structure Calculations (ASIAN12), Oct. 26-28, 2009, Beijing, China

[16] Liang Feng, Jiang Zhu, Shenjin Wei, Jing Li； Spectroscopic Ellipsometry Study on a (Si/SiO2)x Periodic Multilayered Film；2009 中韩双边光电子会议，浙江绍兴，2009.7.26-31

[17] 陈良尧；高分辨、快速、高密度光谱折叠繁荣光谱分析原理和方法研究；2009 全国信息光学与光子期间学术会议，青岛，2009.8.3-6 (邀请报告)

[18] 陈良尧；微纳结构的光学性质及其应用研究；东方论坛（130），上海，2009.8.22 (邀请报告)

[19] 周薇溪，戴仲鸿，沈彦，郑玉祥，陈良尧； 微纳光电子结构和器件的光学性质及其应用研究；宇航学会（先进光学技术及其应用研讨会）,杭州, 2009.11.21-24，(邀请报告)

[20] 周薇溪，戴仲鸿，沈彦，郑玉祥，陈良尧；光波在贵金属基界面的传播机理研究；全国光学材料会议，哈尔滨, 黑龙江 (邀请报告)

[21] 王刚, 吴松, 耿昭华，王松有, 陈良尧；Hg1-xCdxTe 的电子结构和光学性质的第一性原理研究；2009 年上海市激光年会

[22] 耿昭华, 王刚, 吴松, 王松有, 陈良尧；三元化合物 X0.5Y0.5O2(X, Y=Si, Ge, Sn)电子结构和光学性质的第一性原理研究；2009 年上海市激光年会

[23] 毛鹏辉，郑玉祥*，陈岳瑞，蔡清元，张荣君，陈良尧；使用组合检偏器的椭圆偏振态并行测量方法研究；2009 年上海市激光年会。

[24] 陆卫杰，张荣君，蔡清元，周薇溪，郑玉祥，陈良尧，周慧，钱士雄；SiOx/SiO2 超晶格法制备的硅纳米晶的非线性光学性质研究；2009 年上海市激光年会

[25] 单炯, 杨佩, 刘丽英, 徐雷；偶氮染料顺式异构体二阶光学超极化率的测量； 第八届全国光学前沿问题讨论会, 云南丽江, 2009.11.8-13

[26] 李颖峰，王绍军，刘丽英，徐雷；硅基弱束缚型光波导制备及性质研究；上海激光学会年会，2009.11 (口头报告)

[27] Xin Tu, Hao Li, Xiang Wu, Liying Liu, Lei Xu； Single-frequency coupled concentric ring resonator laser； 上海激光学会年会，2009.11

[28] 胡婧婷，邱静燕，徐雷，刘丽英；新型 DR1/SiO2、DCM/SiO2 有机/无机复合材料电光调制器件研究； 上海激光学会年会，2009.11

[29] Xin Tu, Xiang Wu, Hao Li, Liying Liu, Lei Xu；High-Q unidirectional emission properties of the symmetric half spiral microcavities； 复旦大学博士生学术论坛之信息科学与技术篇，上海，2009.11.28-29

[30] Jiong Shan, Pei Yang, Liying Liu, Lei Xu； The second order hyperpolarizability of cis azobenzene isomer；复旦大学博士生学术论坛之信息科学与技术篇，上海，2009.11.28-29

学位论文/Dissertations

1. 博士学位论文

[1] 张　鹏，**利用遗传算法对金属表面纳米团簇结构性质的研究**；导师：庄军

[2] 杨　佩，**液晶中的主客体相互作用及光学非线性增强效应研究**；导师：徐雷

[3] 尚　磊，**新型非圆对称回音壁模光学微腔激光器的制备与特性研究**；导师：刘丽英

[4] 刘　伟，**飞秒激光诱导 GeSbS 硫系玻璃光学非线性增强的研究**；导师：刘丽英

[5] 王洪宇，**基于 D-A 结构有机功能材料的合成及性能研究**；导师：韦玮

[6] 王　科，**基于二阶非线性过程的非线性相移产生和相速度测量**；导师：钱列加

[7] 魏小红，**高功率激光非线性过程中的光束质量与传递特征**；导师：范滇元

[8] 李　瑛，**微波光子学中的毫米波产生及其应用**；导师：范滇元

[9] 胡　巍，**等离子体沉积相关技术在制备纳米结构碳氮薄膜上的应用**；导师：吴嘉达

[10] 沈轶群，**ZnO 薄膜掺杂机理及其特性研究**；导师：吴嘉达，许宁

硕士学位论文

[1] 蔡秀龙，**基于幻数团簇$(SiO_2)_4O_2H_4$的 Au 吸附团簇的光学性质研究**；导师：庄军

[2] 顾培培，**铁磁/亚铁磁双层薄膜的制备**；导师：马斌

[3] 段朝阳，**L10 结构薄膜的有序化研究**；导师：马斌

[4] 李　暄，**垂直磁化薄膜的制备和自旋转移矩效应模拟研究**；导师：张宗芝

[5] 王　娜，**阳极氧化铝模板成孔机理研究及其在合金纳米材料制备中的应用**；
导师：金庆原

[6] 赵佳琦，**FePt 基磁性薄膜的超快自旋动力学研究**；导师：金庆原

[7] 李锦江，**钇铝石榴石纳米粉体的制备及其性能表征**；导师：彭波

[8] 刘燕妮，**掺钕氟磷酸锶纳米材料的制备及其性能研究**；导师：彭波

[9] 刘　磊，**高紫外透过高能激光窗口材料的制备与性能研究**；导师：彭波

[10] 陶光明，**新型硫系玻璃红外材料的制备及其性能研究**；导师：韦玮

[11] 冯　雷，**Dy^{3+}掺杂的 Ge-In-S-CsI 硫卤玻璃的结构及荧光特性研究**；导师：韦玮

[12] 尹德金，**高效全息聚合物分散液晶布拉格光栅制备研究**；导师：刘建华

[13] 许晓峰，**碳氮纳米锥阵列和 P 型氧化锌的制备研究**；导师：许宁

[14] 方　芳，**纳晶硅镶嵌二氧化硅薄膜及其发光性质研究**；导师：吴嘉达

[15] 唐隽逸，**脉冲激光烧蚀等离子体和 ECR 放电等离子体相互作用的光谱研究；**导师：孙剑

[16] 张东方，**超短脉冲信噪比单次测量技术**；导师：钱列加

[17] 裴　斐，**若干新型材料性质、TiO_2 掺杂改性的理论研究**；导师：王松有

[18] 戴仲鸿，**金属基薄膜结构的光学性质研究**；导师：陈良尧

[19] 陈一鸣，**硅纳米晶体与铁电薄膜的椭偏光谱研究**；导师：张荣君

[20] 赵二刚，**光纤光栅液位传感器研究**；导师：钱列加

[21] 邢美术，**激光前端系统光纤放大技术研究**；导师：钱列加

主办国际会议/ Sponsored International Conferences

第七届（2009）中韩双边光电子会议；2009-7-26；浙江，中国

2009 年 7 月 26－30 日，第七届（2009）中韩双边光电子会议在浙江诸暨召开。来自中、韩、美等国家 40 余位代表参加了会议。大会主席由复旦大学信息学院陈良尧教授和韩国物理学会会长、汉阳大学教授 Young-Pak Lee（李英白）共同担任。与会代表共提供了 37 篇大会报告，其中包括 7 篇特邀报告，12 篇口头报告和 18 篇张贴报告。内容覆盖纳光子学、薄膜光学、光子学器件、应用光学及材料光学性质等领域研究新进展。在本次会议中复旦大学提供了 4 篇口头报告和 11 篇张贴报告。本次会议为中外光子学领域的同行提供了很好的交流平台，为进一步的国际合作研究创造良好的条件。

学术组织与期刊任职/Academic Service

国际学术组织任职/Service to the International Professional Societies

干福熹 国际光学工程学会资深会员 1998-
Gan Fuxi Fellow，International Society for Optical Engineering (SPIE)
美国光学学会资深会员 1990-
Fellow，Optical Society of America (OSA)

金庆原 IEEE 国际磁学学会技术委员会委员；2005-2006
JinQingyuan Member , IEEE Magnetics Society Technical Committee

国际期刊任职/Service to the International Journals

干福熹 Gan Fuxi
国际《非晶态固体》杂志编辑委员会委员 1982-
Member of Editorial committee international journals USA《Noncrystalline Solids》

国际《光学材料》杂志编辑委员会委员 1992-
Member of Editorial committee international journals USA《Optical Materials》

国际《玻璃物理与化学》杂志编辑委员会委员 1996-
Member of Editorial committee international journals U.K《Glass physics and chemistry》

《马来西亚科学》杂志编辑委员会委员 1994-
Member of Editorial advisory committee international journals《Malaysia Science》

《马来西亚固体科学和技术》杂志编辑委员会委员 1994-
Member of Editorial committee international journals 《 Malaysia Solids Science and Technology》

国内学术组织任职/ Service to the Domestic Professional Societies

干福熹	中国硅酸盐学会名誉理事长	2004-
金庆原	中国光学学会基础光学专业委员会副主任	2005-
徐　雷	上海激光学会副理事长	2005-
钱列加	中国宇航学会光电专委会常务理事	2005-
王培南	上海激光学会理事	2005-
陈良尧	中国光学学会理事	2006-
	中国宇航学会光电专委会常务委员	2007-

国内期刊任职/Service to the Domestic Journals

干福熹	《辞海》编委会, 副主任	2004-
	《无机材料学报》顾问	1985-
	《自然科学进展》顾问	1992-
	《材料研究学报》顾问	1998-
	《光学学报》顾问	1998-
	《功能材料》杂志编辑顾问委员会委员	1990-
	《硅酸盐通报》杂志编辑顾问委员会委员	1995-
	《河南大学学报》杂志编辑顾问委员会委员	2000-
	《中国光电医学》杂志编辑顾问委员会委员	1992-
	《世界科技研究与发展》；杂志编辑顾问委员会委员	1995-

客座研究课题及来访人员/ Open Subjects & Guest scientists

重点实验室高访学者研究课题/Open Subjects

序号	课题名称	负责人	职称	工作单位	起止时间
1	新型液晶显示模式设计研究	吴诗聪 (Shin-Tson Wu)	教授	美国中佛罗里达大学（UCF）	2007.7 -2009.7
2	磁记录介质研究的关键技术和实验方法	刘小晰	副教授	日本国信州大学工学部信息工学科	2007.7 -2009.7
3	半导体量子点/嵌段聚合物复合膜的光谱性质	陈鑫	副研究员	中科院上海技术物理所	2007.7 -2009.7
4	电流诱导磁化翻转效应的物理原理及微纳米器件制备的关键技术	Paulo Freitas	教授	Physics Dept. of instituto superior tecnico and INESC MN, Lisboa, Portugal	2007.7 -2009.7
5	基于紧束缚近似的理论研究方法	王才壮	研究员	Ames Laboratory-USDOE	2007.7 -2009.7
6	超高密度光磁混合数字信息存储	王建平	副教授	Electrical and Computer Engineering Dept.Univ.of Minnesota, USA	2007.7 -2009.7
7	异型微腔传感及单频微腔激光	范旭东	副教授	University of Missouri - Colombia	2007.12 -2009.12
8	纳米液晶的非线性光学效应及光角动量和自旋交换	Lorenzo Marrucci	副教授	意大利那波里大学	2007.12 -2009.12
9	单分子技术在生物研究中的研究中的应用	杨炜东	副教授	Bowling Green State University，USA	2007.12 -2009.12
10	热辅助磁记录的动态测试	车晓东	实验室主任 Director	Hitachi Global Storage Technologies，USA	2008.5 -2010.5
11	新光学活性玻璃和透明玻璃-陶瓷材料的制备和性能研究	陈丹平	研究员	中国科学院上海光学精密机械研究所	2008.5 -2010.5

来室访问及作报告的学者/ Guest scientists & some visitors

序号	学者姓名及身份	国别	讲学（访问）内容	时　间
1	John Chapman 教授，University of Glasgow	英国	来室讨论合作研究项目	2009.1.5-1.7
2	Prof. Shin-Tson Wu, 美国中佛罗里达大学	美国	Next waves of TFT-LCDs	2009.4.22
3	Dr. Guanghao Zhu， 加州大学洛杉矶分校	USA	Photonics-real life applications	2009.5.13
4	Prof. David J. Brady, Dept.of Electrial and Computer Engineering, Duke U.	USA	Computational optical imaging and spectroscopy	2009.5.15
5	Associate Prof. Junpeng Guo, Dept. of electrical and Computer Engineering U.of Alabama in Huntsville	USA	Control surface plasmon-polariton with nanolayers	2009.5.15
6	Prof.J.W.Harrell, Dept.of Physics & Astronomy, U. of Alabama, Tuscaloose	USA	Materials for ultra-high density magnetic media-extending the superparamagnetic limit	2009.5.22
7	Li You，教授，美国佐治亚理工学院	美国	学术交流访问	2009.7.6，7.14，8.24－25，9.4
8	Vincent Liu，副教授，University of Pittsburgh	美国	交流访问	2009.7.29
9	Prof.Lorenzo Marrucci,Dipartimento di scienze fisiche, Universita di napoli Federico II, Napoli, ITALY	意大利	Rotating photons: conversion of the angular momentum of light from the spin form to the orbital form and vice versa, Hong-ou-mandel quatum interference, and quantum cloning of single photon vortices.	2009.9.23
10	Prof.Lorenzo Marrucci,Dipartimento di scienze fisiche, Universita di napoli Federico II, Napoli, ITALY	意大利	The conducting interface between the two insulating oxides SrTiO3 and LaAlO3: evidence from second harmonic genertion spectroscopy	2009.9.25
11	Prof. An-Ping Li, Oak Ridge	USA	Probing electron transport with a	2009.10.

	National Lab. USA		cryogenic four-probe scanning tuneling microscope	14
12	Professor Xiangqian Jiang PhD DSc FIET FRSA AMCIRP, Hudderfershield University, UK	UK	Ultra Precision Surfaces: The New Paradigm	2009.10. 19
13	Wenhui Li，副教授，新加坡国立大学	新加坡	Fermion Pairing in the BEC-BCS crossover	2009. 11.20-28
14	Dr. Xuaodong Che, Director,Hitachi Global Storage Technologies，USA	USA	学术交流	2009.12. 30