

复 旦 大 学
光 科 学 与 工 程 系

**Department of Optical Science & Engineering
Fudan University**

2003年 报
Annual Report

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课题进展
Progress in Research Projects

玻璃基质光波导：材料、物理与器件

Glass optical waveguides: materials, physics and devices

光子芯片以光波导、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。本课题组的工作是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。

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 micro-electronics 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. 光学微腔研究。Study on optical microcavity fabricated by sol-gel technique.

制备了一维光学微腔，由于采用双布拉格反射器结构作为激光染料掺杂聚合物膜的夹层，得到了高达354的微腔质量因子。微腔的光子晶体禁带为597-789nm，研究了光泵情况下腔的窄带光发射及偏振依赖特性。研究结果发表于*Applied Physics Letters*。

A cavity of laser dye-doped polycarbonate film sandwiched between two Bragg reflectors was fabricated. The cavity has a photonic band gap between 597 and 789 nm with defect state inside the gap. Narrow-band optical pumped light emission from the cavity and its polarization dependence were observed. A cavity quality factor as high as 354 was achieved. This work has been published on *Applied Physics Letters*.

在方形光纤外通过提拉的方法制备了有机/无机复合材料薄膜，形成变形的方微环结构。变形微腔的好处为有利于微腔激光的输出。近场和远场发射图样和发射光谱实验发现，该微腔中同时存在混沌的回廊耳语模式和四次反射模式，同时还观察到角调制的激光发射。研究结果发表于*Optics Letters*。

Intense directional light emission from a deformed square-shaped light-emitting microring cavity was observed. From the near-field and far-field emission patterns and their emission spectra we found, for the first time to our knowledge, the simultaneous existence of chaotic whispering-gallery modes and four-bounce reflection modes. High-contrast angle-modulated light emission was also

observed. This work has been published on *Optics Letters*.

2. 玻璃材料二阶光学非线性和光敏性研究。Study on the second-order nonlinearity and photosensitivity of glasses.

研究了硼酸铅玻璃的二阶光学非线性产生机理。光学二次谐波测量发现玻璃中非线性极化层的厚度与极化电压之间存在依赖关系。玻璃极化前后拉曼光谱测量发现玻璃中存在的非对称diborate微结构单元对硼酸铅玻璃中二阶光学非线性产生起重要作用。研究结果发表于*Physics and Chemistry of Glasses*. Second-harmonic generation study was made on poled PbO/B₂O₃ glass samples. A relationship between the thickness of the nonlinearity layer in the glass sample and the poling voltage was obtained. Raman spectra measurement on glass before and after poling was made, which showed the asymmetric three coordinated borate units in the diborate groups play an important role in the second-order nonlinearity of lead borate glass. This work has been published on *Physics and Chemistry of Glasses*.

研究了硅酸铅玻璃的光敏性机理。紫外可见吸收光谱测量发现，当紫外光照射硅酸铅玻璃样品后，不同的照射强度下吸收光谱变化不同，可能与形成不同的缺陷有关。研究结果发表于*Journal of Non-Crystalline Solids*.

The mechanism of photosensitivity of lead silicate glasses was studied. UV-visible absorption spectra changes of the glasses was measured after UV laser irradiation, which showed different defects formed under laser irradiation with different energy densities. This work has been published on *Journal of Non-Crystalline Solids*.

3. 飞秒激光照射石英玻璃和激光玻璃导致色心产生的机理研究。Study on mechanism of color center formation in silica glasses and laser glasses irradiated by femtosecond laser.

研究了飞秒激光照射石英玻璃后玻璃吸收光谱、ESR谱和荧光谱的变化。发现飞秒激光照射后，在石英玻璃中产生了E'心，所产生E'心的数目和光照强度成正比。这是由于吸收了光子能量的自由电子通过声子将能量传递给晶格，导致晶格温度升高，并引起石英玻璃网络结构的畸变造成的。研究结果发表于*Chinese Physics Letters*.

Optical absorption, electron spin resonance and photoluminescence spectra were used to study the defect formation in high purity fused silica induced by a focused infrared fs laser. Si E' centers were found forming in the silica, with the number increased linearly with power density of the fs laser. It is concluded that the color centers were formed at the defect sites that were newly generated by radiolysis of silica tetrahedral network and displacement of oxygen between two silicon atoms. This work has been published on *Chinese Physics Letters*.

掺钕硅酸盐玻璃和磷酸盐玻璃在飞秒激光照射下会出现暗化，通过ESR测量和紫外-可见吸收光谱的测量，我们发现在硅酸盐玻璃中产生了HC₁空穴心和Si E'心，在磷酸盐玻璃中产生了色心II、色心III杂化形式。通过和纳秒紫外

激光照射激光玻璃的对比研究，认为纳秒紫外激光照射下色心的产生是由于单光子电离和缺陷结构捕获空穴形成；飞秒激光作用下的多光子电离和热效应是色心产生的原因。研究结果发表于 *Optical Materials*。

Laser induced darkening in Nd doped soda-lime silicate glass and type N₃₁ barium metaphosphate glass was studied by exposing the glass samples under 800nm fs laser. HC₁ hole center and Si E' center were found to form in silicate glass and intermediate structure of oxygen ions type II and type III in phosphate glass. By comparing with the results on glass samples irradiated by 266nm UV laser, it is considered that free electrons from single photon ionization is the main cause of defect formation in glasses irradiated by ns UV laser, rapid cooling of the melted glasses heated by energetic electrons generated from multi-photon and avalanche ionization should be the causes of defect formation in glasses irradiated by fs laser. This work has been published on *Optical Materials*.

2003年度本课题组完成国家自然科学基金项目2项，教育部博士点基金1项。完成上海市应用材料专项基金（AM项目）1项，通过验收。2003年新申请到国家自然科学基金项目1项，上海市科委重大项目1项。2003年度课题组在国内外刊物上发表文章14篇，其中SCI论文7篇；在国际会议上报告6次，其中邀请报告2次；在国内会议上报告6次，其中大会报告1次。申请国家发明专利1项。

飞秒时域的非线性光学研究

Studies on Femtosecond Nonlinear Optics

1. 创建了波长覆盖近紫外至中红外的飞秒激光实验平台 Tunable femtosecond optical parametric amplifier with weak CW seeding

钛宝石激光是主要的飞秒激光系统，典型的工作波长在800nm附近。因其有限的波长范围，应用受到限制。我们以飞秒钛宝石激光再生放大器为基础，自建了波长覆盖近紫外至中红外（0.4 μm -4 μm ）的千赫兹（KHz）飞秒激光实验平台，输出脉冲能量从数 μJ 至数100 μJ 不等，脉冲宽度约100fs。宽范围可调谐飞秒激光实验平台主要应用了光参量放大（OPA）技术，并结合倍频（SHG）技术来进行频率拓展。实验平台的建设中，发现了红外OPA的独特工作特性，可见光或近红外波段信号光（Signal）的稳定性不能表征中红外波段闲置光（Idler）的情况。为此，我们发展了若干新颖的光参量技术，实现飞秒OPA器件的稳定输出，其中突出的学术创新成绩是首次提出和实现了OPA器件的连续光“弱”注入（Weak seeding）工作方式，它可以大幅度提高器件的稳定性，同时又兼容了信号光的调谐能力。“弱”注入技术为OPA器件创造了一种全新的理想方案。

A tunable femtosecond optical parametric amplifier with weak CW seeding, a compromise between OPG/OPA and strongly seeded OPA configurations has been demonstrated. A CW Nd:YVO₄ laser with sub-watt power helps to saturate and stabilize the output pulses from the OPA, and meanwhile a direct tunable range from 1.01 μm to 1.08 μm at the signal wavelength is obtained. Output signal energies as high as 30 μJ with pulse durations less than 250fs within the tuning range are reported from this two-stage device.

2. 获得了创新性宽带激光技术成果（APLS2004邀请报告）Efficient second harmonic generation of femtosecond laser at one micron

宽范围可调谐飞秒激光系统为发展创新的激光技术提供了实验平台，我们近期已获得了有突出科学意义的创新性宽带激光技术成果。解决了1 μm 波段宽带激光二倍频（SHG）技术，突破了长期制约惯性约束聚变（ICF）大型激光装置发展的一个技术瓶颈（研究论文即将发表于Opt. Express.）。采用和发展了创新的激光和光学材料技术，实验上成功地实现了1 μm 波段宽带激光高效倍频技术，激光带宽大于20nm，而倍频效率优于55%。该创新激光技术成果已得到863激光技术领域主要专家的重视和赞扬，可望为我国的大型激光装置发挥重要作用。

By using spectrally noncritical phase-matching in a partially deuterated KDP around its retracing point of phase-matching, we have experimentally and

numerically investigated the characteristics of second-harmonic generation (SHG) with femtosecond laser at $1\mu\text{m}$ for the first time. This phase-matching configuration can support efficient SHG over 20nm bandwidth of the fundamental laser at $1\mu\text{m}$ in a 10-mm-long crystal. Efficiency of harmonic conversion as high as 55% has been demonstrated.

3. 提出和形成了新一代大型激光装置发展的新概念 A conceptual design of high-power laser system

通过吸收、比较、提高和创造的工作方式，形成了一种兼容目前的高能量、高功率和高强度三类主要的先进固体激光装置的总体发展技术路线，其核心基础是我们近期正在发展的 $1\mu\text{m}$ 波段宽带激光技术。这方面的工作将作为课题组今后5年的发展目标，为我国的大型激光工程事业做出贡献。

We have proposed a conceptual architecture of high-power laser system based on innovative broadband laser technologies. It potentially has the versatility to (deliver high-energy and high-power pulses with durations from $\sim 100\text{fs}$ to several ns in one laser system.

该研究小组在2003年度发表8篇SCI和2篇EI论文，国际会议邀请报告一次；申请发明专利2项；获得3项国家级项目。

Achievements in 2003:

- (1) 8 SCI & 2 EI papers were published;
1 invited talk was given on **APLS'2004**.
- (2) 2 patents were applied.
- (3) 3 national research projects were approved.

纳米发光材料的形貌和光致荧光性质研究

Morphology and Photoluminescence Study of Light-emitting Nano-materials

在3个方向上开展了工作，分别是：1) 分别利用反应蒸发法和共溅射法制备镶嵌在SiO₂基体中的发光纳晶硅(nc-Si)材料。发现了纳晶硅光致荧光发光波长和退火温度以及SiO₂膜厚有关。鉴定了峰位，建立了模型并解释了实验结果。另外，发现掺杂稀土可以大大增强纳晶硅的发光强度。2) 利用离子束辐射方法，在Si(100)和Si(110)上生成有序纳米结构。发现束流密度对表面形貌有决定性的影响，对原有理论提出了质疑。在Si(110)上还发现了两种纳米结构，它们和温度—离子能量有关，已给出相图。另外，已着手ZnO表面的纳米图形生成工作。3) 利用非稳态辐射增强扩散技术，开展高马赫数航天器窗材料的研究。已经研究了部分扩散性质和机械性质，和预期相符。

Research works cover three subjects. 1) Preparation nanocrystal Si embedded in SiO₂ matrix by using reactive evaporation and co-sputtering techniques, respectively. Photoluminescence (PL) peaks have been found to be related to the annealing temperature and SiO₂ thin film thickness. PL peak identification has been performed, and an empirical model has been made to explain the experimental data. Also we found that by doping CeF, the PL intensity of nanocrystal Si was enhanced by a factor of 3-4. 2) Growth of ordered nanostructures on Si(100) and Si(110) by ion erosion. Ion flux has been found critical in the formation of surface morphology, which provided an evidence against previous theories' conclusions. On Si(110), two types of surface morphologies existed; they were dependent on temperature and ion energy. A phase diagram of temperature and ion energy was measured. On the other hand, nanostructuring of ZnO is also underway. 3) Study of dome material modification for hypervelocity missiles by using the technique of nonsteady state radiation enhanced diffusion. Diffusion properties and mechanical parameters were studied, which were in line with what we expected.

本年度发表SCI论文3篇，包括1篇《物理化学学报》，2篇《Chinese Physics Letters》。另外，还在《Nanotechnology》上发表论文1篇（2004年2月）。即将在《Journal of Physics: Condensed Matter》上发表1篇评论性论文。另有3篇SCI论文已经投稿。

申请专利3项，包括2项发明专利，1项实用新型专利。

获得国家自然科学基金1项；国家教育部优秀青年教师基金1项；上海市科委重大基础项目子课题1项（总项目由徐雷教授负责）；航天科工集团支撑技术基金1项。

氮原子离子束源的研制

Design of an atomic nitrogen ion beam source

氮化物由于其独特的性质和广泛的用途，近年来受到了越来越多的关注。具有较高化学活性的原子态氮是合成氮化物的关键因素，因此如何得到高原子比例的氮源，一直是氮化物研究人员孜孜以求的目标。为此我们进行了氮原子离子束源的研制，设计了一种基于空心阴极放电的氮原子离子束源。我们对束源的放电参数和特性进行了详尽的研究。对离子束成分的飞行时间质谱分析表明，使用纯氮气在一定的放电条件下， N^+/N_2^+ 的比率大于95%，几乎是纯的氮原子离子束。其 N^+/N_2^+ 比率远远高于一般的商用离子源，譬如Kaufmann离子源的 N^+/N_2^+ 最高达到2/3。而且我们研制的束源十分简单，制作成本很低。我们关于金刚石膜氮化产生 $\beta-C_3N_4$ 的研究，就是使用了我们自己研制的氮原子离子束源，取得了非常好的效果。

Nitrides have attracted more and more attention because of their novel properties and wide applications. Atomic nitrogen plays an important role in the synthesis of nitride due to its high chemical reactivity. A nitrogen source with high atomic ratio is always a goal for the designer to pursue. For that purpose, we designed a nitrogen ion source using hollow cathode discharge. The discharge parameters and the characteristics of the extracted ion beams have been studied in detail. The time-of-flight mass spectra show that the ratio of N^+/N_2^+ could be higher than 95% under certain discharge conditions for pure nitrogen gas, much higher than that of the commercial ones, such as Kaufmann ion source, the maximum N^+/N_2^+ ratio is only 2/3. The ion source we developed is nearly a pure atomic nitrogen ion source and its very cheap with simple structure. With this ion source, $\beta-C_3N_4$ was successfully produced by low energy N^+ implantation into a diamond film

低维磁结构的磁性研究和纳米磁存储介质制备

Magnetic properties in low-dimension magnetic structures studied by in-situ Magneto-optical Ker effect (MOKE), fabrication of nano- magnetic recording media

① 超高真空MBE设备实现double wedge或wedge/step两种成分薄膜的生长，一次可以生长出两种薄膜厚度渐变的样品，效率大大提高且更具系统性。但是问题是测量往往花费很长时间，有待进一步改善和优化。

Double wedged or step/wedged ultrathin films with two materials was able to be grown, which can largely increase the efficiency of the sample growth in series But the consuming measurement time needs to be optimized with the wedge growth because of the possible contamination of the films over a long time duration.

② 利用RHEED、LEED、磁光克尔效应（MOKE）等手段，着重研究了不同厚度的外延Fe薄膜上覆以超薄Ni薄膜的结构、自旋重取向和矫顽力变化过程。

Using RHEED, LEED and MOKE, the growth and the spin reorientation transition (SRT) of Ni-capped (at 100 K) Fe ultrathin films with various Fe, Ni thickness were studied. With the increase of Fe film thickness, the SRT critical thickness from out-of-plane to in-plane decreases. Especially at Fe thickness of about 3 ML, the coercivity increases much during transition, to about 1 kOe or even larger.

③ 溅射生长了FePt合金磁性存储介质薄膜，以期得到具有垂直磁各向异性和良好热磁性能的材料，进而制备具有热辅助磁记录的记录介质和盘片。

FePt-alloy magnetic thin film was studied and then fabricated by sputtering to obtain a suitable recording media with perpendicular anisotropy and good thermal-magnetic properties for thermal-assisted magnetic recording (HAMR). This is the major project from NSF which will start in 2004.

本年度发表SCI论文3篇。争取到国家基金委面上项目1项。

Three papers were published in SCI journals and one application of the grant from NSF was approved.

金属表面吸附原子及团簇的扩散动力学研究

Studies on self-diffusion of adatoms and adatom clusters on metal surfaces

1, 利用遗传算法给出了金属系列 fcc(001)表面吸附团簇的最低能量结构。原子的相互作用由原子嵌入势, 表面原子嵌入势及 Rosato-Guillopé-Legrand 势描述。结果显示在不同的表面, 尺寸为 $n=6,9,\dots,36$ 的吸附团簇具有相同的结构, 并且它们具有较好的稳定性, 从而可视为幻数团簇。对于其它尺寸的团簇一般不同的表面有不同的结构。结构随表面的变化可以用相对作用范围及源于原子-基底相互作用的补偿效应来解释。当相互作用范围变大并且/或者补偿效应变强, 最低能量结构的形状趋向于由方形变到长方形甚至一维的链状结构。

With a genetic algorithm, the lowest-energy structures of adatom clusters on a series of metal fcc(001) surfaces are determined. The atomic interactions are modeled by the realistic model potentials including embedded-atom method potential, surface-embedded-atom method potential, and Rosato-Guillopé-Legrand potential. The results show that the adatom clusters of sizes $n=6,9,\dots,36$ have the same structures on the different surfaces. Their special stability indicates that they are magic number clusters. For clusters of other sizes, the structures are generally different on the different surfaces. The change of the cluster structure with surfaces can be interpreted in terms of the relative interaction range and the compensation effect from the adatom-substrate interaction. When the interaction range becomes long and/or the compensation effect becomes strong, the shape of the lowest-energy structure tends to change from square to rectangle or even to one-dimensional chain.

2, 在一系列金属 fcc(001)表面系统地研究了吸附二聚物的扩散现象。原子的相互作用由原子嵌入势, 表面原子嵌入势及 Rosato-Guillopé-Legrand 势描述。基于静态计算及分子动力学模拟的结果, 我们可以把不同的表面分成三类。在不同的类型表面, 不仅主导的扩散机制不同, 而且交换扩散机制所基于的物理模型也不同。另外, 除一般的跳跃和交换扩散机制外, 在模拟中还观察到了其它的一些有趣的二聚物扩散过程, 例如交换旋转, 合作跳跃以及合作交换等等。

We study systematically the dimer diffusion on a series of metal fcc (001) surfaces. The atomic interactions are modeled by the realistic model potentials including embedded-atom method potential, surface-embedded-atom method potential, and Rosato-Guillopé-Legrand potential. Based on the results of the static calculations and the molecular dynamics simulations, three different kinds of fcc(001) surfaces can be distinguished. On the different kind of surfaces, not only the dominant diffusion mechanism but also the physical model for exchange mechanism is different. In addition, besides the conventional hopping and exchange mechanisms, some other interesting diffusion mechanisms for dimers are observed in our molecular dynamics simulations such as exchange rotation mechanism, cooperative hopping mechanism, and cooperative exchange mechanism.

3, 结合遗传算法及密度泛函理论, 研究了在质谱实验中观察到的奇数纯炭及含铑高炭团簇的结构。由遗传算法给出的能量较低的奇数团簇 C51-C59 的异构体进一步再由基于 B3LYP/3-21G 的密度泛函理论进行优化。在遗传算法的计算中, 所给出的奇数纯炭团簇 C51-C59 的能量极小值都比以前报导的要低。奇数团簇的最低能量异构体是类笼状结构, 其中除三价碳原子外还包含了一个二配位的碳原子。含铑奇数高炭团簇是替代型的网络结构, 它是通过铑原子替代在 C55 中的二配位的碳原子而形成的。我们给出了结合能以及结构参数。对于奇数炭团簇的异构体, 我们还讨论了结构随能量的变化。

Using a combination of genetic algorithm (GA) and density functional theory (DFT) approach, the structures of the odd-numbered all-carbon and rhodium-containing high carbon clusters observed in mass spectrometric experiments were studied. The structures of the lower energy isomers of the odd-numbered clusters C51-C59 found by GA global searching were re-optimized with DFT at the B3LYP/3-21G level. In GA calculation all the minimal energy isomers of the odd-numbered all-carbon clusters C51-C59 have energies lower than those previously reported. The lowest energy isomers of the odd-numbered clusters are cage-like pseudo-fullerenes containing a single two-fold coordinated carbon atom in addition to trivalent carbon atoms. The Rh-containing odd-numbered high carbon clusters C54Rh have substitutional networked structures formed by replacing the two-fold coordinated carbon atom in C55 by the Rh atom. The binding energies and the structural parameters are reported. To the isomers of the odd-numbered carbon clusters, the structure change with the energy is discussed.

等离子体特性和应用、氮化物薄膜的制备和性质

Characteristics and Applications of Plasmas, Preparation and Properties of Nitride Thin Films

在等离子体特性研究方面，用时空分辨的光谱分析方法考察了ECR等离子体、PLA等离子体以及在ECR微波放电和脉冲激光烧蚀同时作用下引发的等离子体的时空特性，观察到激光烧蚀产物与ECR等离子体中活性物质的反应生成物的光谱，从而得到了有关ECR等离子体和PLA等离子体相互作用的实验验证，还通过对鞘层中的光谱分析观察到衬底对这种相互作用的增强作用和偏置电压的影响。

以纯石墨或掺有催化剂的石墨为靶材、通过弧热等离子体源所产生的氮原子束辅助的纳秒脉冲激光烧蚀方法开展了氮碳纳米晶的合成工作。研究表明，激光烧蚀产生的等离子体与弧热等离子体源所产生的氮原子束之间的相互作用促进C-N键的形成，从而在覆盖不同配比的Co/N过渡膜的衬底上生长获得一定氮含量、并以N-C键存在的氮碳纳米晶，并初步了解了脉冲激光烧蚀合成氮碳纳米管的合成机理，探讨了Co/Ni的催化作用。

利用特定气氛中的脉冲激光烧蚀和活性源辅助的脉冲激光沉积的特点，摸索化合物功能薄膜的合成制备和原位掺杂新方法，并在此基础开展了制备ZnO纳米棒和氮镓共掺杂ZnO薄膜的前期工作。

Investigation on the temporal and spatial behaviors of ECR plasma, PLA plasma and plasmas induced by simultaneous ECR microwave discharge and pulsed laser ablation was carried out by time- and space-resolved spectroscopy. The optical emissions of products resulted from the interaction between the laser ablated species and the reactive species in the ECR plasma were observed and analyzed, which confirms the interaction between the PLA plasma and the ECR plasma experimentally. The enhancement of substrate sheath and the effects of substrate bias on the interaction were also observed through spectrum analysis.

Nanocrystalline carbon nitride films were synthesized by nitrogen-atom-beam-assisted pulsed laser ablation of targets of pure graphite or graphite doped with catalyzer. The results show that the reaction between the laser ablation plasma and the nitrogen plasma produced by an arc-discharge plasma source enhances the formation of C-N bonds. Nanocrystalline CN_x films with significant nitrogen content and C-N bonds were obtained on substrates covered with different Co/Ni buffer layers. The synthesis mechanisms of carbon nitride nanorods by pulsed laser ablation and the catalysis of the Co/Ni layers were also studied.

Exploration for new methods for synthesis of functional compound thin films and in situ doping was made by pulsed laser ablation in specific ambient and reactive source assisted pulsed laser deposition. The preliminary work on the synthesis of ZnO nanorods and Ga-N co-doped ZnO thin films was performed.

本年度发表SCI论文3篇，另有5篇SCI论文已被接受；在研国家自然科学基金项目2项，新获批准国家自然科学基金项目1项；授权实用新型专利1项，申请发明专利1项。

信息存储有机化合物材料及光学性质研究

The Optical Properties in Optical Data Storage Organic Composite

1. 研究了一种新型有机材料ZnTBP-CA-PhR的光学非线性吸收特性，此材料在激光作用下，在可见光区域具有反饱和吸收，再反饱和吸收和饱和吸收效应。同时发现该材料优良的光学限幅性能，不仅光限幅的阈值低，而且限幅前光透射呈线性状态没有光学非线性效应。用五能级结构模型及速率方程模拟了饱和及反饱和的实验曲线，分析了非线性吸收等的物理机制。

The nonlinear absorption in the organic material ZnTBP-CA-PhR was measured. Saturable absorption, reverse saturable absorption and r-reverse saturable absorption under Ar^+ laser beam in visible light range were observed. This material has fine optical limiting properties. Its intensity threshold is lower than other materials and there is no nonlinear optical effect before input intensity reached threshold. In order to analyse the physical mechanism of nonlinear absorption of this material, a five-level model is presented using rate equation theory to simulate saturable absorption and reverse saturable absorption experiment result.

2. 合成了新型偶氮分子偶氮二苯胺ADPA (Azo-Diphenylamine), 将其掺入聚乙烯吡啶Poly (N-Vinylcarbazole) (PVK) 和聚丙烯丁酯 (Poly-butylacrylate) (PBA) 的聚合物 (PVK-PBA) 以及三硝基芴酮2, 4, 7-trinitro-9-fluorenone (TNF) 聚合制成薄膜器件。实验结果表明掺杂偶氮苯聚合物薄膜在非共振吸收下产生了大的光致双折射, 折射率变化值 Δn 达到 1.3×10^{-3} 以上。样品在双相干光束作用下, 可建立光折射率光栅, 其衍射效率可超过30%, 并由此讨论了影响折射率光栅的诸因素, 实现了光全息存储。文章并对相关结果形成的机制做出了定性的分析。

A novel type of azobenzene molecule (Azo-Diphenylamine)(AZDP) doped in poly (N-Vinylcarbazole)(PVK), Poly-butylacrylate(PBA) and 2,4,7-trinitro-9-fluorenone(TNF) was synthesized and studied. The experimental results showed that the polymer film produces large magnitude of photo-induced birefringence and its value Δn surpasses 1.3×10^{-3} in the nonresonant absorption. When irradiated by two-beams, the sample can set up refractive index grating with the diffraction efficiency over 30%. Reasons that influence it were discussed. And the optical holographic storage was achieved. The qualitative explanation to the experimental phenomena was given.

新型液晶光电子器件的研究

Investigation for novel electrooptical device of liquid crystal

1. LCOS振幅空间光调制器的研究 Study of LCOS amplitude spatial light modulator

为了寻找作LCOS振幅空间光调制器的合适模式，在参数空间仿真计算了数种模式，其中TN-ECB 63.6°, RTN54°和RTN52°有高的反射率，低的相位移和适宜于器件制作的适当大小的 $d\Delta n$ 。我们制作了TN-ECB 63.6°的实验性器件，它的对比度为200:1。

Several models have been simulated in parameter space to search profitable models for LCOS (Liquid Crystal on silicon) amplitude spatial light modulators (SLM). Three models with high reflectance, low phase shift and proper $d\Delta n$ for cell fabrication are suitable. They are TN-ECB 63.6° (twist nematic electrically controlled birefringence with twist angle 63.6°), reflective TN(RTN) 54° and RTN 52°. A TN-ECB 63.6° experimental cell was fabricated in our Lab, its contrast ratio is 200:1.

2. LCOS相位空间光调制器的研究 Study of LCOS phase spatial light modulator

用Jones矩阵和参数空间表示法优化了LCOS相位空间光调制器的设计，其结果显示反射型平行排列ECB模式和RTN- 52°模式有合适的性能，我们制作了反射型平行排列ECB器件和驱动电源，它的相位调制量在633nm处为 4π 。

Jones matrix method and parameter space representation is used for optimization the LCOS phase spatial light modulator design. The parallel alignment ECB model and RTN- 52° model are suitable. We have fabricated the reflective parallel alignment ECB device and the driver. Its phase modulation is 4π for 633nm.

3. LCOS相位空间光调制器的应用研究 Application of LCOS phase spatial light modulator

我们将已研制的RTN- 52° LCOS相位调制器用于实现相位菲涅尔透镜，LCOS相位空间光调制器在计算机控制下，焦距是可变的，我们实现了1米、2米、3米和4米四种可变焦距。

We utilized the RTN- 52° LCOS phase spatial light modulator which have been developed in our Lab for phase Fresnel zone application. LCOS phase SLM controlled by the computer, the focal length of Fresnel zone is variable. The variable focal lengths of 1m, 2m, 3m and 4m have been realized.

4. 全息聚合物分散液晶研究 Study of Holographic Polymer Dispersed Liquid Crystal

全息聚合物分散液晶 (HPDLC) 是一种新的光电信息材料，我们通过优化配方和扫描电镜分析其微观形貌，得到了改进衍射特性的最佳条件，目前

其衍射效率为85.7%，聚合过程中其收缩仅为2埃，因而与其相连的s分量和p分量衍射效率之差小于15%。我们研制的2X2的HPDLC光开关，对比度为23db，串音为15 db。

Holographic Polymer Dispersed Liquid Crystal (HPDLC) is a novel photoelectronic information material. We optimized the recipe and analyzed the morphologies by scanning electron microscope, the best conditions were found to make the diffraction properties improved. Now, the diffraction efficiency(DE) is 85.7%. In the polymeric process, the shrink which influences the DE difference between s and p components is only 2%, so the DE difference of two polarized components is less than 15%. We have fabricated a 2X2 HPDLC optical switch, the contrast ratio is 23db and the crosstalk is 15db.

5. 完成一项国家自然科学基金：“新型液晶全息光交换开关研究”。
 一项上海应用材料与发展基金：“LCOS液晶涂层工艺研究”通过验收。
 一项上海市光科技专项基金：“新型液晶全息光交换开关研究”通过验收。
6. 申报发明专利一项：“液晶器件盒厚控制方法”，受理号03150767.0。
7. 发表论文5篇。

飞秒强激光脉冲激发下Ta₂O₅薄膜光学常数的瞬态变化 Transients of the optical constant for Ta₂O₅ film under the excitation of femtosecond laser pulses

用Pump-Probe方法研究了Ta₂O₅单层膜在预损伤(60%损伤阈值)的泵浦强度下反射和透射率的瞬态变化. 观察到其峰值出现在pump后的约100fs处, 然后以约600fs的时间常数衰减. 用单层吸收膜加透明衬底的理论模型对实验结果进行拟合. 得出光学参数(折射率n和消光系数k)的瞬态变化的峰值为 $\Delta n = -3.4\%$, 和 $\Delta k = 0.042$. 认为这个光生载流子的产生主要还是多光子的强场离子化作用. 进一步的实验和分析正在进行当中.

部分实验结果在2003年第十六届全国激光学术会议上做口头报告[1](报告编号BO12), 相关论文发表在<<中国激光>>2004年增刊[2]. 详细结果由W. Rudolph教授在SPIE国际会议上作了邀请报告[3].

Ultrafast changes of reflection and transmission were measured simultaneously for Ta₂O₅ single layer on fused substrate under the excitation of femtosecond laser pulses. Peak modifications of -3.4% for index of refraction and 0.042 for extinction coefficient were retrieved respectively by a model of single absorption layer on transparent substrate. Maxima of changes emerged about 100fs after the pump pulse, and then decayed with a time constant of about 600fs. These transients were ascribed mainly to the strong field ionization of the bounded electrons in the film by the excitation of the ultrashort laser pulses. Further results are under investigation.

偶氮聚合物薄膜的全光极化性质研究

Research of all-optical poling of azobenzene polymers

具有特定微结构的功能材料及其中的新现象，新效应，新规律和内在机理的研究一直是凝聚态物理，材料科学，光电子学等学科的前沿交叉课题和极富创新和挑战的领域，蕴涵着十分丰富的物理内容，是下一代光信息技术的基础之一。其中，有机共轭聚合物具有非定域的电子体系，显示出了与无机半导体相似的光电特性，被称为有机半导体。大多数共轭聚合物材料比较稳定，不易结晶，用涂敷可以制成各种厚度的面积大而且均匀的单层或者多层结构薄膜，相对无机半导体工艺来说，制备方法简单，且共轭聚合物的资源比较丰富。本工作主要的目标用全光极化(AOP)技术在有机聚合物中诱导出周期调制的 $\chi^{(2)}$ 光栅，实现这类新型微结构波导的制备技术和准相位匹配的SHG原型器件。工作取得的研究成果如下：

- 一，合成和制备了两类共四种偶氮聚合物薄膜：分散红共聚物膜 HMMM-DR1，HMMM-DR19和偶氮侧链聚合物膜PCN6和PCN2
- 二，以HMMM-DR1和PCN6为代表比较研究了这两种具有不同吸收性质材料的全光极化特性：
 - I. 研究了他们的实时极化和弛豫过程，对他们的全光极化性质作了最基本的表征。
 - II. 研究了倍频光吸收对薄膜光极化效率的影响，讨论了偶氮聚合物材料光诱导 $\chi^{(2)}$ 的效率和倍频光透射率之间的折衷关系，这对实用化的全光器件的研制是至关重要的。
 - III. 实验确证了在PCN6薄膜中实现了准相位匹配。对厚膜（几十微米到100微米）中光诱导 $\chi^{(2)}$ 的弛豫抑制效应作出解释
- 三，建立了两种全光极化的实验光路并比较了他们的优缺点。我们实验中主要使用共线光路。
- 四，科研论文“All-optical poling investigation of low absorbing azobenzene side-chain polymer films”提交SCI期刊杂志，另有两片文章在整理中。

New phenomena, effecton and principals of the functional materials having special micro structures as well as its interior mechanism are continuously researched as the frontier cross subjects fields of challenge and innovation. It contains rich physical knowledge and is one of the next generation's fundamental subjects in optical information techniques. Among so many kinds of polymers, organic conjugate polymer with non-local electron system , which demonstrates similar photo-electronic characteristics with abio-semiconductor, is called organic semiconductor. Most conjugate polymer materials are relatively stable and not inclined to crystalize. Single-layer and multi-layer films with different areas and

even thickness can be made by coating. Compared with the abio-semiconductor technics, the way of manufacturing organic semiconductor is much more simplified and the conjugate polymers have rich source. Our programme aims the $\chi^{(2)}$ gratings photoinduced in the organic polymer that can be modulated periodically and realize this new kind of micro structure waveguide and quasi-phase-match SHG original devices.

The main research contents and results are presented as the following:

First, two kind of azobenzene polymers (including four samples) were synthesized and prepared: the films of deperse red HMMM-DR1, HMMM-DR19 and films of side-chain azobenzene polymers PCN₆ and PCN₂

Second, HMMM-DR1 and PCN₆ are studied comparatively with all-optical poling(AOP) technique. Their absorption proverties vary much.

- I. Their poling and decaying process were studied and the fundamental AOP proverties were described.
- II. Double frequency absorption dependence of AOP efficiency of thin films and the trade-off relationship between efficiency of photo-induced $\chi^{(2)}$ of the azobenzene and the transmission efficiency of double frequency were investigated, which are critically important to practical all-optical devices.
- III. The quasi-phase matching in the thin film PCN₆ is proved and relaxation retardation effect of photo-induced $\chi^{(2)}$ in thick films (from dozens of micrometers to 100 micrometers) was interpreted.

Third, two experimental setups were designed and their merits and shortage were given out. The coaxal one is used by us.

Fourth, our research paper "All-optical poling investigation of low absorbing azobenzene side-chain polymer films" has been submitted to SCI journal., two paper else is being preparation.

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

1. 本年度获国家自然科学基金委仪器专项基金一项。项目名称：“二维CCD快速成像光谱仪研制”。

A project, entitled “Study on two dimensional CCD rapid imaging spectroscopy”, was supported by a special funding of national science fundation.

2. 完成国家自然科学基金一项。项目名称：“高数值孔径下磁光多层膜系统的光学与热分析”。

A project, entitled “The optical and thermal analysis for Magneto-optical multilayer system under high NA lens” supported by national science fundation, was ended with agreement.

3. 完成高真空等离子体辅助电子束蒸发镀膜系统的安装调试。

An electron beam evaporation coating system with the advanced plasma-ion assisted deposition was assembled and tested.

4. 凝聚态光学性质方面主要取得如下研究结果Results on the study of optical properties of condensed matters:

1) 用多靶磁控溅射生长Ag:Bi₂O₃混合膜样品，其中银的组分从13.2% 变到59.3%。用椭圆偏振光谱仪测量各样品的光学常数谱，光能量范围自1.5到4.5 eV。在光吸收谱中观察到银颗粒表面等离子振荡峰。采用飞秒时间分辨克尔技术测试Ag:Bi₂O₃混合膜样品的非线性效应。薄膜厚度约80 nm，纳米银颗粒的原子比35%，其三阶非线性光频磁化率为 4.1×10^{-10} esu。这些特性归于银颗粒中费米面附近带内电偶极跃迁造成的。

The Ag:Bi₂O₃ composite films with Ag concentration varying from 13.2% to 59.3% were prepared by magnetron sputtering system. The optical constants of the samples were determined by spectroscopic ellipsometry in the range of 1.5eV to 4.5eV. The absorption peaks due to the surface plasmon resonance of Ag particles were observed in the absorption spectra. The nonlinear optical properties of the samples were measured by the femtosecond time-resolved optical Kerr effect technique. The third-order nonlinear optical susceptibility of the thin films with the thickness of approximate 80 nm and the atomic ratio of Ag nanoparticles in thin film about 35% was estimated to be 4.1×10^{-10} esu at the incident laser wavelength of 800 nm. We explain this result as due to the intra-band electric-dipole transition from the occupied state near the Fermi level to the unoccupied state in the Ag nanoparticles.

2) 采用离子束共溅射方法制备一系列Cr_xAg_{1-x} (x=19, 28, 36)，并经1小时真

空环境退火，通过x射线衍射、原子力显微镜和光学测量，研究了这些样品在不同退火温度下的结构、表面形貌和光学性质。结果表明其光学性质与颗粒尺寸密切相关。

A series of $\text{Cr}_x\text{Ag}_{1-x}$ ($x=19,28,36$) samples were prepared by ion beam co-sputtering and post-annealed in vacuum at different temperatures for one hour. The structure, surface topography and optical properties of the samples for different annealing temperatures were studied by using X-ray diffraction, AFM and optical measurement. Results show that the optical properties are closely related to the particle size.

- 3) 用磁控溅射生长Si/Ge异质结多层膜样品，用椭圆偏振光谱仪测量各样品的光学常数谱，光能量范围自1.5到4.5eV。结果表明，在低能区域，随压强的增加，多层膜结构所有的光学常数均有不同程度的增加。在高能区域，溅射气压对光学常数的影响不再明显。

The optical constants of Si/Ge multilayers, which prepared by magnetron sputtering system, have been measured by spectroscopic ellipsometry with photon energy ranging from 1.5eV to 4.5eV. The results show that the optical constants of Si/Ge multilayers increase to some extent with increasing Ar pressure in the lower energy band, while no obvious affect of Ar pressure on the optical constants was observed in the higher energy band.

5. 光谱学研究方面主要进展Progresses on the study of spectroscopy:

- 1) 研制成功面阵CCD探测的全自动椭圆偏振光谱系统，并实验系统的结构更为紧凑和小型化。采用面阵CCD探测器和3个平面光栅组成的光谱仪，无需光栅扫描，就能在很短时间内对200–1000 nm波段范围的光谱进行快速准确的数字凝视式成像，光谱分辨精度优于1.0nm，显著提高了系统的可靠性和效率。

A new spectrometer with no moving parts uses a two-dimensional (2D) Si-based charge-coupled diode (CCD) array detector and an integrated grating consisting of three subgratings. The spectrometer is compact and of small size. The digitized spectral image with wavelength in the range of 200–1000 nm can be measured quickly and the spectra resolution is better than 1.0 nm. The reliability and efficiency of the system is obviously improved without scanning the grating.

- 2) 研制成功二维成像磁光克尔谱测试系统，柱形永久磁铁可在0–8000高斯范围内连续可调。被调制的磁光图象信号由1536×1024象素的CCD阵列探测器接收。经傅立叶变换后可得到二维的磁光克尔信号。

An experimental system for measuring the 2D image of magneto-optical Kerr effect has been designed and constructed. The magnetic field is provided by two cylindrical permanent magnets in the range of 0–8000 Gauss. The Kerr image signal was measured by using a 2D charge coupled diode (CCD) array detector with 1536×1024 pixels. The Fourier transformation method was used to retrieve the Kerr signal in data analysis.

6. 光存储与光通讯器件方面主要研究进展Progresses on the study of optical recording and optical communication devices:

- 1) 在窄带滤波器的研制过程中, 模拟分析了采用极值法对膜层厚度进行光学监控及其偏差对滤波器件光学特性的影响, 并给出了一个4腔DWDM滤波片的理想工艺曲线以及模拟计算所得到的光学特性曲线, 计算结果有利于指导高品质薄膜器件的研制, 并研制出符合工业应用标准要求的3腔和4腔100GHz、200 GHz的DWDM滤波片以及CWDM滤波片。

The simulation study of the filter's optical character affected by the *in-situ* optical monitoring the layer thickness and its deviation during deposition process for the optical narrow band-pass filter thin film was reported. Both the ideal monitor trace and the simulation of optical parameters distribution curve of the 4-cavity DWDM filter were given. The simulation results are very useful in the practice of high quality optical filter thin film deposition. The filters are designed to meet specific 100GHz, 200GHz DWDM and CWDM bandwidth requirements, and the three and four cavity narrow band-pass filters are produced for the industry application.

- 2) 根据全介质F-P多层介质薄膜滤波器的原理, 设计并模拟计算了一个3腔100GHz窄带通滤波片膜系结构, 利用等离子体辅助镀膜和光学监控技术, 在F7玻璃衬底上完成了器件的制备, 并解决了衬底减薄、抛光和后继镀膜等关键工艺。光谱特性测量的结果表明, 研制的器件将在光通讯以及信息技术的其他领域具有重要的应用价值。

A 3-cavities 100GHz narrow band-pass filter was designed simulated according to the theory of dielectric Fabry-Perot filter. With the help of the Advanced Plasma -ion Assisted Deposition and an optical monitoring system, a DWDM filter was coated on the F7 substrate. And problems regards grinding, polishing etc. were solved. This device could be used in the optical communication or the areas related to information technology.

- 3) 采用光学转移矩阵法计算激光照射下磁光存储多层膜的光强分布及焦耳热损失分布, 并将多层膜系统的焦耳热损失分布作为热源项, 再用有限元方法求解在这种热源条件下的多层膜中的热传导方程, 进而得到激光照射下多层膜系统中的温度场分布, 其结果对磁光光盘的设计具有重要的参考价值。

Optical matrix method was used to analyze the optical and magneto-optical responses for a magneto-optical recording media exposed with a laser beam, and the finite element method was applied to determine the temperature profile by solving the heat diffusion equation with Joule loss as a heat source. The results are useful for designing the magneto-optical disk.

以上结果共发表文章9篇, 均被SCI或EI收录。

9 papers on the results aforementioned have been published in the core Journals of abroad or domestic. All papers are included in EI or SCI.

金刚石纳米晶/微晶多层膜的生长和光学性质

Growth and optical properties of nanocrystalline/microcrystalline diamond multilayer films

已研究成功金刚石纳米晶/微晶多层膜，对金刚石纳米晶/微晶多层膜的各种光学及理化特性进行表征，在可见/红外波段以研制具有比金刚石微晶薄膜更优良透射性能。

The chemical vapor deposition (CVD) diamond has shown a number of interesting physical and chemical properties. As a polycrystalline material, the surface of a diamond film is usually quite rough. One of the main challenges in its optical applications is to deposit high quality diamond film with smooth surface to reduce optical absorption and scattering on the surface. Optimized deposition parameters were adopted to grow nanocrystalline/microcrystalline diamond (NCD/MCD) multilayer film with smooth surface by modulating the substrate temperature from 700 to 660 °C for several cycles. The nanocrystallinity, purity and the multilayer structure of the deposited diamond films were characterized by Raman spectroscopy, x-ray diffraction (XRD), scanning electron microscopy (SEM) and surface profile measurements. The smoothness of the film surface was further verified by its high optical transmittance from visible to infrared band. This newly proposed NCD/MCD film would have a variety of optical applications.

Keywords: diamond, film, microcrystalline, nanocrystalline

发明专利:

“纳米微晶金刚石薄膜及其制备方法” 第一发明人
申请专利号: 200310109045.4 2003年12月3日

相关科研项目:

- 金刚石软X光滤波器的研制及其应用 17万
国家自然科学基金 2002-2004
- 新型超薄金刚石X光器件研究（重点用户课题） 1.5万
中科院高能所北京同步辐射装置（BSRF）2002-2004
- X光波段CVD金刚石薄膜的研制
2001-04年复旦大学同步辐射研究中心支持项目

在研课题和经费
Projects & Budgets

157纳米高透过率氧化硅玻璃的制备

负责人：刘丽英, 起止年月：2003.1-2003.12

拨款来源：国家基金60278039（7万），2003年到款7万

强激光光束质量的非线性控制研究

负责人：王韬, 起止年月：2003.1-2005.12

拨款来源：国家基金10276012（25万），2003年到款10万

稀土掺杂宽能隙III族氮化物薄膜的特性研究和应用探索

负责人：吴嘉达, 起止年月：2003.1-2005.12

拨款来源：国家基金90201029(重大研究计划)（24万），2003年到款9.6万

纳米光电子器件光学性质的实时光谱学分析和研究

负责人：陈良尧, 起止年月：2003.1-2005.12

拨款来源：国家基金60277031（24万），2003年到款9.6万

等离子体辅助高温脉冲激光烧蚀合成CN_x纳米管研究

负责人：许宁, 起止年月：2003.1-2004.12

拨款来源：国家基金10275013（16万），2003年到款8万

有机铁电超薄膜的相变特性研究

负责人：马世红, 起止年月：2003.1-2005.12

拨款来源：国家基金10274014（25万），2003年到款10万

单量子点的物理性质和物理调控(市重大基础研究项目)

负责人：徐雷(首席专家), 起止年月：2003.7-2005.12

拨款来源：上海市科委 03DJ14001（600万），2003年到款55+28万

导弹武器用电磁材料技术

负责人：陆明, 起止年月：2003.8-2005.8

拨款来源：中国航天科工集团2002-HF-FD（8万），2003年到款4万

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拨款来源：国家教育部重点项目（13万）

低能氮离子注入金刚石薄膜的氮化改性研究

负责人：王培南, 起止年月：2001.1-2003.12

拨款来源：国家基金10075012(21万)，2003年到款6.3+4万

新型液晶全息光交换开关研究

负责人:徐克璠, 起止年月: 2001.1-2003.12
拨款来源: 国家基金 60077003 (16万), 2003年到款4.8万

玻璃态材料光敏性的来源与增强机理
负责人:王文澄, 起止年月: 2001.1-2003.12
拨款来源: 国家基金 10074011 (22万+3.9万国际合作), 2003年到款6.6万

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负责人: 庄军, 起止年月: 2001.1-2003.12
拨款来源: 国家基金 10004002 (15万), 2003年到款4.5万

用于宽带光通信的光纤维拉曼放大器研究
负责人: 孙迭篪, 起止年月: 2001.1-2003.12
拨款来源: 国家基金 60077005 (18万), 2003年到款5.4万

低微磁结构的光学响应和自旋动力学过程研究
负责人: 金庆原, 起止年月: 2001.1-2004.12
拨款来源: 国家杰出青年基金 (80万), 2003年到款16万

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掺铒凝胶玻璃光波导的结构光学性质
负责人: 王文澄, 起止年月: 2001.1-2003.12
拨款来源: 博士点基金 (5万)

高能皮秒级脉冲的线性色散和非线性B积分控制
负责人: 钱列加, 起止年月: 2001.1-2003.12
拨款来源: 国家基金 60088003 (13.21万), 2003年到款3.97万

神光III总体技术可行性研究
负责人: 钱列加, 起止年月: 2001.1-2005.12
拨款来源: 863-804北京总装备部 416-5-1-11(150万)

飞秒光脉冲基本物理问题的研究
负责人: 钱列加, 起止年月: 2001.1-2003.12
拨款来源: 973 G19990752023 (15万)

金刚石软X光滤波器的研制及其应用
负责人: 应萱同, 起止年月: 2002.1-2004.12

拨款来源：国家基金 60178031 (17万) ， 2003年到款5.1万

全光极化的准相位匹配有机非线性光波导研究

负责人：王恭明, 起止年月：2002.1-2004.12

拨款来源：国家基金 60178030 (17万) ， 2003年到款5.1万

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负责人：徐克璠, 起止年月：2002.1-2004.12

拨款来源：国家基金 10176007 (15万) ， 2003年到款4.5万

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负责人：朱鹤元, 起止年月：2002.1-2004.12

拨款来源：国家基金 10104006 (22万) ， 2003年到款6.6万

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负责人：钱列加, 起止年月：2002.1-2005.7,

拨款来源：上海市科委光科技专项012261065 (50万)

可变光衰减器

负责人：徐雷, 起止年月：2002.1-2004.12,

拨款来源：上海市科委光科技专项012261025 (40万)

光纤放大器

负责人：孙迭箴, 起止年月：2002.1-2003.12,

拨款来源：上海市科委光科技专项012261031 (20万)

新型液晶全息光交换开关的研制

负责人：张斌, 起止年月：2002.1-2004.12,

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负责人：王韬, 起止年月：2002.7-2003.12

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负责人：朱鹤元, 起止年月：2002.1-2005.12

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拨款来源：863-416总装备部2002AA842031(10万), 2003年配套1万

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负责人：陈良尧(首席专家), 起止年月：2002.1-2004.12

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“溅射气压对Si/Ge多层膜结构光学常数的影响”, Chinese J. Infrared Millim. Waves, 22, 77 (2003)
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参加国际、国内会议情况
Scientific Activities

1. Lei Xu, Qinghai Song, Liying Liu, Wencheng Wang,
“Narrow band polarized light emission from organic micro-cavity
fabricated by sol-gel technique”, (Oral), XII International Workshop on
Sol-gel Science and Technology, Sol-gel 2003, Sydney, Australia, Aug.
24-29, 2003
2. Lei Xu, Tao Lin, Liying Liu, Qinghai Song, Wencheng Wang,
“Intense directional lasing from a deformed square-shaped
organic/inorganic hybrid glass micro-ring-cavity”, (Oral?), OSA ‘2003
Annual Meeting, Arizona, USA, Oct. 5-9, 2003
3. Lei Xu,
“Sol-gel techniques for micro-photonics”, (invited talk), China-Korea
bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
4. Xianjiang Wang, Lei Xu, Dongxiao Li, Liying Liu, Wencheng Wang,
“Study of the thermo-optic properties of sol-gel-fabricated
organic-inorganic hybrid waveguides”, (Oral), China-Korea bilateral
symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
5. Haitao Dai
“Characteristics of LCOS phase-only spatial light modulator and its
application”, (Oral), 3rd Annual SPIE International conference:APOC
2003 Nov. 2-6, Wuhan, China
6. Xin Wang
“Amplitude SLM based on reflective LCOS” ,(Oral), 3rd Annual SPIE
International conference:APOC 2003 Nov. 2-6, Wuhan, China
7. Weiqing Li, Lejun Qi, Ming Lu
“Observation of syep-edge diffusion in the nanopatterning of Si(100)
by normal-incident ion sputtering”, (Oral), China-Korea bilateral
symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
8. Peinan Wang, Weidong Yang, Lan Mi, Hong Shen
“Study on the quantum confinement effect in the photoluminescence
of InN nanoparticles”, (Oral), China-Korea bilateral symposium 2003,
Wuyishan, Fujian, China, Oct. 26-30, 2003
9. Ning Xu, Hao Ling, Li Li, Weijian Pan, Jian Sun, Jiada Wu, Zhifeng
Ying, Peinan Wang, Yuancheng Du, Fuming Li
“Synthesis of carbon nitride nano-crystals on Co/Ni-covered substrate
by nitrogen-atom-beam-assisted pulsed laser ablation”, (Oral),
China-Korea bilateral symposium 2003, Wuyishan, Fujian, China,
Oct. 26-30, 2003

10. Jianhu Jia, Peng Zhou, Hang Xie, haiyang you, Jing li, Liangyao Chen
“Study of optical and electrical properties of TiO₂/Ag/TiO₂ multilayers” , (Oral), China-Korea bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
11. Jinglong Luo, Xuantonng Ying, Peinan Wang, Liaoyao Chen
“Multi-nucleation growth of nano-crystalline diamond film for optical applications” , (Oral), China-Korea bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
12. P.Zhou, T.Han, J.Li, Y.X.Zheng, S.Y.Wang, Y.M.Yang, L.Y.Chen
“Structural and nonlinear optical properties of Ag:Bi₂O₃films” , (Oral), China-Korea bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
13. Jun Ye, Bin Ma, Yuan Zhao, Qingyuan Jin
“The spin reorientation of Fe films studied by the magneto-optical Kerr effect” , (Oral), China-Korea bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
14. Yang Ren, Jun Ye, Bin Ma, Qingyuan Jin
“Nonlinear magneto-optical properties in sputtered and epitaxial ultrathin films” , (Oral), China-Korea bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
15. Xiaoyong Gao, Songyou Wang, Jing Li, Yuxiang Zheng, Rongjun Zhang, Peng Zhou, Yuemei Yang, Liangyao Chen
“Optical properties of GaN prepared by MOCVD” , (Oral), China-Korea bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003
16. Li Li, Yuxiang Zheng, Jing Li, Liangyao Chen
“An approach in analyzing the noise characters of optical disk” , (Oral), China-Korea bilateral symposium 2003, Wuyishan, Fujian, China, Oct. 26-30, 2003

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本系访问学者和部分参观人员
Guest Scientists & Some Visitors

一.重点实验室高访学者

- 1.沈维滇, 男, 58岁, Prof., Eastern Michigan University USA
(2003.7-8, 2003.12.18-2004.1.23) 与课题组交流合作、研究生的培养及本科生的教学。5万
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- 5.李佛生, 男, 44岁, 副研究员, 同济大学物理系
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- 6.潘正瑛, 女, 60岁, 教授, 复旦大学现代物理所
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- 7.刘慧民, 男, 59岁, 美国波多黎各大学物理系, “材料光学性质与光谱研究”。5万
8. Tong Hua-ching, 男, 67岁, Read-Rite Corporation, Fremont California, USA
“给学生和教师开设培训课程, 详细介绍磁记录领域发展情况、实验方法和关键技术并做出混合光-磁存储的器件”。5万
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- 10.余玮, 男, 54岁, 上海光机所 “超短超强激光与物质的相互作用”。4万

二. 部分来室访问及作报告的学者

- 2003.1.18 Prof.Young Pak Lee, Dept.of Physics, Hanyang University Seoul, Korea
报告: “Quantum photonic science :Issues and perspective”
- 2003.3.21 雀部博之教授, 日本千岁科学技术大学校长
报告: “Organic molecules for photonics application”
- 2003.3.21 郭光灿教授, 中国科技大学物理系, 973科学家。
报告: “量子通信”
- 2003.4. 8 彭坤墀教授, 山西大学校长, 量子光学与量子器件
国家重点实验室主任
报告: “压缩态光场产生及其在光量子通信中的应用”
- 2003.9.16 范滇元院士
报告: “光科学与技术前沿”
- 2003.9.28 Dr.Wang Jian, Director of Nanoopto Corporation USA
报告: “Nanofabrication and its applications on optical devices”
- 2003.9.30 Dr.Wang Jian, Director of Nanoopto Corporation USA
报告: “Agere/Lucent’s optoelectronic devices”
- 2003.10.21 Dr.Chen Datong, 美国 Agilent (HP子公司)
报告: “Optical cross-connect switches”
- 2003.11.18 小川宏一博士, 富士通公司
报告: “中国在世界光盘/产业/商务上取得领导地位的日子”
- 2003.11.20 干福熹院士
报告: “光学的发展在人类进步中的作用”
- 2003.12.23 干效松博士, Swinburne University of Technology, Australia
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报告: “Nanophotonocs in center for micro-photonics”
- 2003.12.10-2004.1.20 顾敏教授, Swinburne University of Technology, Australia
与光科系共同建设微光子学研究试验平台。

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