

复 旦 大 学
光 科 学 与 工 程 系

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

2004年 报
Annual Report

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课题进展
Progress in Research Projects

微光子学材料与器件

Micro-photonic materials and devices

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 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. 新型掺铒光学材料及光波导的制备与光学性质研究。Fabrications of novel erbium doped optical materials and waveguides and study on their optical properties.

1) 用 CCl_4/O_2 气氛化学除水干燥的办法制备出了具有较高荧光寿命（6.2 ms）和很好光学质量的掺铒凝胶玻璃体材料，是目前报导的荧光寿命最长的掺铒凝胶玻璃体材料之一。2) 设计并测量比较了六种含铒有机配合物的荧光性质，证明了有机配合物中的OH和CH基团都会对 Er^{3+} 荧光产生严重淬灭作用。报道了一种完全不含OH和CH基团的含铒有机配合物全氟辛酸铒的荧光性质，测量表明它的荧光量子效率达到1%，比现有的含铒有机配合物大两个数量级。3) 利用飞秒激光脉冲写波导的技术手段在掺铒硅酸盐玻璃中成功得到了具有较低传输损耗的光波导结构，并获得了1 dB的内增益。获得了飞秒激光脉冲焦点附近玻璃材料二氧化硅三元环拉曼振动峰强度随激光脉冲能量、焦点扫描速度等实验条件的变化，测量得到了三元环拉曼振动峰随生成波导横截面直径的分布以及与波导中心折射率变化的对应关系。研究结果发表于Journal of Sol-gel Science and Technology。

1) The erbium doped bulk sol-gel glass samples with good optical quality were prepared. Annealing the samples in CCl_4/O_2 atmosphere was used as the chemical dehydration process. The fluorescence lifetimes of these samples at 1.55 μm were as long as 6.2 ms, which was one of the longest for the bulk sol-gel glasses as we know.

2) Six erbium organic complexes were designed and synthesized. Their fluorescence properties were measured and compared. The results showed that both the OH and CH groups in the complexes could quench the erbium ions fluorescence heavily. Er(perfluorooctylate)₃, a novel organic complex of erbium which contains neither OH nor CH groups was synthesized for the first time. Its quantum yield was found to be as high as 1%, 100 times higher than that has ever reported. 3) Waveguides with low propagation losses were written in the erbium doped silicate glasses by femtosecond laser pulses. Internal gains of 1 dB were obtained. The Raman spectra in the micro areas near the focus of femtosecond laser pulses were measured. The relation between the heights of vibrational Raman peaks of the 3-membered rings in the silica network with the energy of laser pulses and the scanning rates of focus were recorded. The relationships between the heights of the 3-membered rings vibration peaks and the Δn in the centers of the written waveguides were obtained for the first time. And the distributions of the 3-membered rings along the diameter of the waveguides were also measured. The results supported the “microexplosion” theory which contributes the laser pulses induced refractive index changes in the silicate glass to the increase of the low rank rings structures in the silica network.

2. 掺杂二氧化硅玻璃光敏性及光纤光栅器件研究。Study on the photo-induced refractive index changes and the mechanism of photosensitivity in Sn-doped silica glasses, and the sensing characteristics of Hi-Bi fiber Bragg gratings.

1) 采用MCVD方法和液相掺杂工艺制备了掺锡二氧化硅玻璃薄膜，经248nm准分子激光照射后获得 2×10^{-4} 的光致折射率变化。实验发现该光致折射率变化的机理与照射的紫外激光脉冲的能量密度有关，高能量密度时是由微观结构变化引起的，低能量密度时主要归结于光学活性缺陷的光致转化。2) 制备了镱锡共掺二氧化硅玻璃光纤预制棒，研究结果表明它同时具有掺锡二氧化硅光纤特有的高光敏性和掺镱二氧化硅光纤的光致发光特性。3) 采用相位掩模法在“类巨型”高双折射光纤上刻写了均匀布拉格光栅，获得了比商用高双折射光纤更大的两个正交偏振模所对应的布拉格波长差值（0.765nm）。对该种光纤光栅的温度、应变、静流体压力的传感特性进行了研究，发现该光纤光栅能作为同时测量温度/应变或温度/压力的传感器。研究结果发表于Journal of Applied Physics, IEEE Photonics Technology Letters 和Optical Communications。

1) Thick Sn-doped silica films were produced by MCVD followed by solution-doping method, in which a positive UV-induced refractive index change of 2×10^{-4} was observed. The measured UV absorption and Raman spectra under different irradiation conditions indicate that the photosensitivity of the Sn-doped silica film depends on the energy density. Under high energy density irradiation, photosensitivity should be mainly originates from the microscopic structural modifications, while under low energy density irradiation, photo-conversion of optically active defects should play an important role. 2) Yb doped tin-silicate optical fiber perform were also produced. The peculiar photosensitivity of Sn-doped silica and the gain property of Yb-doped silica are both preserved. 3) A fiber Bragg grating was written in a novel “quasi-rectangle” Hi-Bi fiber by the phase-mask

method. Two Bragg wavelengths corresponding to the fast-axis mode and slow-axis mode are observed in this grating, and a wavelength splitting as large as 0.765nm was obtained. The grating can be used to measure the temperature and strain or the temperature and hydrostatical pressure simultaneously.

3. 新的芪类有机聚合物薄膜的光致异构特性及其对二阶光学非线性影响的研究。 Observation and mechanism of photo-isomerisation induced rapid photo-degradation of optical nonlinearity in cyano substituted stilbene derivative doped poled polymer.

研究了一种新的芪(CNDS)衍生物的光致异构特性及对材料二阶非线性光学性质的影响。实验结果表明当C=C双键链接上CN基团后,分子构性从平面分子转为立体构形,从而大大加大了分子的光致异构能力。因此,该分子虽然具有比母体分子DANS更大的光学非线性,但强光致异构性质限制了其作为二阶非线性分子被应用。研究结果发表于Journal of Physics D-Applied Physics, Journal of the Korean Physical Society。

We found that, although α' -cyano-4'-nitro-4-N, N-dimethylaminostilbene (CNDS) has larger hyperpolarizability than that of conventional 4'-N,N-dimethylamino-nitrostilbene (DANS), the addition of cyano group makes it be much more easily photo-isomerized, thus destroys the molecular ordering in poled chromophore doped polymers. Experimental evidences were given by monitoring the second-harmonic generation (SHG) intensity, UV-Vis absorption spectrum and FTIR spectrum. Photo-isomerization reaction process was monitored by optical pump induced absorption anisotropy measurement. Comparisons with the behavior of an azobenzene dye were also given.

2004年度本课题组完成基础研究重大项目前期研究专项子课题1项,上海市科学发展基金“光科技”项目1项,通过验收。2004年新申请到国家自然科学基金项目2项,上海市科委重大项目子课题1项。2004年度课题组在国内外刊物上发表文章16篇,其中SCI论文7篇,EI文章14篇,合作发表SCI论文5篇;在国际会议上报告8次;在国内会议上报告9次,其中大会邀请报告2次。申请国家发明专利2项,实用新型专利1项。

飞秒时域的非线性光学研究

Studies on Femtosecond Nonlinear Optics

1. 新颖的高倍率整形啁啾脉冲展宽器。 Construction of a High-ratio Optical Pulse Stretcher.

飞秒脉冲展宽器是飞秒光学的一个重要元件,可用于全光开关等许多应用。我们利用高性能的商品化飞秒钛宝石再生放大器作为起始光源,采用新颖的光栅展宽并结合光谱滤波方案,构建了800nm整形啁啾脉冲展宽器。实验上由50 fs超短脉冲产生了宽度~1.5 ns、上升沿<1000 ps、具有良好幅度稳定性的近平顶激光脉冲。

Stable shaped optical pulses with proper duration and rise time are highly desired in all-optical switching at the front end of a high-power laser system. We have constructed a single-grating eight-pass pulse stretcher with spectral filtering, based on a commercial femtosecond Ti:sapphire regenerative amplifier. The stretcher permits to convert a 50 fs pulse to a 1.5 ns-long near flat-topped pulse with a rise time less than 100 ps and good amplitude stability, which is ideal for pumping a nonlinear all-optical switcher.

2. 发明和研制了基于萨格纳克环的多用途全光光学整形器。 A Versatile All-optical Shaper Based on the Sagnac Loop Configuration

利用构成Sagnac环的光纤中的非线性效应,如自位相调制(SPM)、互位相调制(XPM)等,可以实现光脉冲整形、波长变换和信号再生等功能。例如,由飞秒光脉冲经过展宽和整形,产生纳秒级、近平顶啁啾脉冲,用来泵浦(控制)Sagnac环,可以实现对另一束低功率窄带连续光的调制:在无控制脉冲时,连续光束被反射;而加上控制脉冲时则被透射。我们用800 nm啁啾脉冲(~1 ns)控制Sagnac环,调制1 μ m波段单纵模连续激光,获得了1 μ m波段窄带长脉冲输出,该窄带长脉冲与起始飞秒激光脉冲具有天然的同步性。

Based on the optical nonlinear effects in fibers, e.g., SPM and XPM, Sagnac loops are promising in pulse shaping, wavelength conversion, signal regeneration,

etc.. The flat-topped nanosecond chirped pulses, obtained by stretching and shaping the output pulses from a femtosecond Ti:sapphire regenerative amplifier, were used to pump a Sagnac loop modulating the transmittance of a low-power single longitudinal-mode CW laser beam at $1\mu\text{m}$. A sequence of narrow-band nanosecond pulses at $1\mu\text{m}$ was generated, which was synchronized with the femtosecond pulses at 800 nm.

3. 研制了 $1\mu\text{m}$ 波段飞秒光学参量放大器实用化样机。A Compact Femtosecond Optical Parametric Amplifier Near $1\mu\text{m}$.

在对原有实验室桌面系统改进和完善的基础上，重新设计和研制了更为紧凑的 $1\mu\text{m}$ 波段飞秒光学参量放大器样机，其实用化程度接近商品化器件的水平。利用商品化飞秒钛宝石再生放大器作为泵浦源，采用基于 $\text{MgO}:\text{LiNbO}_3$ 晶体I类匹配的二级放大方案。 $1\mu\text{m}$ 波段（信号光）最大输出光脉冲能量大于 $40\mu\text{J}$ ，脉冲宽度小于250 fs；总的光-光转换效率大于10%；脉冲能量起伏~5%，中心波长稳定性优于 $\pm 1\text{ nm}$ 。

A compact $\text{MgO}:\text{LiNbO}_3$ -based femtosecond optical parametric amplifier, pumped by a commercial Ti:sapphire regenerative amplifier, was constructed as a movable device. The device delivers pulse energy as high as $40\mu\text{J}$ and duration less than 250 fs within the tuning range near $1\mu\text{m}$, with a total conversion efficiency of $>10\%$. The pulse-to-pulse fluctuation of $\sim 5\%$ and the stability of the central wavelength better than $\pm 1\text{ nm}$ can be obtained.

该研究小组2004年度发表8篇SCI论文，作国际会议邀请报告2次。

Eight papers were published in SCI journals and two invited talks were given on international conferences in 2004.

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) 通过稀土Ce掺杂，增强镶嵌在SiO₂基体中的纳晶硅(nc-Si)的发光强度。研究发现Ce和nc-Si之间存在强烈的能量耦合。另外，发现nc-Si存在光学非线性效应。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。结合计算机模拟，解释了纳米结构的温度效应和能量效应。3) 利用EFM研究Si量子点的量子尺寸效应。

Research works cover three subjects. 1) Enhancement of photoluminescence of nanocrystal Si embedded in SiO₂ matrix via Ce doping. Strong coupling has been found between cerium ions and nc-Si. Also we discovered the optical nonlinear effect of nc-Si. 2) Growth of ordered nanostructures on Si(100) and Si(110) by ion erosion. Combined with the computer simulations, we explained the effects of sputtering temperature and ion energy on the formation of nanostructures. 3) Si quantum dots were investigated with electrostatic force microscopy.

本年度发表SCI论文2篇，包括1篇《Nanotechnology》(**15**, 494-500 (2004)), 1篇《Journal of Physics: Condensed Matter》(**16**, R581-R602(2004))。另外，还在《Chinese Physics Letters》上发表论文2篇(2005年，22卷，431-434页；同年同卷，919-922页)。另有3篇论文分别被《Nanotechnology》，《Applied Physics Letters》和《Physical Review B》接收，将发表。

PLD制备氧化钛和掺杂氧化钛 Synthesis of doped TiO₂ by PLD

锐钛矿相的纳米氧化钛在环保和能源领域有广泛的应用。我们用PLD法合成了纳米结构的氧化钛(TiO₂)薄膜。通过光谱诊断分析了激光烧蚀等离子体的成份。对以SiO₂为衬底的氧化钛薄膜,研究了其结构和表面形貌与O₂气压和激光能量等参数的关系。AFM和XRD结果显示,随着氧气气压的增加薄膜的表面形貌由平滑变成粗糙,当衬底的温度为400°C时得到的晶体结构是锐钛矿相。

氧化钛的缺陷是必须使用紫外光,而掺氮氧化钛薄膜具有较好的光学反应特性并且可在可见光和紫外光的照射下作为光催化剂。我们以金属钛为靶材,在氮气/氧气或氮气/氨气/氧气气氛中,用PLD的方法在SiO₂衬底上合成了掺氮的氧化钛薄膜。我们用AFM,拉曼光谱,XPS以及吸收光谱分别分析了薄膜的表面形貌,晶体结构,组成情况以及吸收边界。结果显示,在氮气/氨气/氧气混合气氛中合成的薄膜比仅用氮气/氧气混合气体合成的薄膜在光学活性上有很大的提高。

Nano-structured titanium dioxide (TiO₂) thin films in anatase phase have wide potential applications in environment protection and energy sources. In this project, nano-structured TiO₂ films are synthesized by pulsed laser deposition (PLD). Spectral diagnostics was applied to analyze the composition of the ablation plume. The dependence of the structure and surface morphology of the films prepared on the SiO₂ substrates on the deposition parameters, such as O₂ pressure and laser fluence, was studied. The atomic force microscope (AFM) and X-ray diffraction (XRD) results show that by increasing O₂ pressure, the surface morphology changed from smooth to rough, and the crystal structure is anatase phase at a substrate temperature of 400 °C.

The TiO₂ films must be used in the UV region, which greatly restricts their applications. Nitrogen doped titanium oxide (TiO_{2-x}N_x) films have a better optical reactivity and can be activated by both ultraviolet and visible light as a photocatalyst. The N-doped TiO₂ films were prepared by laser deposition of Ti target in an atmosphere of N₂/O₂ or N₂/NH₃/O₂ mixture. The surface microscopy, crystalline structure, composition and absorption edges of the films deposited on SiO₂ substrate were investigated by AFM, Raman, X-ray photoelectron spectra (XPS) and UV-Vis absorption, respectively. As a result, the films prepared with N₂/NH₃/O₂ mixture have higher optical activity in visible region.

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 Ag(111)表面吸附团簇的最低能量结构。原子的相互作用由表面原子嵌入势描述。获得了 $n=3-20$ 吸附团簇的最低能量结构, 其中发现尺寸为 $n=7, 10, 12, 14, 16, 19$ 的吸附团簇具有幻数性质。在此基础上进一步研究了能量接近最低的各种异构体, 并研究了这些结构的特点。结果表明除幻数团簇及一些小团簇外, 每个团簇构形都有两个不同的吸附位, 因此异构体总是成对出现。

We study the structures of Ag adatom clusters supported on the metal Ag(111) surface using the genetic algorithm. The atomic interactions are modeled by the surface-embedded-atom method. The lowest-energy structures of adatom clusters with sizes $n=3-20$ are obtained, in which $n=7, 9, 10, 12, 14, 16, 19$ are the magic numbers. Furthermore, we give a series of structures with energies close to the lowest energy, and the structure features are studied in detail. Except for some magic clusters and small clusters, every configuration of adatom clusters generally has two distinct adsorption ways, so the isomers always appear in pairs.

2, 利用密度泛函理论 (DFT) 并以遗传算法进行全局结构搜索作为辅助研究了在实验上观察到的 $[(\text{SiO}_2)_n\text{O}_2\text{H}_3]$ -团簇的幻数结构 $n=4, 8$ 。对于第一个幻数团簇 $n=4$, 除结构参数的略微不同外, DFT 得到的结构与之前用 Hartree-Fock 得到的结构一致。这些结果表明第一个幻数团簇 $(\text{SiO}_2)_4\text{O}_2\text{H}_4$ 及其离子 $[(\text{SiO}_2)_4\text{O}_2\text{H}_3]$ -的结构很可能是一种准笼状的结构。为了研究第二个幻数团簇的结构特点, 我们在 B3LYP/6-31G**水平上全面优化了纯 $(\text{SiO}_2)_8$ 团簇, 中性复合 $(\text{SiO}_2)_8\text{O}_2\text{H}_4$ 团簇, 以及离子团簇 $[(\text{SiO}_2)_8\text{O}_2\text{H}_3]$ -的结构, 并同时计算了振动频率。结果显示纯 $(\text{SiO}_2)_8$ 团簇的基态能量结构是链状的而中性复合

(SiO₂)₈O₂H₄ 团簇以及它的离子团簇[(SiO₂)₈O₂H₃]-的结构很可能是内部含一个氧的立方类笼状异构体以及一些准双笼异构体的混合。这些稳定的结构可归结于在团簇的形成过程中氧原子 2O 和氢原子 4H (或 3H) 以化学成键方式的有效参与。另外, 我们的计算还解释了实验中为什么只观察到 n=4 和 8 的幻数团簇, 而没有更大的幻数团簇。

The magic number silica clusters [(SiO₂)_nO₂H₃]- with n=4 and 8 have been observed in the XeCl excimer laser (308nm) ablation of various porous siliceous materials. The structural origin of the magic number clusters has been studied by the density functional theoretical calculation at the B3LYP/6-31G** level, with genetic algorithm as supplementary tool for global structure searching. The DFT results of the first magic number cluster are parallel to the corresponding Hartree-Fock results previously reported with only small differences in the structural parameters. Theoretical calculation predicts that the first magic number cluster (SiO₂)₄O₂H₄ and its anion [(SiO₂)₄O₂H₃]- will most probably take pseudotetrahedral cage-like structures. To study the structural properties of the second magic number cluster, geometries of the bare cluster (SiO₂)₈, the neutral complex cluster (SiO₂)₈O₂H₄, and the anionic cluster [(SiO₂)₈O₂H₃]- are fully optimized at the B3LYP/6-31G** level, and the corresponding vibrational frequencies are calculated. The DFT calculations predict that the ground state of the bare silica octamer (SiO₂)₈ has a linear chain structure whereas the second magic number complex cluster (SiO₂)₈O₂H₄ and its anion [(SiO₂)₈O₂H₃]- are most probably a mixture of cubic cage-like structural isomers with an O atom inside the cage and several quasi-bicage isomers with high intercage interactions. The stabilization of these structures can also be attributed to the active participation of the group of atoms 2O and 4H (3H for the anion) in chemical bonding during cluster formation. Our theoretical calculation gives preliminary structural interpretation of the presence of the first and second magic number clusters and the absence of higher magic numbers.

新型液晶光电子器件研究及超快过程研究

Studies on new types of optical devices based on liquid crystal and ultrafast phenomena

在聚合物分散液晶体系中，开展了相分离机理的研究，着重测量聚合物单体在曝光时所发生的聚合现象，已获得了一种测量这一过程的新方法，具有约0.1%的精度。发现其光反应达到饱和的时间约1秒，并且与曝光强度有很大的关系。

Phase separation mechanism was investigated in polymer dispersed liquid crystal components. A new measurement method was obtained to characterize the polymerization amplitude with a resolution of 0.1% in photo polarization. The photo reaction speed is about 1 s, which is strongly dependent on the exposure intensity.

在基于LCOS的相位空间光调制器的研究中，通过参数空间的工作模式的优化模拟发现存在两个可用于纯相位的工作模式，一个是RTN-52°，另一个为平行排列的ECB模式。测量了相位随LCOS上加电压的变化，并用LCOS实现了可变焦的Fresnel透镜。

The working models of LCoS (Liquid Crystal on Silicon) were optimized in parameter space by simulation. Two modes were selected, which were suitable for phase modulation. One was the RTN-52° mode, the other was parallel alignment ECB mode. Phase changes were measured when various voltages are applied to LCoS. In addition, we showed some results when the LCoS was used as a Fresnel lens.

基于单层吸收膜-透明衬底模型，采用一种网格算法，我们从pump-probe实验测量的瞬态反射率和透射率，拟合出飞秒脉冲激光辐照下五氧化二钽薄膜光学参数的超快变化。实验中脉冲能量为单脉冲损伤阈值的60%。计算中反射率和透射率同时满足千分之一的误差容限。我们得到峰值变化：折射率-2.2%、消光率0.035。变化的峰值约出现在泵浦脉冲后的90fs，之后以约600fs的时间常数弛豫。According to experimental results of time-resolved pump-probe reflection and transmission, the photo-induced complex dielectric constants of thin Tantalum pentoxide film illuminated by femtosecond laser pulses were retrieved, based on the model of a single absorbing thin film on a transparent substrate.

The pump pulse intensity was kept at 60% of the single-shot damage threshold. A grid algorithm was developed to retrieve the constants, which satisfied the error tolerance of 0.001 for reflectivity and transmissivity simultaneously.

Peak modifications of -2.2% for index of refraction and 0.035 for extinction coefficient, which emerged at about 90fs after the pump pulse, were obtained. And the changes decayed with a time constant of about 600fs.

发表论文3篇。

低维磁结构的磁性和光磁混合存储介质研究

Magnetic properties in low-dimension magnetic structures, heat-assited magnetic recording (HAMR) media

① 为了在超高真空中实现wedge磁性样品的快速磁光克尔效应（MOKE）测量，我们尝试研究了远场MOKE对wedge样品的成像装置的搭建工作，采集到step样品一些图样和Kerr回线，但是噪音较大，图样清晰度不够。我们将继续努力，希望实验成功后大大缩短每点测量所消耗的大量时间，并且同时具有直观性。

The far-field MOKE image was tried for the wedged ultrathin films for rapid detection in UHV system. Some patterns and Kerr loops were recorded in stepped samples, but with big noise. We will try to focus on it, in order to much prove the efficiency of MOKE measurement in ultrathin magnetic films.

② 利用RHEED、LEED、磁光克尔效应（MOKE）等手段，研究了外延Fe薄膜上覆以超薄Ni薄膜的结构、气体吸附对自旋重取向的影响；利用LEED等手段研究了对于Fe超薄膜低温生长后热处理过程对结构的影响。

Using MOKE, RHEED and LEED, we studied in-situ the gas absorption influence on the spin reorientation transition (SRT) of Ni-capped Fe ultrathin films. The SRT critical thickness therefore happened 0.3 ML in advance with gas absorption, but reversed if we desorbed the film to room temperature. This SRT is thought to be due to the surface modification of magnetic anisotropy, not the effect of the structure phase change. With careful LEED detection, the process of structure change during annealing from low temperature (deposition temperature) to room temperature and back was studied.

③ 完成了旧溅射台的改造，在此设备上制备了具有很好有序度的FePt合金薄膜，通过改变薄膜厚度和衬底层结构，获得了很高的矫顽力，满足了光磁混合存储对介质矫顽力的要求；在此基础上，尝试利用耦合薄膜的结构改善FePt有序金薄膜矫顽力的温度特性，取得了初步的结果，并以此为基础申请自然科学基金面上项目。

High L1₀-ordered FePt-alloy magnetic thin films were fabricated by sputtering machine for the purpose of HAMR media with a perpendicular anisotropy and good thermal-magnetic properties. Some samples with very high coercivity were obtained via adjusting the film thickness and underlayer. Based on this, multilayer structures with FePt ordered films was designed and finishin fabrication. Some primiry results were got.

④ 研究了一些特殊磁结构的退磁过程，得到一些有意义的结果，正在分析之中。

The spin dynamics of a special kind of magnetic material was studied. Some interesting results were obtained and under analysis.

本年度发表SCI论文2篇，接受2篇论文。负责承担国家自然科学基金委重大项目2004年正式启动。

Two papers were published in SCI journals and two papers were accepted. The Major grant from NSF started this year.

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

用时空分辨的光谱分析考察了PLA等离子体光谱在不同环境中的空间分布和时间演变，在实验上观察到背景气体的种类和气压、磁场、活性等离子体、非活性等离子体以及衬底条件等对PLA等离子体的不同影响，观察到PLD过程中激光烧蚀产物在不同环境中的演变、气相膜物质的形成，特别是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等离子体相互作用和鞘层增强反应的实验验证。还进行了PLA等离子体光谱在材料痕量元素分析检测上尝试。

The space distribution and time evolution of pulsed laser ablation (PLA) plasma in various gaseous environments were studied with time- and space-resolved spectroscopic technique. We examined the influences of ambient gas, magnetic field, reactive plasma, non-reactive plasma and substrate conditions on the PLA plasma. The evolution of the laser ablated species in various environments and the formation of the gaseous precursors for films were observed, and the optical emissions of the products of the reaction between the laser ablated species and the reactive species of ECR plasma were obtained, confirming experimentally the interactions between ECR plasma and PLA plasma and the plasma sheath enhanced reactions. We also made some attempts on the application of PLA plasma in the analysis and detection of trace elements in materials.

以多晶GaAs为靶材料、用ECR氮等离子体辅助脉冲激光沉积的方法制备了GaN薄膜，并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，摸索了化合物薄膜的合成制备和原位掺杂新方法，在此基础上用ECR氮等离子体辅助双靶双激光共烧蚀的方法制备了GaN:Er薄膜,其中Er的掺杂浓度可以按要求在较大范围内控制变化。

GaN thin films were prepared by means of ECR nitrogen plasma assisted pulsed laser deposition using polycrystalline GaAs as target material. Taking advantage of

the features of PLA in certain atmosphere and pulsed laser deposition (PLD) assisted with reactive sources, we explored a new method for synthesis of compound films and in-situ doping. This method was used for the first time to prepare GaN:Er thin films using ECR nitrogen plasma assisted pulsed laser deposition with co-ablation of two target by dual laser beams. With this method, the concentration of dopants can be controlled to vary in a wide range.

用Nd:YAG脉冲激光烧蚀纯石墨靶材，并通过弧热等离子体源所产生的氮等离子体与激光烧蚀产生的碳等离子体相互作用促进C-N键的形成，氮碳薄膜直接在覆盖不同配比的Co/Ni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。

By pulsed laser ablation of a graphite target and by means of the formation of C-N bonds enhanced by the interaction between nitrogen plasma generated from arc discharge and the carbon species created from graphite ablation, carbon nitride films were grown on Co/Ni-covered substrates, resulting in efficient incorporation of nitrogen and growth of nanocrystalline with C-N bonds.

进行了ZnO纳米棒的PLD法试生长，通过GaAs衬底对生长的ZnO薄膜进行了渗As处理。

Some attempts were also made to grow nanorods of ZnO by PLD. By As doping into ZnO films grown on GaAs substrates, we obtained low-resistance p-type ZnO thin films.

本年度发表SCI论文5篇；国家自然科学基金项目结题1项，在研2项，新获批准2项。

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

一. 高分辨率光谱信息的快速获取研究。 Study of the method to measure the optical spectra with high speed and high resolution.

为了实现在高真空条件下对高性能光子薄膜材料和器件的特性可控制备, 需要研究在器件制备过程中高速获取和分析器件光谱信息的方法。针对在光通信领域有重要应用价值的纳米和亚纳米带通特性的超窄带光子滤波器件, 采用二维光谱折叠模式, 研制了由五块子光栅组成的集成光栅结构和五个高性能 InGaAs 红外波段线阵探测器组成的新型红外光谱分析仪。实验系统免除了任何机械扫描和转动部件, 显著提高了光谱数据采集的重复性和可靠性。光谱测量覆盖范围为 1450-1650nm, 光谱分辨率为 0.08nm, 全光谱数据的采集时间小于 40ms, 达到了目前国际上同类光谱分析系统能够同时实现宽光谱工作区、高分辨率和高速数据采集等综合指标的最好水平。通过对所获取的光谱线形、峰值位置和带宽等特征进行快速和高稳定性分析, 所研制的红外光谱分析系统不仅可用于高性能薄膜器件制备过程中的透射和反射光谱特性的原位实时监控, 精确控制 $1/4$ 波长多层膜的生长, 还可控制非 $1/4$ 波长的分数薄膜结构的生长过程, 为具有复杂结构的新型高性能光子器件的研制打下了实验基础。

In order to monitor and control the growth of the advanced photonics thin film materials and devices in the high vacuum condition, more studies of the methods to obtain the optical spectral information of the devices in the in-situ growth process will be required. Especially aiming at the narrow-band filter devices that have nano/sub-nanometer band-pass properties and are widely used in the optical communication field, a new type of infrared spectrometer has been studied, designed and constructed by the new method to fold the spectrum into a 2-dimensional spectral space. The system has a higher spectral resolution with fast data acquisition speed, and can be used to dynamically monitor and control the growth of multi-layered thin film structure precisely and reliably. The system was made by five InGaAs infrared line-array detectors and an integrated grating consisting of five

sub-gratings. Without any mechanical scanning and moving parts, the full real-time spectral image of the sample can be obtained rapidly and accurately in less than 40 ms and with a spectral resolution of about 0.08 nm. By analyzing the spectral pattern in a fast speed with excellent data repeatability, the system will have the advantage to be used in an advanced film deposition chamber to in-situ monitor and control the spectral properties and the growth process of the multi-layered film that has an integral or a fractional quarter-wavelength layer structure. More works to develop the new photonics materials and device with many new functions will be carried out in the future.

二. 光电子功能材料的光学性质研究。Study of the optical properties of photonics materials.

采用椭圆偏振光谱、非线性光谱和克尔光谱等方法研究了由贵金属和氧化物纳米颗粒组成的薄膜材料的光学性质。研究了Ag: Bi₂O₃的线性和非线性光学性质, 对这类体系的光学性质随Ag成分和尺寸变化的规律进行了细致分析, 以及研究了杂质对贵金属薄膜结构Drude参数的影响。对纤维矿结构的GaN发光和光学性质进行了研究, 与北京大学和上海光机所等单位合作, 开展了稀土磁光材料光学和磁光性质方面的研究。

By using the methods, such as the spectroscopic ellipsometry, non-linear optical spectrum and magneto-optical Kerr spectrum, and so on, the optical properties of synthesized thin film materials consisting of noble metals and oxides compounds have been studied. The researches have been carried out to study the linear and non-linear optical properties of Ag: Bi₂O₃ by exploring the mechanism of those optical features changing with the Ag composition and particle size. The impurity also plays a significant role to affect the Drude parameters of noble metal thin film structures. Both photoluminescence and optical properties of the GaN and rare-earth magneto-optical Kerr materials have been studied through the research cooperation with other groups in the Peking University and Shanghai Fine Machinery and Optical Institute of CAS.

三. 光电子材料和器件的结构计算和特性研究。Computing of the band structure and properties of photonics material and devices

采用数值模拟分析和计算的原理和方法，对高密度磁光存储器件的多层结构和材料性质对器件的噪声信号和热分布特性进行了数值模拟分析；利用第一性原理研究了由半导体和金属组成的合金在高温下的结构、扩散机制和电子态性质，为这类材料和器件的实际应用提供了理论指导。

In terms of the digitalized simulation methods, multi-layered structures and material properties of the high density magneto-optical Kerr storage device have been analyzed and calculated to obtain the heat and noise signal distribution in the device. The material structures with the impurity diffusing and electronics states in the high temperature have been studied and calculated using the first principle computing method for the alloys and compounds materials consisting of the semiconductors and metals. The results are useful for the applications of the materials in many fields.

2004年度本课题组承担了5项研究项目，其中上海市科委重大项目1项，国家自然科学基金3项，自然科学基金重大项目子课题1项。获得国家发明专利1项。在国内外学术期刊上发表论文14篇，国内会议论文5篇，国际会议论文2篇，其中特邀报告1篇。

In 2004, five research projects, including one key project supported by the Shanghai Science and Technology Commission, three by the NSF of China and one by the key project of NSF of China have been carried out in this group. One patent, 14 journal papers and 7 conference papers, including one invited paper had been approved and published, respectively.

在研课题和经费
Projects & Budgets

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), 2004年到款7.5万

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), 2004年到款7.2万

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), 2004年到款7.2万

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), 2004年到款8万

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), 2004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), 2004年到款7.5万

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), 2004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), 2004年到款5.1万

液晶相位调制器研制及特性研究

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), 2004年到款4.5万

共轭聚合物分子中光致极化反转效应的研究

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), 2004年到款6.6万

高功率脉冲激光谐波转换光束质量研究

负责人：钱列加, 起止年月：2004.1-2006.12

拨款来源：国家自然科学基金 10376009(25万) ， 2004年到款10万

激光诱导冷等离子体及其在痕量元素分析中的应用

负责人：应质峰, 起止年月：2004.1-2006.12

拨款来源：国家自然科学基金 10375014(31万) ， 2004年到款12.4万

离子束刻蚀生成的自组织半导体量子点：形貌调控及发光性质研究

负责人：陆明, 起止年月：2004.1-2006.12

拨款来源：国家自然科学基金 10374016 (27万) ， 2004年到款10.8万

特殊磁结构的自旋动力学研究

负责人：金庆原, 起止年月：2004.1-2006.12

拨款来源：国家自然科学基金 10374019 (30万) ， 2004年到款12万

光照飞秒激射硫系玻璃和碲玻璃产生增强三阶光学非线性效应的机理及直写光波导的光-开关效应研究

负责人：徐雷, 起止年月：2004.1-2006.12

拨款来源：国家自然科学基金 60378034 (26万) ， 2004年到款10.4万

二维CCD快速成像光谱仪研制(科学仪器基础研究专款)

负责人：陈良尧, 起止年月：2004.1-2006.12

拨款来源：国家自然科学基金 60327002 (70万) ， 2004年到款32万

掺杂有序组装有机分子超薄膜热释电特性及应用

负责人：马世红, 起止年月：2004.1-2006.12

拨款来源：国家自然科学基金 60378035 (21万) ， 2004年到款8.4万

超高密度、高速光-磁混合数字信息存储研究

负责人：金庆原（首席专家），起止年月：2004.7-2008.6

拨款来源：国家自然科学基金（重大）60490290 （800万），2004年到款104万

高强度飞秒激光的真空电子加速研究（实验部分工作）

负责人：钱列加, 起止年月：2004.1-2007.12

拨款来源：国家自然科学基金（重点）10335030 （30万），2004年到款10万

强激光束非线性传输模拟

负责人：王韬, 起止年月：2002.1-2005.12

拨款来源：863-804-5-3.3, 2002AA845033(40万)

级联非线性在高能激光驱动器技术创新中的应用

负责人：朱鹤元, 起止年月：2002.1-2005.12

拨款来源： 863-804-5-20, 2002AA845180(10万)

用于前端全光开关的整形啁啾脉冲展宽器

负责人：钱列加, 起止年月：2004.4-2005.12

拨款来源： 863, 2003AA849071, 2004AA849071(35万)

光学参量放大（OPA）技术研究

负责人：朱鹤元, 起止年月：2004.4-2005.12

拨款来源： 863, 2003AA849071-3, 2004AA849071-3(35万)

高能宽带超短光源的创新技术及实验系统

负责人：朱鹤元, 起止年月：2004.9-2005.12

拨款来源： 863探索基金, 2004AA84TS12(50万)

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(90万) , 2004年到款15万

宽带激光高效的二倍频技术及实验研究

负责人：王韬, 起止年月：2003.10-2005.10

拨款来源： 863创新基金 2003AA84TS12 (11万) , 2004年到款11万

光参量啁啾脉冲放大光束耦合传输特性研究和增益稳定研究

负责人：王韬, 起止年月：2004.4-2006.3

拨款来源： 总装武器装备预研基金51480040204JW0701 (15万) 2004年到款3万

新一代全宽带光网中的关键器件及其应用的基础研究（重大）

负责人：陈良尧(首席专家), 起止年月：2002.1-2004.12

拨款来源： 国家科技部20021CCA04600(110万) , 2004年到款15万

快速信息获取和传输中的关键技术基础研究（重大）

负责人：陈良尧, 起止年月：2002.1-2005.12

拨款来源： 市科委02DJ14001(500万) , 2004年到款48+12万

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) ,

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），2004年到款3万

离子辐射引发的硅表面量子点阵列及其光学性质

负责人：陆明, 起止年月：2004.1-2006.12

拨款来源：教育部优秀青年教师（8万），2004年到款8万

掺杂氧化钛纳米材料

负责人：王培南, 起止年月：2004.1-2006.12

拨款来源：上海市科委03ZR1401（5万），2004年到款4万

高性能小型全固化飞秒激光器

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）

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,

拨款来源：上海市科委光科技专项012261009（25万），2004年到款5万

FePt基薄膜的结构和磁化翻转机理研究

负责人：马斌, 起止年月：2004.1-2005.12

拨款来源：校青年基金（4万），2004年到款2万

有序组装分子超薄的光电特性及其在红外探测器中的应用研究

负责人：马世红, 起止年月：2002.1-2004.6

拨款来源：上海市教委 曙光计划（10万）

新型超薄金刚石X光器件研究（重点用户课题）

负责人：应萱同, 起止年月：2002.1-2004.12

拨款来源：中科院高能所同步辐射装置(BSRF)（1.5万）

实用化视网膜高分辨诊断装置研制及临床应用研究

负责人：范滇元, 起止年月：2002.6-2004.12

拨款来源：上海市科委光科技专项 012261013（50万）

2004年总到款：470万元人民币

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4. Li-Ying Liu, (oral)
“The properties of the thermo-optic waveguide devices based on ARROW structures”, 2nd International Symposium on Advanced Photonic Science and Technology (2nd ISAPST), Korea, Aug. 20-24, 2004
5. Lei Xu, (oral)
“Ultrafast time response of Optical Nonlinearity of nano liquid crystalline solids”, 2nd International Symposium on Advanced Photonic Science and Technology (2nd ISAPST), Korea, Aug. 20-24, 2004
6. Liyong Ji, Liying Liu, Ye Mingxin, Lei Xu, Wencheng Wang, (oral)
“Photo-isomerisation induced rapid photo-degradation of optical nonlinearity in cyano substituted stilbene derivative doped poled polymer”, Photonics Asia, Beijing, China, Nov. 8-12, 2004
7. Qinghai Song, Liying Liu, Lei Xu, Wencheng Wang, (poster)
“Random lasers emission from surface-disordered waveguide”, Photonics Asia, Beijing, China, Nov. 8-12, 2004
8. L. J. Qian, (invited talk)
“Quadratic nonlinear technologies for femtosecond lasers at 1 micro”, **APOC** 2004.11.8-11 (北京), SPIE, 2004.
9. L.J. Qian, H. Y. Zhu, T. Wang, (invited talk)
“ Quadratic nonlinear technologies for femtosecond laser”, **APLS** 2004.3.1-6 (Yongpyong, Korea)
10. D. Fan, X.Zheng, X.Fu, and L.Qian, (oral)
“A Conceptual design of multi-PW laser system”, **APOC** 2004 (北京), SPIE, 2004.

11. G. Q. Xie, T. Wang, L. J. Qian, (oral)
 “Diode-Pumped Cr:LiSAF Laser with two-cavity configuration”, **APOC** 2004 (北京), SPIE, 2004.
12. Liangyao Chen, (invited talk)
 “Fabrication and optical properties of silver oxide by reaction magnetron sputtering”, The 2nd International Symposium on Advanced Photonic Science and Technology, August 21-24, Seoul and Seorak-San, Korea (2004)
13. Yuxiang Zheng and Liangyao Chen, (oral)
 “Numerical Simulations for Magneto-optical Data Storage” , The 2nd International Symposium on Advanced Photonic Science and Technology, August 21-24, Seoul and Seorak-San, Korea (2004)
14. Jian-Hong Qiu, Peng Zhou, Xiao-Yong Gao, Jia-Ni Yu, Song-You Wang, Jing Li, Yu-Xiang Zheng, Yue-Mei Yang, Qing-Hai Song, and Liang-Yao Chen
 “Ellipsometric Study of the Optical Properties of Silver Oxide Prepared by Reactive Magnetron Sputtering”. The 2nd International Symposium on Advanced Photonic Science and Technology, August 21-24, Seoul and Seorak-San, Korea (2004) (oral)
15. Ying-Cui Fang, Wei-Qing Li, Le-Jun Qi, Ming Lu (oral)
 “Photoluminescence enhancement of Si nanocrystals embedded in SiO₂ Matrix via doping of CeF₃”, 2nd International Symposium on Advanced Photonic Science and Technology (2nd ISAPST), Korea, Aug. 20-24, 2004
16. Pei-Nan Wang (oral)
 “Study of amorphous carbon-nitride films grown on the nitridated diamond substrates”, 2nd International Symposium on Advanced Photonic Science and Technology (2nd ISAPST), Korea, Aug. 20-24, 2004
17. Yu Jitong, Y.Cen, J.Ma, D.X.Lee, L.Xu, J.Y.Chen (oral)
 “The stretching force on the surface of erythrocytes under low power laser irradiation”, 10th Congress, Asian-Pacific Association for Laser Medicine and Surgery, 2004 Shanghai International Conference on laser Medicine and Surgery, 15th Congress, International YAG Laser Society
18. 徐雷 (特邀报告)
 “溶胶-凝胶技术在微光子学中的应用”,全国第三届溶胶-凝胶科学技术学术会议, 浙江杭州, 2004.5.29-6.1

19. 徐雷 (特邀报告)
“光泵浦下有机分子异构的动力学过程及其非线性光学响应”, 第十一届全国基础光学与光物理学术讨论会, 江西井冈山, 2004.11.28-12.2
20. 徐雷 (大会报告)
“复旦大学光科学系工作汇报”, 第十二届激光物理讨论会, 云南丽江, 2004.10.24-30
21. 李毅刚, 何子安, 汤恒晟, 刘丽英, 徐雷, 王文澄 (分组报告)
“溶胶-凝胶法制备低含水量石英玻璃体材料的研究”, 全国第三届溶胶-凝胶科学技术学术会议, 浙江杭州, 2004.5.29-6.1
22. 李冬晓, 刘丽英, 徐雷, 王文澄 (分组报告)
“有机/无机复合材料热光特性的研究”, 全国第三届溶胶-凝胶科学技术学术会议, 浙江杭州, 2004.5.29-6.1
23. 凌涛, 肖淑敏, 宋清海, 姬利永, 刘丽英, 徐雷, 王文澄 (分组报告)
“椭圆形微环的光学性质的研究”, 中国光学学会年会, 浙江杭州, 2004.4.14-16
24. 叶小炜, 刘丽英, 徐雷, 王文澄 (分组报告)
“用红外光谱研究极化对硼酸铅玻璃表面结构的影响”, 中国光学学会年会, 浙江杭州, 2004.4.14-16
25. 叶明新, 姬利永, 张艳武, 刘丽英, 徐雷, 王文澄 (分组报告)
“席夫碱类有机分子的合成和非线性研究”, 中国光学学会年会, 浙江杭州, 2004.4.14-16
26. 王雷, 刘丽英, 徐雷, 王文澄 (分组报告)
“基于ARROW结构的热光型波导器件的特性研究”, 中国光学学会年会, 浙江杭州, 2004.4.14-16
27. 邱建宏, 周鹏, 郜小勇, 韩涛, 李晶, 王松有, 郑玉祥, 陈良尧 (分组报告)
“磁控反应溅射的氧化银的制备及其光学性质”, 第十二届全国凝聚态光学性质学术会议论文集, 2004年8月, 新疆.
28. 周鹏, 游冠军, 李毅刚, 李晶, 王松有, 郑玉祥, 陈良尧, 钱士雄
“纳米颗粒光子材料 $\text{Ag:Bi}_2\text{O}_3$ 的结构与光学性质研究”, 第十二届全国凝聚态光学性质学术会议论文集, 2004年8月, 新疆. (分组报告)

29. 张晋敏, 郜小勇, 李晶, 周鹏, 郑玉祥, 王松有, 张冬青, 陈良尧(分组报告)
“Ag/TbFeCo薄膜的短波磁光Kerr效应的增强”, 第十二届全国凝聚态光学性质学术会议论文集, 2004年8月, 新疆.
30. 郑玉祥, 李莉, 徐综辉, 张荣君, 王松有, 李晶, 陈良尧(分组报告)
“采用不同介质膜的双记录层磁光存储系统热光特性比较”, 第十二届全国凝聚态光学性质学术会议论文集, 2004年8月, 新疆.
31. 孔宇菲, 周鹏, 徐综辉, 陈岳瑞, 孙斌, 王松有, 陈良尧(分组报告)
“Ag-TiO₂薄膜光学性质研究”, 第十二届全国凝聚态光学性质学术会议论文集, 2004年8月, 新疆.
32. Xu, Lei, Ling, Tao, Song, Qinghai, Liu, Liying, Wang, Wencheng, “Intense directional lasing from non-circular micro-ring cavities”, LEOS Summer Topical Meetings 2004, San Diego, CA, July 28-30, 2004
- Miao, J; Chen, DY; Zhang, RJ; Li, L; Wu, YH; Chen, LY
“Optical characterization of the narrow-band filter with in-situ thickness monitoring at fixed wavelength”, 6th Chinese Optoelectronics Symposium SEP 12-14, 2003,

人员名单
Faculty Members

在研人员: **Faculty members in 2004**

陈良尧 教授, 博士, 凝聚态光学

CHEN Liangyao, Prof., Ph.D., Optical properties in condensed matter

范滇元, 教授, 工程院院士, 高功率激光技术、激光与物质相互作用

FAN Dianyuan, Prof., Academician, Highpower laser physics, Laser-material interactions

干福熹 教授, 中科院院士, 光学和凝聚态物理

GAN Fuxi, Prof., Academician, Optics and condensed matter physics

金庆原 教授, 博士, 低维结构磁性和磁光性质、自旋动力学、超高密度光-磁混合存储

JIN Qingyuan, Prof., Ph.D., Magnetism in low-dimensional structures, Spin dynamics, Hybrid recording

李 晶 副教授, 博士, 凝聚态光学

LI Jing, Associate Prof., Ph.D., Optical properties in condensed matter

刘建华 副教授, 博士, 超短光脉冲和超快现象

LIU Jianhua, Associate Prof., Ph.D., Ultra-short optical pulse, Ultra-fast phenomena

刘丽英 教授, 博士, 非线性光学与光波导器件物理

LIU Liying, Prof., Ph.D., Nonlinear optics, Physics of optical waveguide devices

陆 明 教授, 博士, 材料物理

LU Ming, Prof., Ph.D., Material physics

马 斌 副教授, 博士, 磁性薄膜及器件, 光磁混合存储技术

MA Bin, Associate Prof., Ph.D., Magnetic thin films and devices, Hybrid recording technology

钱列加 教授, 博士, 激光物理

QIAN Liejia, Prof., Ph.D., Laser physics

孙迭箴 教授, 超短光脉冲和超快现象

SUN Diechi, Prof., ultra-short optical pulse generation and ultra-fast phenomena

孙 剑 讲师, 博士, 激光物理

SUN Jian, Lecturer, Ph.D., Laser physics

王恭明 副教授, 光学非线性LB膜及光波导
WANG Gongming, Associate Prof., Optical nonlinear LB films and waveguides

王培南 教授, 博士, 激光光谱、激光烧蚀过程的动力学
WANG Peinan, Prof, Ph.D., Laser spectroscopy, Laser ablation dynamics

王松有 副教授, 博士, 凝聚态光学
WANG Songyou, Associate Prof., Ph.D., Optical properties in condensed matter

王 韬 副教授, 博士, 激光物理
WANG Tao, Associate Prof., Ph.D., Laser physics

王文澄 教授, 非线性光学与光波导器件物理
WANG Wencheng, Prof., Nonlinear Optics, Physics of optical waveguide devices

吴嘉达 教授, 博士, 激光物理, 等离子体物理
WU Jiada, Prof., Ph.D., Laser physics, plasma physics

徐克璠 教授, 信息光学和铁电液晶器件
XU Keshu, Prof., Optical information processing, Ferroelectric liquid crystal display device

徐 雷 教授, 博士, 玻璃波导线性和非线性光学性质
XU Lei, Prof., Ph.D., Silica waveguide and its linear & nonlinear optical properties

许 宁 副教授, 博士, 氮原子束辅助激光烧蚀合成氮化物薄膜
XU Ning, Associate Prof., Ph.D., Nitrogen-based thin film deposition via laser ablation with atomic nitrogen ion beam

应萱同 教授, 博士, 金刚石薄膜的研制、测试与分析
YING Xuanton, Prof., Ph.D., Fabrication and analysis of diamond thin films

应质峰 副教授, 硕士, 激光溅射成膜研究
YING ZhiFeng, Associate Prof., Films deposition by laser ablation

张荣君 副教授, 博士, 凝聚态光学
ZHANG Rongjun, Associate Prof., Ph.D., Optical properties in condensed matter

张宗芝 副教授, 博士, 自旋电子学薄膜材料与器件
ZHANG Zongzhi, Associate Prof., Ph.D., Spin-based electronic thin film materials and devices

郑玉祥 副教授，博士，凝聚态光学
ZHENG Yuxiang, Associate Prof., Ph.D., Optical properties in condensed matter

朱鹤元 副教授，博士，超短光脉冲和超快现象
ZHU Heyuan, Associate Prof., Ph.D., Ultra-short optical pulse, Ultra-fast phenomena

庄 军 副教授，博士，原子分子物理，理论物理
ZHUANG Jun, Associate Prof., Ph.D., (theoretical) Atomic and molecular physics

戴祝萍 工程师 DAI Zhuping, Engineer

胡谊梅 工程师 HU Yimei, Engineer

钱红声 实验师 QIAN Hongsheng, Engineer

吴善亮 实验师 WU Shanliang, Engineer

徐新民 技 师 XU Xinmin, Technician

张敏毅 工程师 ZHANG Minyi, Engineer

杨月梅 YANG Yuemei

返聘人员:

陈凌冰 教授，激光物理和激光光谱，重点在室温微粒烧孔
CHEN Linbin, Prof., Laser physics and laser spectroscopy, especially in spectral hole burning based on morphology-dependent resonance in micro-particles

李郁芬 教授，团簇物理、激光光谱
LI Yufen, Prof., Cluster physics, Laser spectroscopy

伍长征 教授，激光物理、激光材料改性
WU Changzheng, Prof., Laser physics, Laser assisted material modification

赵有源 教授，高分辨率激光光谱与固体光谱烧孔研究
ZHAO YouYuan, Prof., Laser spectroscopy and spectral hole burning in solids

郑家骠 教授，表面、界面的非线性光学性质
ZHENG Jiabiao, Prof., Optical nonlinear properties of surfaces and interfaces

李富铭 教授，激光物理、激光光谱和超快光学
LI Fuming, Prof., Laser physics, Laser spectroscopy, Ultra-fast optics

邢中菁 实验师
XING Zhongjing, Engineer

王国益 副教授, 激光光谱
WANG Guoyi, Associate Prof., Laser Spectroscopy

博士后: **Postdoctoral fellows**

文双春(WEN Shuangchun), 吴翔(WU Xiang)

博士生: **Ph.D. candidates**

02级 李毅刚(LI Yigang), 刘秀(LIU Xiu), 韩涛(HAN Tao),
缪健(MIAO Jian), 周鹏(ZHOU Peng), 傅喜泉(FU Xiquan),
沈宏(SHEN Hong), 苏文华(SU Wenhua), 戴海涛(DAI Haitao)

03级 盛明裕(SHENG Mingyu), 张豫(ZHANG Yu), 张浩(ZHANG Hao)
张艳武(ZHANG Yanwu), 袁鹏(YUAN Peng), 罗航(LUO Hang)
任久春(REN Jiuchun), 王昕(WANG Xin)

04级 邬云华(WU Yunhua), 何子安(HE Zian), 谢国强(XIE Guoqiang),
宋清海(SONG Qinghai), 糜岚(MI Lan), 蒋丹(JIANG Dan),
魏小红(WEI Xiaohong), 谢逸群(XIE Yiqun), 刘伟(LIU Wei),
尚磊(SHANG Lei), 王科(WANG Ke), 杨佩(YANG Pei)

硕士生: **M.S. students**

02级 李丽(LI Li), 李维卿(LI Weiqing), 沈小康(SHEN Xiaokang),
邱恒山(QIU Hengshan), 邵和助(SHAO Hezhu), 漆乐俊(QI Lejun),
武爱民(WU Aimin), 叶小炜(YE Xiaowei), 刘俊峰(LIU Junfeng),
李冬晓(LI Dongxiao), 邱建红(QIU Jianhong), 孙志华(SUN Zhihua)

03级 汤恒晟(TANG Hengcheng), 宫兆松(GONG Zhaosong), 孙斌(SUN Bin),
徐琮辉(XU Conghui), 孔宇菲(KONG Yufei), 陈岳瑞(CHEN Yuerui),
姬利永(JI Liyong), 任杨(REN Yang), 肖淑敏(XIAO Shumin),
董占斌(DONG Zhanbin), 范文彬(FAN Wenbin), 王闯(WANG Chuang),
何兵(HE Bing), 徐鹏(XU Peng), 王锋(WANG Feng), 高静(GAO Jing)

04级 周信传(ZHOU Xinchuan), 魏慎金(WEI Shenjin), 孙海彤(SUN Haitong),
冯守志(FENG Shouzhi), 肖金华(XIAO Jinhua), 张璋(ZHANG Zhang),
贾李琛(JIA Lichen), 沈轶群(SHEN Yiqun), 张鹏(ZHANG Peng),
张贻松(ZHANG Yisong), 姜书同(JIANG Shutong), 顾闻(GU Wen),
谢志强(XIE Zhiqiang), 蒋建兴(JIANG Jianxing), 殷刚(YIN Gang),
张成先(ZHANG Chengxian), 张廷卫(ZHANG Tingwei),
胡魏(HU Wei), 陆舟军(LU Zhoujun)

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. 车晓东, 男, 出生年月 1965.12, 博士, 高级技术主管, Hitachi Global Storage Technologies Eastern Michigan University USA
(2004.6-2006.6) 给学生和教师开设培训课程, 详细介绍磁性存储的原理及处理技术。5万
2. Cheung Nai Ho, 男, 出生年月 1951.9, 教授, Hong kong Baptist Univ.
(2004.6-2006.6) “单量子点光谱分析”和“脉冲激光沉膜研究”。5万
3. Tatsuo Okada, 男, 出生年月 1952.1, 教授, 日本九州大学
(2004.6-2006.6) “等离子体辅助脉冲激光烧蚀法合成ZnO纳米棒”。5万
4. 陆斌, 男, 出生年月 1967.9, 技术主管经理, Seagate Technology
(2004.10-2006.10)课题组交流合作, 给学生和教师开设培训课程
5. Jeong Weon Wu, 男, 出生年月 1957.7, 教授, 韩国梨花女子大学
(2004.10-2006.10) “非线性光学材料的研究”。5万

二. 部分来室访问及作报告的学者

- 2004.2.24 Prof. Bong Hyon Boo, Department of Chemistry Chungnam National U. Korea
报告: “Spectroscopic and Ab initio studies of some molecules and thin films grown by pulsed laser deposition”
- 2004.4.6 胡仁宇院士, 中国工程物理研究院高级科学顾问、“863 “第8领域专家, 在804主题办主任方勤学研究员的陪同下来检查” 863 “工作, 并参观实验室。
- 2004.4.11 Dr.车晓东, Hitachi Global Storage Technologies USA
系列报告: 1. “Introduction to data storage technology”
2004.4.14 2. “Inside hard drive-media, head & characterization (Part I)”
2004.4.15 3. “Inside hard drive-media, head & characterization (Part II)”
4. “Push the envelop of physical limitation-the future of the data storage technology”
- 2004.4.19 Dr.Hua-Ching Tong, 原美国Read Rite 磁记录公司经理
系列报告: 1. “Thin film technology and the magnetic thin films”
2004.4.21 2. “The magnetic recording disks”
2004.4.22 3. “The antiferromagnetic and synthetic antiferromagnetic films”
2004.4.26 4. “The magnetic recording heads”
2004.5.8 5. “The emerging data storage technology”
- 2004.5.11 Prof. Richard K Chang ,Yale University USA , 来室访问。
报告: “Bio-aerosol edtection and osc.-amp. with micro-resonators”
- 2004.5.14 Dr. Mario Affatigato Coe College USA
报告: “Studies of oxide glass structure using laser ionization time of flight mass spectrometry”
- 2004.5.25 Dr. Mario Affatigato Coe College USA
报告: “Brief introduction to glassy state”
- 2004.6.3 Dr. Karel Kolacek, Group head of ITP 捷克等离子体物理所
报告: “Research on capillary discharge X-ray laser in ITP”
- 2004.7.9 Dr. Sining Mao, Director, 美国希捷工业公司
报告: “Magnetoelectronics to spin electronics: Applications in magnetic data storage industry”

- 2004.9.9 蒋仕彬博士, Optics Science Center, University of Arizona, CTO of NP Photonics Co. USA
报告: “Single frequency narrow linewidth fiber laser and their applications”
- 2004.10.25 陆斌博士, Seagate Technology(Pittsbough Research Center)USA
系列报告: 1. “Data storage overview”
- 2004.10.26 2. “Perpendicular magnetic recording”
3. “Heat assisted magnetic recording”
- 2004.10.28 4. “Materials sciences in magnetic recording media”
- 2004.11.5 程亚博士, 日本理化学研究所 RIKEN
报告: “3-D Integration of micro-optics and micro-fluidics in photo sensitive glass using fs laser”
- 2004.11.9 潘永乐博士, Yale University USA
报告: “光学在空气微层的探测、区分、分离和确定中的应用”
- 2004.11.16 Dr. Kai Shum Senior design engineer at Triquint Semiconductor USA
报告: “Recent development of 10Gb/s electro-absorption modulated lasers”
- 2004.12.13 童利民副教授, 浙江大学现代光学仪器国家重点实验室
报告: “氧化硅纳米光纤的制备及特性”

附录：发表文章首页
First Page of Selected Publications

