# 复 旦 大 学

# 光科学与工程系

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

# 2000年报

**Annual Report**

# 目录(Contents)




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# 简　介

复旦大学激光物理和光学研究室是全国最早建立的光学专业之一。本学科点前身是于1954年成立的、以周同庆教授（我国著名光谱学家，中科院学部委员）为主任的光学教研室。教研室于1964年研制出He-Ne等多种气体激光器后，积极开展各类激光器和相关元器件、激光技术和应用及光物理等研究工作，研究队伍迅速扩大。1978年成立以章志鸣教授为主任的激光物理和光学研究室，1981年批准成为光学硕士点。

1984年被批准为光学博士点，1988年批准为国家级重点学科，同年建立三束材料改性国家重点联合实验室复旦分部。在1988年的光学学科点评估和1993年的博士点评估中，本学科排列全国高校光学专业的第一，并于1990年荣获国家科委和教委共同颁发的“全国高等学校科学研究先进集体”称号。1996年被确立为“211工程”重点建设学科。2000年9月该学科点大部与陈良尧教授研究组合并，成立光科学与工程系。

本系现有科研人员31人（具有博士学位20人），其中教授12名（含院士2名），副教授14名，国家杰出青年科学基金获得者2名（1名为教育部长江特聘教授）和年轻优秀专家多名，一些优秀年轻教授已成为本学科未来发展的主要学术骨干和带头人。

本学科（本系）以从事基础研究为主，同时开展应用课题和器件的研究。1986年以来获国家发明奖1项、国家教委（现国家教育部）科技进步奖10项、上海市科技进步奖6项。其中本年度获上海市科技进步三等奖1项、国家专利1项。获全国优秀博士论文1项。2000年承担国家自然科学基金委项目19项，其中重点3项。承担攀登计划2项，863项目2项，国家教育部基金9项（其中跨世纪优秀人才计划和优秀年轻教师基金各1项），上海市科委基金12项（其中重大和重点各1项）、上海市教委基金2项。2000年各类基金总到款288万元。

目前共承担项目47项，有国家自然科学基金项目18项（含重点2项），攀登计划2项、863项目1项、973项目1项等国家项目以及省部委项目15项。其中包括国家杰出青年基金1项。

本学科设备先进，拥有飞秒、皮秒、纳秒、高分辨率等大型激光器，多套成膜设备及各种光学、电子学测量仪器，总投资超过两千万元。

本系新专业“光信息科学与技术”已获国家教育部批准，将于2001年在全国招收本科生。光学楼已获得兴业证券公司的捐赠和校方的支持，将于2001年夏季进行大修，2001年9月我们将以崭新的光学楼迎接新生的到来。

目前主要研究方向有：1．超短脉冲激光与物质相互作用及超快光物理；2．光子学物理基础和器件；3．固态物质的光学和光谱性质；4．光电子功能材料和电荷转移过程；5．光生物学和激光医学。（详见课题进展）

# 我室聘请的名誉教授和顾问教授
## Honorary and advisory professors of the Lab

N.Bloembergen　美国哈佛大学教授，诺贝尔物理学奖获得者
Prof. N.Bloembergen, Harvard University, U.S.A.

沈元壤　美国加州大学伯克利分校教授
Prof. Y.R.Shen, U.C.Berkerley, U.S.A

张国龑　美国耶鲁大学教授
Prof. R.K.Chang, Yale University, U.S.A.

厉鼎毅　美国AT&T 公司及Bell实验室教授
Prof. T.Y.Li, AT&T Bell Lab, U.S.A

唐孝威　中科院北京高能所研究员，中科院院士
Prof. Xiaowei Tang, Academician, Insititute of High Energy Physics, Chinese Academy of Sciences

徐至展　中科院上海光机所研究员，中科院院士
Prof. Zhizhan Xu, Academician, Shanghai Institute of Optics & Fine Mechanics, Chinese Academy of Sciences

杨国桢　中科院北京物理所研究员, 中科院院士
Prof. Guozhen Yang, Academician, Insitute of Physics, Chinese Academy of Sciences

侯洵　　中科院西安光机所研究员，中科院院士
Prof. Xun Hou, Academician, Xian Institute of Optics & Fine Mechanics, Chinese Academy of Sciences

干福熹　中科院上海光机所研究员/复旦大学教授，中科院院士
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Prof. Dianyuan Fan, Academician, Shanghai Institute of Optics & Fine Mechanics, Chinese Academy of Sciences

钟业华　美国西北大学材料系教授
Prof.Yip-Wah Chung, North-West University, U.S.A

# 课 题 进 展
# Progress in Research Projects

# 功能薄膜材料的光物理特性研究
# Studies on Optic-physical Properities of Functional Film Materials

(一) 电荷转移有机复合材料的光电特性研究 Study on optical and electric properties of complex material with charge transfer

(1)利用物理喷束淀积技术（PJD）与旋转涂敷法相结合，制备了以下四类纯膜和复合膜：金属富勒烯盐; 金属酞青；$C_{60}$/PPV分层和混合膜；金属酞青/PPV分层膜。

Four kinds of functional films were made by the means of Phyical Jet Deposition (PJD) and spin coating, which were Metal Fullerene, Metal Phthalo-cyanine, $C_{60}$/PPV multilayers or mixed layers and Metal Phthalocyanine/PPV multilayers.

(2)研究了上述四种电荷转移体系的正反向电流特性和光生伏打效应，用界面偶极层模型研究了金属-有机物及有机材料之间界面的能级结构，解释了界面整流效应和光生伏打效应的增强。

Physical Jet Deposition (PJD) method was used to form the $C_{60}$Ni films, one of the metal doped[60]fullerenes films, which were made into the Al/$C_{60}$Ni/ITO (indium/tin-oxide) layered structure photovoltaic cells. The photovoltaic effect and the current-voltage characteristic in dark with the devices were taken. Compared with the Al/$C_{60}$/ITO layer structure devices, the enhancement of photovoltage and rectification rate of $C_{60}$Ni devices was found. Possible reasons were discussed.

(3)研究了$C_{60}$掺杂的PPV电荷转移体系的光谱特性，包括可见-紫外吸收谱。稳态荧光谱，瞬态荧光谱，观察到PPV吸收峰明显的抑止和PPV荧光峰的淬灭。测量了混合体系的荧光寿命。与实验相关的电荷转移的机制正在研究中。

we study the optical properties of the charge transfer system in poly[2-methoxy-5-(2'-ethyl-hexyloxy)-1,4-phenylene vinylene](MEH-PPV), which was doped by $C_{60}$ with different consistence, by means of ultraviolet-visual absorption spectroscopy, steady-state photoluminescence (PL) and time-resolved photoluminescence (TRPL). We observed the restraining effect of absorption peak and PL quenching of fluorescence, which is regarded as the formation of complex compound in the mixed conjugated polymer. The formation is the result of the strong interaction of $\pi$-$\pi$ conjugated system in the base state in the films, which associated with the direct MEH-PPV to $C_{60}$ charge transfer. In the excited state, the excited charge transfer advanced the restraint of luminant transiton process, which strengthen the PL quenching of MEH-PPV.

(4)已发表论文二篇，待发表论文二篇。

(二) 非对称II-VI族耦合多量子阱的光学非线性研究 Second Nonlinear Optical Properties of ZnCdSe/ZnSe Quantum Wells

(1)用反射光学二次谐波产生研究了$Zn_{1-x}Cd_xSe$/ZnSe非对称耦合多量子阱的界面效应，证明多量子阱材料随着阱间耦合的增强，描写不对称量子阱间电荷转移的电子波函数交叠变大，二阶非线性系数$\chi^{(2)}$增大。同时发现随着Cd含量的增大$Zn_{1-x}Cd_xSe$势阱禁带宽度变小$\chi^{(2)}$变小。

SHG intensity in strained $Zn_{1-x}Cd_xSe/ZnSe$ asymmetric coupled quantum wells is at least one order of magnitude larger than that form bulk ZnSe due to the centrosymmetry-breaking effect resulting from the strong interwell coupling interaction. It is also strongly dependent on the QW parameters. SHG intensity was found to increase with decreasing barrier width or cadmium concentration x (barrier height, well depth). Furthermore, an obvious in-plane anisotropy was observed with a period of 180$^o$ in our measured ratios of p in to p out and s in to p out SHG intensities. The s out SHG intensity versus the incident polarization angle displayed a periodic feature, $I_s(\alpha_p) \propto \left|Sin(2\alpha_p)\right|^2$ [2],while the p out SHG intensity varies in a relatively complex way, which agreed well with the theoretical calculations.
(2)待发表论文三篇。

(三) 有机功能材料超薄膜的荧光光谱及非线性特性研究 Nonlinear optical investigation of the organic thin films (LB)

（1）我们用微扰方法研究了有机分子膜中淀积过程诱导的平面内分子定向排列（各向异性）特性，从理论上推导了二次谐波强度与基频光、倍频光的偏振方向，及基板上拉膜方向的关系，与实验符合良好。[Applied Optics, 39(21), 2000: 3781-3784]

Dipping-induced in-plane anisotropy in organic molecular films was characterized by using second harmonic generation (SHG) measurement and analyzed by using a new perturbation method. We derived theoretical formulas for the dependence of SHG intensity on the polarizations of incident fundamental beam, output second harmonic beam and the azimuthal angle of samples, which agreed well with our experimental measurements.

(2)利用稳态和时间分辨荧光及吸收方法研究了不同供-受电子基团半花菁分子在LB多层膜中的H-聚集体性质。我们发现聚集程度主要取决于供电子基团的结构。较大的供电子基团或花生酸的混入可导致较低的聚集度。时间分辨荧光被证明是定量表征有机分子聚集体寿命、大小与组份的有力工具。[Submitted to J phys. Chem. Solid, Sep. 2000]。

Influence of molecular composition in hemicyanine Langmuir-Blodgett (LB) films on the aggregation features was investigated by using steady state and time-resolved photoluminescence spectroscopies. It was found that a lower degree of H-aggregation (smaller aggregate size) could be realized in hemicyanine LB films with larger donor groups, leading to a smaller photoluminescence peak blue shift with respect to their solution spectra and longer aggregate lifetime.

(3) 利用二次谐波产生技术首次研究了氧化铟锡薄膜的非线性光学特性。氧化铟锡薄膜中多晶晶粒的优先取向，使其产生了非常强的二次谐波信号，并且在一定的薄膜厚度以上，随薄膜厚度的增加二次谐波信号显著增强。由于多晶晶粒的优先取向使得薄膜基板平面内存在着非常明显的非线性光学各向异性。

Second harmonic generation (SHG) from indium tin oxide (ITO) films on glass substrates has been investigated in detail for the first time. Significant SHG intensity and nonlinear optical anisotropy was observed from ITO films due to orientation of

the crystal cells. The SHG reached a maximum in intensity at an incident angle of 60° . The effective second order nonlinear optical susceptibility $\chi^{(2)}_{eff}$ was about $2.4\times10^{-10}$esu.

(4) 利用吸收谱和二次谐波产生（SHG）技术研究了温度对半花菁Langmuir-Blodgett（LB）多层膜的膜结构和非线性光学特性的影响。LB膜的二次谐波强度随温度的变化开始随温度的增加而增加，最大值约在45℃左右，然后随温度的增加而减小。在半花菁与花生酸或花生酸铬交替的LB多层膜中，由于花生酸的融化，导致膜结构的变化，使得二次谐波强度随温度变化的有一个突变点。线性吸收谱表明半花菁分子在LB多层膜中形成了H-聚集体，并且加热可以使聚集体分解。

Molecular structure and optical nonlinearity in interleaving hemicyanine/arachidic acid or cadmium arachidate multilayers, and Z-type pure hemicyanine multilayers were investigated as a function of the temperature by means of second harmonic generation (SHG) and linear absorption. The SHG intensity shows a maximum at about 45 °C in the multilayers. An inflection was observed in the temperature dependence of SHG intensity in the interleaving hemicyanine/arachidic acid and hemicyanine/cadmium arachidate multilayers, and was attributed to melting of arachidic acid or cadmium arachidate. The absorption spectra show that the molecules in the multilayers formed H-aggregates which could be dissociated by heating.

(5) 利用时间分辨荧光和三维荧光谱对LB多层膜中半花菁分子的聚集行为和激发态特性进行了研究。在半花菁/花生酸交替的Y型多层膜中，半花菁分子形成的H-聚集体引起其三维荧光谱蓝移，并且荧光峰随时间的变化逐渐向红光方向移动。由时间分辨荧光得到LB膜中的聚集体平均约包含9个半花菁分子，并且由于聚集体内所有分子间的相互作用（耦合）相干叠加，使得LB膜的荧光衰减较快。

The properties of aggregates and excited state were investigated by using time-resolved fluorescence and 3D fluorescence spectra techniques in Langmuir-Blodgett multilayer films. As interaction of hemicyanine molecules caused formation of H-aggregates and a blue shift of the 3D fluorescence spectra in interleaving hemicyanine/arachidic acid multilayers. The peak of fluorescence was a red shift along with the time decay. The size of aggregate can be obtained by time-resolved fluorescence. It is about 9 hemicyanine molecules. The lifetime of the LB fluorescence is much shorter than that of the hemicyanine solution due to the stronger intermolecule interactions in the aggregates.

(6)已发表论文5篇

# 飞秒时域的非线性光学研究
# Investigation on nonlinear optics in femtosecond time scale

一、 探索新的色散物理机制，创造产生全维数时空光孤子的实验室环境

1. 物理上发现了非线性过程感应群速度色散的机制

以往群速度色散的机制均是线性的，如材料本征色散、模式色散及角色散等。我们基于对飞秒光脉冲经非线性传输的深入研究及物理图像上的全新认识，发现了非线性过程也能感应群速度色散的物理现象，并建立了其物理图象。该新颖的色散机制来源于$\chi^{(2)}$: $\chi^{(1)}$级联非线性过程。本项工作不但拓展了对群速度色散这一基本光学问题的物理认识，而且具有重要的科学价值。

2. 创造产生全维数时空光孤子的实验环境

基于我们对非线性感应群速度色散的物理发现，创造了利用现有材料科学及飞秒光学技术能实现的条件来产生全维数的光孤子（光子弹）的实验室环境。“光子弹”的实验产生是光学孤子物理研究的最终目标之一，其学术意义重大。

二、其它非线性光学方面的研究结果

1. 非线性谐波转换过程中光束质量的传输变换规律

线性被动光学系统不会改善光束质量M2因子，受非线性过程处理手段的限制，很难有效地讨论非线性光学系统中M2因子的传输变换规律。基于调制微扰理论，我们成功地掌握了倍频或三倍频过程对M2因子的影响规律。在谐波转换过程中，M2因子光束质量将变差，然而光束的发散角基本保持不变。

2. 准位相匹配（QPM）结构晶体（PPLN）在改善光束质量M2因子上的应用

应用时空等价的物理图像进行类比，我们发现特殊设计的PPLN晶体可以构建可控的空间相移，从而能够有效地补偿激光的各类位相畸变，产生近衍射极限的输出激光束。该项工作有望在产生衍射极限的高功率短波长半导体激光方面发挥作用，同时能够保证整个器件的集成化。

1. Nonlinearly induced group-velocity dispersion (GVD)

GVD is an important issue related with femtosecond optics, which was generally recognized as a linear behavior. Based on the deeply investigation on nonlinear propagation of femtosecond lasers, we found that nonlinear frequency conversion can also induce GVD. The novel scheme of this nonlinear induced GVD is a cascade process of $\chi^{(2)}(2\omega:\omega,\omega) : \chi^{(1)}(\omega)$ or $\chi^{(2)}(\omega:2\omega,-\omega) : \chi^{(1)}(2\omega)$.

2. A feasible laboratory environment to generate 4D optical solitons.

The generation of 4D optical solitons or bullets is one of the most important directions in soliton physics, and is of great scientific significance. Benefited from the novel GVD induced in frequency conversion, we reached a state to approach the generation of 4D optical solitons experimentally. The required laboratory conditions are experimentally feasible with the advance of material science and femtosecond optics.

3. Analysis of beam-quality degradation in nonlinear frequency conversion

Based on the transfer of electric-field amplitude and phase ripple in frequency

tripling, simple formulas are derived for the harmonic laser beam-quality factor, M23w , with an arbitrary fundamental beam incident to ideal nonlinear crystals . Harmonic beam-quality is generally degraded, while the beam divergence is similar to that of the fundamental after a nonlinear frequency-conversion process, For practical crystals with periodic surface ripples due to their machining , a multi-order diffractive model is presented to study the focusing properties of harmonic beam. Predictions of the theories are shown to be in excellent agreement with full numerical simulation of tripling.

4. Beam-quality improved efficient second-harmonic generation in aperiodic quasi-phase-matching gratings

We propose a simple means for improving optical beam quality with second-harmonic generation. By creating spatial walk-off in aperiodic quasi-phase-matching gratings, we show that the harmonic beam experiences a spatial phase shift that can be engineered to correct for arbitrary phase distortions. Diffraction-limited beam quality can be realized without scarifying the conversion efficiency.

# 低维磁结构的磁性和非线性光学响应
# Magnetic properties and nonlinear optical response in low-dimension magnetic structures

① 磁性薄膜的光学二次谐波测量 Measurements of optical second harmonic generation (SHG) on magnetic thin films

本年度完成了大气中磁诱导二次谐波(MSHG)的搭建和测量工作，从而为超高真空系统到来后的在位测量做好了前期准备。探测到单层不同厚度的磁性薄膜Co在p 和s偏振入射时的MSHG信号，发现p偏振时磁信号较s偏振时大一个数量级，且得到其非线性磁光克尔旋转角达2.5度，较其线性磁光克尔旋转角大很多。当Co薄膜厚度从4 nm变成100 nm时，MSHG信号变号，反映了界面和表面共同作用的结果（100 nm时差不多全是表面的贡献）。在4 nm的Co膜上覆以很薄的非磁性Cu膜也同样会使信号反号，此时Co的表面变成了界面。

We finished the construction of magnetization-induced SHG (MSHG) setup and some measurements in the air, being ready for the in-situ measurements on the soon coming MBE system. The MSHG hysteresis curves were detected for the single Co films grown by sputtering with different thickness, in p- and s-polarized input light. It was found that the signal for p-input was one magnitude larger than that for s-input and its nonlinear Kerr rotation was 2.5 degrees, much larger that the linear one. The magnetic second harmonic intensity changed its sign when the thickness of Co film went thicker to 100 nm where only surface part contributed to the signal. The same behavior happened if covered with a 1 nm Cu film on the top of a 4 nm-thick Co film. It is not difficult to be understood if we recall that the MSHG signal results combinedly from both surface and interfaces.

② 平面掺杂磁性多层膜的巨磁电阻 Planar doping effect on GMR in magnetic multilayers

利用$SiO_2$-Ni颗粒膜的界面掺杂（0.3 nm厚），使Co/$SiO_2$-Ni/Cu/Co的巨磁电阻行为发生了较大的变化，磁电阻变化为3.2%，开关场只有± 10 Oe和± 60 Oe，同时其峰值宽度达到了30 Oe，较Co/$Cu_{92}Mn_8$/Co又有较大改善。我们认为$SiO_2$-Ni的加入首先使层间耦合较大的降低，显示出隧道结的作用。同时此夹层的加入使界面得到改变，从而使得开关机制得到很好的体现。

A very large change of GMR behavior was found in Co/$SiO_2$-Ni/Cu/Co sandwiches by inserting a very thin granular $SiO_2$-Ni film (0.3 nm thick). Its GMR ratio was 3.2% and the switching fields were ± 10 Oe, ± 60 Oe, with the width of the peak about30 Oe, which was largerly modified comparing to the Co/ $Cu_{92}Mn_8$/Co case. We think the adding of insulating $SiO_2$-Ni thin layer deduces the interlayer coupling between two Co films and meanwhile modified the interface, thus revealing the switching mechanism.

③ 磁动力学研究 Study of magnetic dynamics.

采用钛宝石飞秒激光作用产生的磁诱导光学二次谐波，搭建了磁性动力学的泵浦-探测装置，并作了初步的测量。

A pump-probed MSHG setup was finished for the study of the magnetic ultrafast

phenomena by using the Ti-sapphire laser (Regenerated amplifier). A preliminary measurements were taken.

本年度发表2篇EI论文，接受国内刊物（海外版）1篇和SCI论文2篇。会议报告有第四届国际薄膜物理和应用会议上的口头报告（2篇）、在巴西举行的国际磁学会议上的张贴报告、第二届亚太激光讨论会的口头报告和全国磁性薄膜和纳米磁学会议报告2篇。获教育部优秀年轻教师基金、教育部科学技术重点基金和973项目分课题各1项，并获2001年启动的国家杰出青年基金。

Three papers were published and two were accepted. The presentations in conferences are: 4th International Conference on Thin Film Physics and Applications, International Conference on Magnetism, 2nd Asian Pacific Laser Symposium, and 2nd National Conference of Thin Films and Nano-magnetism.

New grants: Excellent Young Teacher Foundation and Key Foundation for Science & Technology of State Education Ministry, 973 project (part), and Outstanding Young Scientist Foundation (from 2001).

# 团簇光物理
# Photophysics of fullerenes and silica clusters

一、富勒烯金属化合物的激光烧蚀飞行时间质谱研究：金属富勒烯的形成 Laser ablation of metal fullerides: Formation of metallofullerenes

富勒烯的金属掺杂可能形成具有不同构型及性质的金属富勒烯，因而引起人们兴趣。我们利用 308nm 准分子激光烧蚀多种化学合成的富勒烯金属化合物 $C_{60}M_x$ (M=Sm, Pt,Ni,Rh,La,Y)， 飞行时间质谱研究发现这些衍生物的光诱导转化过程随金属的不同而异。激光烧蚀$C_{60}Sm_x$, $C_{60}Pt_x$, $C_{60}Ni_x$主要形成以$C_{59}M$为主的杂笼金属富勒烯（heterofullerenes），原在笼外的金属原子取代 $C_{60}$笼上的碳原子形成取代型金属富勒烯。$C_{60}La_x$, $C_{60}Y_x$在激光烧蚀下只形成由偶数碳原子组成的$C_{2n}La$ 及$C_{2n}Y$系列。与$(C_{60}+O_3)/La_2O_3$或$Y_2O_3$ 压片样品烧蚀结果的比较表明La、Y可能进入笼内形成内嵌金属富勒烯$La@C_{2n}$, $Y@C_{2n}$ 。$C_{60}Rh_x$的烧蚀质譜则更丰富，包括$C_{2n}Rh$及$C_{2n+1}Rh$ 两个系列，其结构在研究中。此项研究表明激光烧蚀可使金属原子从笼外转到网架上取代碳原子或嵌入笼内，提供了一种制备各种金属富勒烯的方法。

Doping of fullerenes is an interesting topic in fullerene research because it can form various types of metallofullerenes with different properties. A variety of chemically synthesized metal fullerides $C_{60}M_x$(M=Sm,Pt,Ni,Rh,La,Y) have been studied by 308nm laser ablation. Mass spectrometric measurement indicates that the laser-induced transformation process depends on the metal doped. In the laser ablation of $C_{60}Sm_x$, $C_{60}Pt_x$, and $C_{60}Ni_x$, substitutional heterofullerenes, mainly $C_{59}M$, with M substituting one of the carbon atoms of the cage, are formed. Laser ablation of $C_{60}La_x$ and $C_{60}Y_x$ yields only metallofullerenes composed of even-number of carbon atoms. A comparison with the laser ablation results from composite samples of ozonized $C_{60}$ and $La_2O_3$ or $Y_2O_3$ indicates that La or Y may be inserted into the cage forming endohedral metallofullerene $La@C_{60}$ or $Y@C_{60}$. The mass spectra of $C_{60}Rh_x$ are more interesting, two sequences $C_{2n}Rh$ and $C_{2n+1}Rh$ appear, the structures of which are under investigation. Our research illustrates that laser ablation can transform the metal atoms from exohedral sites to network substitutional or endohedral sites, providing a method for the preparation of various metallo-fullerenes.

二、奇数碳笼团簇的实验和理论研究 The experimental and theoretical investigation of odd-numbered “fullerene” clusters

继在多种富勒烯衍生物的激光烧蚀研究中发现对奇数碳笼团簇形成的增强作用后，我们又在对掺$C_{60}$气凝胶的研究中发现形成特别强的奇数碳笼团簇$C_{55}$。更值得注意的是：在对富勒烯金属化合物$C_{60}M_x$的烧蚀研究中，都观察到在负离子通道中奇数碳笼团簇的形成。我们用遗传算法计算奇数碳笼团簇的结构，发现其最低能量异构体具有带一个两配位碳原子的准笼形结构。此两配位碳原子在激光作用下比较容易断键形成窗口。联系奇数碳笼团簇中间产物的形成，我们用“窗口”模型讨论了取代型和内嵌型金属富勒烯的形成机理。

Following the observation of the enhancement of odd-numbered “fullerene” cluster formation from the laser ablation of many fullerene derivatives, we have found the appearance of ultra intense $C_{55}$ from a sample of $C_{60}$-doped silica aerogel. Of particular worthnoting is the observation of the odd-numbered “fullerenes” from the laser ablation of metal fullerides in the negative ion channel. We have calculated the structures of the odd-numbered “fullerenes” and found that the lowest energy isomers have pseudo-cage structures with a two-fold coordinated carbon atom in each cage. Due to the easier opening of the pseudo-cage we discuss the formation of the substitutional and endohedral metallofullerenes through the odd-numbered “fullerene” intermediate by means of the “window” mechanism.

三、紫外激光烧蚀多孔二氧化硅材料的研究：二氧化硅幻数团簇的形成及结构计算 UV laser ablation of porous silica materials: Formation of magic number silicon dioxide clusters and the structure calculation

对大量多孔二氧化硅材料的激光烧蚀研究都观测到丰富的二氧化硅团簇系列。我们在对掺 Rhodamine 6G 的二氧化硅气凝胶的实验中首次观察到幻数团簇 $[(SiO_2)_nO_2H_3]^-$,n=4,8. 用 Gaussian 94 计算中性团簇 $(SiO_2)_4O_2H_4$ 及负离子 $[(SiO_2)_4O_2H_3]^-$的结构，给出两者的最低能量结构均为三维笼形，对称性分别为 $S_4$ 和 $C_3$。幻数团簇的研究对于新材料的发现有所启示。

From the laser ablation of a majority of porous silica materials, abundant silica cluster sequences have been observed. We studied the formation of magic number silicon dioxide clusters $[(SiO_2)_nO_2H_3]^-$ with n=4,8 for the first time. Theoretical calculation with Gaussian 98 shows that the neutral cluster $(SiO_2)_4O_2H_4$ and the anionic cluster $[(SiO_2)_4O_2H_3]^-$ take the 3-dimensional cage structures with symmetries $S_4$ and $C_3$ respectively. The study of magic number clusters might shed light on the discovery of new materials.

四、富勒烯团簇的光限幅特性研究：固体光限幅材料的制备 Optical limiting properties of fullerene derivatives: Fabrication of fullerene derivative doped glass

寻找具有良好光限幅性能及溶解性能的富勒衍生物并将掺杂于玻璃中，制固体光限幅材料是激光防护研究中的一个重要课题。我们测试分析了系列富勒烯衍生物，发现 $C_{60}C_9H_7$–$C_9H_7$ 具有良好的光限幅性能，并且溶于极性溶剂。基于此，我们利用溶胶-凝胶方法成功地将其掺入固体玻璃中，得到了具有良好光学性能的均匀材料，初步测试表明该掺杂玻璃是制备光限幅器件的良好材料。

Our investigation of optical limiting properties of series fullerene derivatives shown that the Diels-Alder mono-adduct of $C_{60}$ with 1,1’-biidene is a promising candidate for the fabrication of practical optical limiting devices. This derivative not only posses good optical limiting properties in toluene as $C_{60}$, but show good solubility in polar solvents which is advantageous to the fabrication of the derivative-doped xerogel glass. Using sol-gel technique, the derivative molecules were successfully incorporated into glass. Solid sample with low scattering and obvious optical limiting properties has been obtained.

五．表面自扩散及富勒烯团簇结构的理论计算 Theoretical calculations of adatom diffusion and structures of fullerene clusters

1．用静态能量计算及分子动力学方法进一步系统地研究了EAM金属fcc(100)表

面的自扩散机制. 给出了关于金属fcc(100)表面自扩散机制的一般性规律；2. 进一步研究了吸附原子在 Pt(100)表面的自扩散机制. 对所观察到的以二聚物形式扩散的机制进行了详细的分析；3. 采用原子嵌入势,用分子动力学方法系统地研究了金属fcc(111)表面的自扩散机制. 结果表明在fcc(111)表面, 交换扩散的机制也有可能出现, 而且这种扩散过程只能在hcp吸附位之间发生；4. 用PRP( Pacheco and Ramalho potential)势描述(C60)n团簇, 采用遗传算法并结合数据库的共轭梯度方法系统地研究了C60)n团簇的最低能量结构. 考虑温度效应后, 我们所给出的结果与实验结果相吻合.

(1) Adatom diffusion mechanisms on metal fcc(100) surfaces is studied further by a systematic static calculation and molecular dynamics based on a series of embedded-atom method(EAM). A generic law about the diffusion mechanisms on metal fcc(100) is given. (2) The diffusion mechanisms on Pt(100) surface is studied further. An ad-dimer diffusion mechanism is observed and analyzed in details. (3) On a series of fcc(111) surfaces modeled by embedded-atom method (EAM), adatom diffusion mechanisms are studied systematically by molecular dynamics. The results show that the exchange mechanism is also possible besides the well-known hopping mechanism, and exchange diffusion process only occurs between the hcp sites. (4) The lowest energy structures of fullerene clusters (C60)n(n<57) described by the Pacheco and Ramalho potential(PRP) are systematically optimized by a global optimization procedure which combines the genetic algorithm and database conjugate gradient method. When the thermal effect is considered, our results are in good accordance with that in experiment.

# 玻璃基质光波导：材料、物理与器件
# Glass optical waveguides: materials, physics and devices

1. 玻璃基质光波导器件制备 Fabrication of glass optical waveguide devices

采用溶胶-凝胶技术制备了折射率和厚度符合要求的有机/无机复合低损耗波导，条形光波导损耗达0.5dB/cm。在此基础上，制备了1x4玻璃光波导分波合波器件，掌握了分叉波导制备的关键工艺及V形槽制备工艺，解决了波导与光纤之间耦合的关键技术。经测量该器件的插入损耗为8.7dB(其中附加损耗为2.7dB)，分束比偏差为7.5%。完成市科委项目原定的技术指标，通过了市科委组织的鉴定。

Low loss glass planar waveguide with aquired refractive index and thickness were fabricated by sol-gel technique. Ridge waveguides were made with transmission loss as low as 0.5 dB/cm. A 1x4 glass waveguide splitter was fabricated which was coupled to single mode fibers that were packaged on silicon V-grooves. The insertion loss of the device was 8.7 dB(6 dB of 1x4 splitting, 2.7 dB of additional loss).

2. 有机分子掺杂光波导二阶光学非线性研究 Second order optical nonlinearity of organic dye doped optical waveguides

和复旦大学材料系合作，研究了一种新合成的有机分子链接密胺聚合物薄膜的制备，进行了二阶光学非线性和热稳定性的研究。研究发现，和有机分子掺杂型聚合物相比，链接型聚合物的热稳定性进一步提高，该材料的玻璃化转变温度已超过200℃，160℃下可很好地保持二阶光学非线性的稳定性。

A new organic dye side-chain linked melamine formaldehyde resin was synthesized, thin films from this polymer was fabricated and its second order nonlinearity was studied. The glass transition temperature of the polymer thin film is over 200 degree C, second harmonic generation(SHG) intensity of the film was stable at temperature as high as 160 degree C.

3. 玻璃态材料的二阶光学非线性的产生机理研究 Mechanism of second order optical nonlinearity generation from glassy materials

受国家自然科学基金委资助，与美国依阿华州Coe College的S. Feller教授领导的玻璃研究组开展国际合作研究，取得以下结果：

(1)详细研究了$PbO/B_2O_3$玻璃中平板极化诱导产生的二阶光学非线性。发现该玻璃中的二阶光学非线性系数$c^{(2)}(z)$在整个体内都存在，并具有非均匀分布。(2)发现在$SiO_2$（熔石英）块状玻璃中，不同的极化方法（平板电极极化和电晕放电极化）对诱导产生的二阶光学非线性有显著的影响。这一发现可以解释从1991年以来国际上各个不同研究小组所发表的结果的差异。(3)提出在极化过的玻璃中存在“诱导偶极子”的理论模型，解释了文献中及我们自己测量到的实验结果：在$SiO_2$-$GeO_2$玻璃薄膜中光学二次谐波强度$I_{SHG}$与平板极化电压$V_p$之间具有超平方关系，$I_{SHG} \propto V_p^t$, $2<t<4$。

We cooperated with Prof. S.Feller'group from Coe College, USA to study on the second order nonlinearity of glasses, the main results are:

(1)SHG from plate poled $PbO/B_2O_3$ was studied. We found that the nonlinearity exists inside the whole glass plate with non-uniform distribution. (2) For fused quartz plate, we found that the induced nonlinearity greatly depends on the method of poling. Plate poling generates a thin depletion layer near the anode side, which results in an intense SHG from the layer, on the other hand, corona poling induces a bulk nonlinearity. (3) An "induced dipole" model was proposed to explain the over-quadratic relation between SHG intensity and poling field.

4．掺杂玻璃光波导荧光特性和光放大特性研究 Fluorescence and light amplication from dye doped glass wavguides

（1）对有机染料RhB掺杂的聚合物/二氧化硅光波导的光发射进行研究。实验发现，对楔型光波导薄膜。利用光波导的模式厚度截止条件，改变泵浦光在薄膜上的位置，即可改变输出的ASE的波长，在我们的实验中波长调谐的范围可达30nm。该方法可用于有机波导激光器的输出波长的控制。（2）采用溶胶-凝胶法制备不同比例的Er/Yb共掺的玻璃样品，制备得到块状玻璃样品，并测量得到其荧光峰。

(1) Light emission from dye(RhB) doped polymer/silica hybrid waveguides was studied. A wedge wavguide was fabricated, tunable amplified spontaneous emission was realized by optical pumping of the wedge waveguide with different thickness. The tuning range is 30 nm. (2) Er/Yb co-doping glass samples were made by sol-gel technique. Fluorescence at 1.55 μm region was observed.

2000年度本课题组完成国家自然科学基金项目2项，市科委重大项目1项，“跨世纪人才计划”和“曙光计划”各一项。2000年新申请到国家自然科学基金1项、国家教育部博士点项目1项，市科委项目1项，上海应用材料项目1项。在国内外正式刊物上发表文章8篇，其中3篇文章分别发表在Appl.Phys.Lett., Opt. Lett. 和Opt. Commun.国际刊物上，5篇文章发表在物理学报、光学学报和物理化学学报等国内刊物上。另外在有关国际会议报告（美国光学学会2000年会、第二届亚太激光会议和第四届薄膜物理与应用国际会议）5次（包括邀请报告1次）。

# 新型液晶光电信息功能材料与器件的研究
# Study for electrooptical material and device of novel liquid crystal

1. 新型液晶全息光开关 Novel optical switching of holographically liquid crystal

在独特配方的聚合物弥散液晶（PDLC）中记录的全息可电控开关。其开关速度快，衍射效率高，且价格低，结构轻巧便于集成与生产，有可能成为光通讯中具有广阔市场的产品。通过详细分析新型PDLC位相体全息Bragg光栅的形成机理，产生散射的原因等，提出了提高材料性能的方法，并建立了氩激光全息记录系统及衍射效率测量系统。即将进行PDLC材料配方优化的分析和研究工作。

The holographic grating formed in a novel polymer-dispersed liquid crystal (PDLC) can be switched with an applied electric field. It has advantages of fast response times, high diffraction efficiency, low cost and compact configuration, and will have the wide market in the optical communication. The mechanism of the holographically-formed PDLC and the reason of the scatting have been analyzed, and the methods of improving the material performance have been put forward. The optical holographic recording system and the measuring system of diffraction efficiency have been established. On the bases above, the study work of PDLC material optimization will be carry on.

2. 实验性2×2液晶光开关 Experimental 2×2 optical switching of liquid crystal

TN型液晶光开关是一种插入损耗低、对比度高、功耗低、价格便宜的光开关。通过对开关机理的分析，设计了开关结构，加工了液晶盒、偏振分光棱镜，制作了精密装调夹具。正采用光学检测及校准方法保证光束合并的精确性。同时将进一步研究用铁电液晶代替向列相液晶应用于光开关，以期获得更快的响应速度。

The optical switch used with nematic liquid crystal has the advantages of low cross loss, high contrast ratio, low voltage and low cost. The structure of switch has been designed through the analysis of switching mechanism. The LC box and polarized beam separation prism are fabricated. The clamp has been manufactured. The optical testing methods are being used to assure the accuracy of beams combine. Next step, the study to replace the nematic LC using ferroelectric LC will be progressed so as to get faster response times.

3. 立体显示 Stereo display

利用时序技术和液晶开关实现了立体显示。由于液晶开关用特殊方式驱动，它们比一般的TN液晶开关有更快的响应特性和更高的对比度，从而避免了左右图象的交叉串扰，在电视机屏和计算机显示屏上得到了很好的立体显示效果。

Using sequential technique and liquid crystal shutters we have realized the stereo display . The liquid crystal shutters are driven by special type, they have faster response properties and higher constracts than conventional TN liquid crystal devices. So the cross-talk between the left and right images are avoided. The good stereo effect is obtained on the screens of televisions and computer displays.

# 新一代超薄金刚石X光及红外窗口的研制

# Study on extra-thin diamond windows for IR and X-ray optics

1. 建立金刚石薄膜生长表面反射率原位检测系统，能实时研究金刚石生长质量及光学常数，精密控制金刚石薄膜生长速度和厚度。

Established an in-situ measurement system to determine the reflectivity from growing surface of diamond thin film. Using this system we could study the quality and optical properties of CVD diamond film. The growing rate and the thickness of the CVD diamond film could be accurately monitored and controlled.

2. 学术论文3篇，会议论文2篇。

Paper published 3, conferece presentations 2

3. 中国专利 China patent

中国国家专利：ZL 97125204.1 “金刚石红外增透滤光窗口及其制备方法”

China patent: “Diamond IR anti-reflective filter window and its fabrication method” 97125204.1

# 凝聚态光学性质的研究

# Studies on the optical properties of condensed matter materials

研究了由金属和非金属介质形成的颗粒膜形成的结构，具有可调节折射率的性质，在特定的波长区获得了折射率接近于1，甚至为零的低折射率材料，如Au:$SiO_2$ 和 Ni:$SiO_2$薄膜结构。

研究了贵金属银的磁光效应，准确测量到了完整的磁光克尔效应，包括其实部和虚部。这一部分来自在磁场下s电子回旋的贡献，另一部分来自Ag的带边4d电子跃迁的贡献。并对银基磁性材料的磁光性质进行了分析。

研究了银基低组份颗粒膜的红外光学性质，获得有效光学质量和散射时间等常数随组份有规律变化的特性。

完成了双重傅立叶变换方法的红外椭圆偏转光谱实验系统的研究，这是基于既对光子能量，又对偏振角作傅立叶变换的原理，用于若干金属材料的红外光学性质性质，获得了满意的结果。

研制完成了新型面阵凝视式CCD光谱成象仪，在极短时间内实现300-600nm光谱区的单色成象，正将光谱区拓宽到200－1000nm范围。获得实用新型专利一项。

研制完成了新型多光栅扫描单色仪，以一种简便的控制方式，实现了波长扫描，滤色片置换和更换光栅三种功能。获得实用新型专利一项。

研制完成了一台便携式低温和室温荧光光谱仪，可供实时测量。

圆满完成了上海科委项目“凝聚态光谱扎实信息技术中的应用”，给出研制报告，通过鉴定，获得好评。

以成立高科技企业的形式，与企业联合从事WDM滤色膜的研制和生产，项目成功起动，投入的资金约2000万元。

The structures of the metal–insulator granular films such as Au:$SiO_2$ and Ni:$SiO_2$ have been studied, and it has found that the refractive index of these materials can be adjusted, even reaches to one or zero at certain wavelengths range.

The magneto-optic and optical properties of evaporated and sputtered Ag were studied experimentally and theoretically. An apparent Kerr effect was measured at room temperature. It was found to originate from the small off-diagonal term of dielectric function tensor, induced by the free electron movement under an applied magnetic field. The special optical properties near plasma edge due to the strong plasma absorption affect the line shape of the spectrum. The magneto-optical properties of the silver matrix magnetic materials were also studied.

The infrared optical properties of Ag-matrix granular films have been studied, it was found that the electron’s effective mass and scattering time changing regularly as a function of the composition.

The experimental system of the variable angle infrared spectroscopic

ellipsometer using double Fourier transforms has been finished. It's on the basis of the principle of the double Fourier transforms, one is of the photon energies, the other is of the polarized angles. This equipment can been used to study the infrared optical properties of metal materials.

The novel plane array staring form CCD imager has been completed. This equipment can capture mono-color pictures in the wavelength range of 300-600nm in a very short time. In the near future we will expand the measurement range from 200nm to 1000nm. This technology is of the practical new type patent.

A new type multi-grating scanning monochromator has been completed and can be controlled in a simple way. It is of the three functions of scanning wavelength, replacing filters and changing gratings . This technology was protected by the practical new type patent in China.

A portable low- and room-temperature fluorescence spectrometer has been finished and it can be used for real-time measurements.

The project , Applications of the condensed matter spectroscopy in the information technology, given by the committee of science and technology in Shanghai was completely finished. Ti was identified by experts and wined a good reputation.

We have established a high-tech company in the form of collaboration with other enterprise, engaging in the research and development of the WDM filters. The corporation has been started operation with the capital of about 20 million yuan RMB .

# 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

以激光烧蚀等离子体、微波放电等离子体为对象，进行了等离子体特性研究。实验上，用时空积分和分辨的光谱方法，考察了在真空和一定环境气氛中激光烧蚀、等离子体的形成和演变等过程，观察到处于不同能量状态的同一烧蚀产物（离子、高能原子、低能原子）呈现不同的时间演变和空间分布，以及环境气氛对它们不同的影响。同时，开展了激光烧蚀在痕量元素分析、激光烧蚀和微波放电在薄膜沉积方面的应用探索。

Further research has been made on the characteristics of plasmas generated from laser ablation and microwave discharge. With spatially and temporally integrated and resolved spectroscopic methods, we studied the processes involved in laser ablation, plasma formation and evolution in vacuum and in gaseous environment. For the same ablated species at different energy states (ions, high-energy atoms, low-energy atoms), different behaviors in their time evolution and space distribution were observed, and different influence of the gaseous background examined. We also explore application possibilities of laser ablation for trace element analysis and those of laser ablation and microwave discharge for film deposition.

利用ECR等离子体辅助PLD方法进行CN薄膜的制备，得到了N含量大于50%的CN薄膜，并考察了衬底偏压等成膜条件对膜层成分、化学结构及成膜速率的影响。用ECR辅助PLD 方法和离子束辅助PLD 方法尝试进行了CBN三元氮化物薄膜的制备。

CN films have been prepared by mean of ECR assisted PLD method, and films with N content above 50% were obtained. Deposition conditions such as substrate bias have been studied to study their influence on composition, chemical structure and deposition rate. Meanwhile, preparation of CBN films has been attempted by ECR-PLD and ions beam assisted PLD methods.

在III族氮化物薄膜合成制备方面，摸索了一种分别以纯Al和GaAs为靶材料的低温制备AlN、GaN薄膜的新方法，其中在ECR氮等离子体环境中激光烧蚀GaAs靶制备GaN，可以免除通常以Ga为靶材料所带来的诸多不便。

On the preparation of III-nitride films, we presented a new method for low-temperature preparation of AlN, GaN films from pure Al and GaAs target materials. The preparation of GaN films by laser ablation of GaAs targets in the environment of ECR nitrogen plasma could get rid of some disadvantages while using Ga as target material.

由于AlN晶体的能隙高达6.2eV，合成的AlN薄膜的能隙通常也接近6eV，因此难以找到合适的带间激励光源，目前尚未见到AlN光致发光的报道。我们以ArF准分子脉冲激光为光源，进行了AlN薄膜带间激励的脉冲光致发光及时间演变特性的研究，并首次观察到紫外至蓝光的发光谱以及光致发光的非指数衰减特性。

Because of the wide energy gap of AlN (6.2 eV for AlN crystal, about 6 eV for AlN films prepared by various methods), and probably it is hard to find an appropriate light source for above-band-gap excitation of AlN, work on the photoluminescence of AlN is very scarce. By using ArF excimer laser pulses as excitation resource, we studied pulsed photoluminescence and examined its time evolution. Photoluminescence spectra from UV to blue and non-exponential decay of the luminescence were observed for the first time.

课题组得到4项国家自然基金、1项上海市科学技术发展基金和1项高校博士点专项基金资助。

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本年度发表论文5篇。另有6篇论文分别被J. Vac. Sci. Technol. A, Appl. Spectrosc., Appl. Phys. A, Phys. Lett. 等刊物接受，3篇被国际会议LPM2001接受。

5 papers have been published this year. Other 6 papers have been accepted for publication by J. Vac. Sci. Technol. A, Appl. Spectrosc., Appl. Phys. A, Phys. Lett. etc., 3 by the Second International Symposium on Laser Precision Microfabrication (LPM2001).

# 新型氮化物材料研究
# Study on advanced nitrides

1，新型超硬材料β-$C_3N_4$的研究Study of the advanced super-hard material of β-$C_3N_4$

80年代末，物理学家通过理论计算预言了亚稳相的β-$C_3N_4$材料可能比目前世界上最硬的金刚石还要硬，因此，引起了科技界广泛的关注。我们采用低能氮原子离子束注入金刚石膜，使金刚石表面氮化形成β-$C_3N_4$结构，首次得到了与理论结果符合得很好的RAMAN光谱。在表面氮化形成β-$C_3N_4$结构的金刚石膜上进一步采用激光烧蚀结合弧热原子束方法合成了β-$C_3N_4$薄膜，有关结果已经在Thin Solid Films 发表。此项研究已得到国家自然科学基金资助。

Since the metastable β-$C_3N_4$ was theoretically predicted in late 80's that its hardness might be comparable to or greater than that of diamond, extensive experimental effort has been made on preparing this new material. In our work, β-$C_3N_4$ structure was formed by low energy implantation of atomic nitrogen ions into diamond surface. The Raman spectrum measured is in good agreement with the theoretical results. β-$C_3N_4$ film was epitaxially grown on this nitridated diamond film by nitrogen-arc-discharge-assisted laser ablation deposition. These results have been published in Physical Review B and Thin Solid Films. This project was supported by the National Natural Science Foundation of China.

2，用脉冲放电方法制备Ⅲ族氮化物纳米材料Nanosized Ⅲ-nitrides prepared by pulsed discharge

Ⅲ族氮化物材料是短波长光电子器件十分理想的选择对象。纳米材料在光电子学方面最令人感兴趣的便是波长的蓝移及可调谐、更高的发光效率和增强的三阶非线性效应。我们发现氮氨混合气体放电更有利于氮气的解离而且能够抑制氧化杂质的产生，利用光谱诊断方法得到了氮氨的最佳配比。采用氮氨混合气体的高压脉冲放电直接合成了纯度很好的InN 纳米材料并测量了光致发光光谱，发现了谱带的蓝移。此项研究已得到国家自然科学基金资助。

Ⅲ-nitrides are ideal materials for opto-electronic devices in short wavelength region. The most interesting properties of nanosized materials in opto-electronics are the blue-shift, tunable, higher luminescence efficient and the enhanced third harmonic non-linear effect. We found that the dissociation of nitrogen gas was enhanced and the oxide contaminants were eliminated when the mixture of nitrogen and ammonia gases were used as the discharge gas. The optimal mixture ratio was obtained by the method of spectral diagnostics. High purity nanosized InN was synthesized by high voltage discharge of the mixture of nitrogen and ammonia. The blue-shift was deteced in its photoluminescence. This project was supported by the National Natural Science Foundation of China.

# 菌视紫质光电荷转移特性研究

# Study on photocharges transfer in bacteriorhodopsin

实验和理论研究了细菌视紫红质（bR）的光电荷转移特性。实验上：系统测量了bR在不同波长、脉宽和光强的脉冲光作用下的不同光电压信号；并用多种不同的回路阻抗测到了多个不同的光电压信号。理论上：建立了较为完整的bR光泵质子中光电荷转移的物理模型；通过解析方法和数值模拟方法对实验结果的模拟，得到了bR内光电荷转移过程中的各个物理参数，较好地揭示了bR内光生电荷转移的规律。

The photocharges transfer in bacteriorhodopsin was theoretically and experimentally studied. In experiment, we systematically measured the photovoltage produced by bR when it was excited by different wavelength, pulse-width and intensity of light. Moreover, we measured quite a few different photovoltage signals with different circuit resistances. In theory, we have supposed a more perfect physical model for charge transfer in bR. By analytically and numerously simulating the experimental results, we got the physical parameters that the photocharges go through some intermediates, which reveals the rule of charge transfer in bR.

# 在研课题和经费
# Projects & Budgets

掺Yb光纤放大器研制
负责人:李富铭, 起止年月：1997.1-2000.3
拨款来源：863-416-2(军口) (54万)

玻璃基质光波导的光学特性及新型光子学器件研究
负责人:王文澄, 起止年月：1998.1-2001.12
拨款来源：国家科委 攀登项目(105万)

团簇的结构、碰撞动力学、光物理和成膜机理研究（重点子课题）
负责人:王培南, 起止年月：1997.1-2000.12
拨款来源：国家基金 19634030 (15万)

电场调制光谱法研究有机分子二阶非线性激化率的色散
负责人:马世红, 起止年月：1998.1-2000.12
拨款来源：国家基金 19704004 (10万), 2000年到款3.0万

玻璃态材料的二阶光学非线性的产生机理
负责人:王文澄, 起止年月：1998.1-2000.12
拨款来源：国家基金 19774018 (22万), 2000年到款6.6万

有机/无机混合型极性反转结构波导制备及光倍频研究
负责人:徐 雷,起止年月：1998.1-2000.12
拨款来源：国家基金 69708005 (10万), 2000年到款3.0万

若干非线性光学材料的新效应及其机制（重点子课题）
负责人:孙迭篪, 起止年月：1998.1-2001.12
拨款来源：国家基金 19734004 (25万), 2000年到款5.0万

氮原子束辅助激光溅射合成ZnSe基氮化物薄膜及其性质研究
负责人:许 宁, 起止年月：1998.1-2000.12
拨款来源：国家基金 69706001 (11万), 2000年到款3.3万

高密度信息存储有机光折变聚合物及光物理研究
负责人:赵有源, 起止年月：1999.1-2001.12
拨款来源：国家基金 69888001 (12.5万), 2000年到款3.75万

周期性极化有机掺杂玻璃光波导准位相匹配光倍频研究
负责人:刘丽英, 起止年月：1999.1-2001.12
拨款来源：国家基金 69808001 (11.71万), 2000年到款3.51万

纳米GaN嵌镶薄膜的光发射和光学非线性
负责人:吴嘉达, 起止年月：1999.1-2001.12
拨款来源：国家基金 69878004 (14.3万), 2000年到款4.29万

光敏增强共轭有机高聚物超快全光调制特性研究
负责人:刘建华, 起止年月：1999.1-2001.12
拨款来源：国家基金 19804003 (13万), 2000年到款3.9万

实用化的电寻址铁电液晶空间光调制器研制
负责人:徐克寿, 起止年月：1999.1-2001.12
拨款来源：国家基金 69877004 (40万), 2000年到款12万

光电功能分子电荷转移动力学及光电特性（重点）
负责人:李富铭, 起止年月：1999.1-2002.12
拨款来源：国家基金 19834030 (85万), 2000年到款25.5万

硅基光波导分波合波器（重大子课题）
负责人:王文澄, 起止年月：1997.10-2000.6
拨款来源：市科委基金 (25万)

纳米晶氮化物嵌镶薄膜和GaN系材料匹配衬底及外延生长
负责人:吴嘉达, 起止年月：1998.5-2000.5
拨款来源：市科委基金 98JC14011 (15万)

隧道结型巨磁电阻器件的研究
负责人:金庆原, 起止年月：1998.10-2000.12
拨款来源：市科委基金 98ZA14014 (2万)

新一代超薄膜金刚石 X 光及红外窗口的研究
负责人:应萱同, 起止年月：1999.10-2001.12
拨款来源：市科委基金 99JC14038 (20 万) ,2000 年到款 4 万

磁电阻器件及物理问题研究
负责人:金庆原, 起止年月：1999.10-2001.12
拨款来源：市科委基金 99JC14003 (10 万) ,2000 年到款 2 万

有机薄膜电致发光矩阵显示及新型有机器件的研制
负责人:徐建华, 起止年月：1999.10-2001.12
拨款来源：市科委基金 99JC14007 (5 万) , 2000 年到款 1. 0 万

紧凑型全固化兰色相干光源研究
负责人:朱鹤元, 起止年月：1999.10-2001.6
拨款来源：市科委基金 99JC14011 (10 万), 2000 年到款 1.4 万

跨世纪优秀人才培养计划
负责人:徐雷, 起止年月：1998.1-2000.12
拨款来源：国家教育部 (30万)

有机/无机波导制备及光倍频研究
负责人:刘丽英, 起止年月：1997.12-2000.6
拨款来源：市教委曙光计划 (8万)

磁性薄膜的线性和非线性光学研究
负责人:金庆原, 起止年月：1999.9-2000.12
拨款来源：教育部回国人员启动基金 (3万)

若干有机聚合物三阶光学非线性及其增强机制的研究
负责人:朱鹤元, 起止年月：1999．1-2001．12
拨款来源：教育部回国人员启动基金 (2.5万)

磁性薄膜的光学二次谐波
负责人:金庆原, 起止年月：1999.9-2001.9
拨款来源：市教委青年教师基金 (2 万)

有机光学非线性薄膜分子取向及其控制研究
负责人:陆兴泽, 起止年月：1999.1-2001.12
拨款来源：博士点基金 (5.5万), 2000年到款1.3万

YAG激光溅射合成并研究氮碳硼多层膜及其纳米管结构
负责人:任忠民, 起止年月：1998.1-2000.12
拨款来源：博士点基金 (5万)

Linear and nonlinear optical response from magnetic and multilayers
负责人:金庆原, 起止年月：1999.9-2001.2
拨款来源：第三届世界科学院 (TWAS) $0.5 万

光波导中光栅的制作和光纤与光波导对接研究
负责人:徐雷, 起止年月：1999.5-2000.5
拨款来源：校基金 (2.5 万)

光寻址铁电液晶空间研究
负责人:吕瑞波, 起止年月：1999.1-2001.12
拨款来源：校青年基金 (2 万)

超快脉冲激光烧蚀动力学研究
负责人：应质峰, 起止年月：2000.1-2002.12
拨款来源：国家基金19974009 (14.5万) , 2000年到款5.8万

微波放电和激光烧蚀混合等离子体的特性和应用
负责人：吴嘉达, 起止年月：2000.1-2002.12
拨款来源：国家基金 19975012 (15.0万) , 2000年到款6.0万

快脉冲放电制备尺寸可控纳米III族氮化物及光学特性研究
负责人：王培南, 起止年月：2000.1-2002.12
拨款来源：国家基金69978005 (14.0万) , 2000年到款5.6万

有机半导体微片激光器的制备及其特性研究
负责人：徐建华, 起止年月：2000.1-2002.12
拨款来源：国家基金69978004 (13.5万) , 2000年到款5.4万

激光溅射和 ECR微波放电及离子源结合
负责人：应质峰, 起止年月：2000.10-2001.10
拨款来源：国家基金 (10万) , 2000年到款10万

磁性体系的超快过程，线性和非线性磁光效应
负责人：金庆原, 起止年月：2000.1-2002.8
拨款来源：国家教育部优秀年轻教师 (8万) , 2000年到款8万

磁性超薄多层膜的光学非线性技术研究
负责人：金庆原, 起止年月：2000.7-2003.6
拨款来源：国家教育部重点项目 (13万) , 2000年到款13万

特殊结构和大分子体系中的非线性效应和超快探测
负责人：金庆原, 朱鹤元，起止年月：2000.1-2001.12
拨款来源：973分课题 (16万) , 2000年到款16万

OPCPA相关技术研究
负责人：朱鹤元，起止年月：2000.10-2002.10
拨款来源：863-416-2,3,1 (5万) , 2000年到款5万

细小 H1 病毒绿色荧光蛋白基因表达的双光子荧光特性研究（1）
负责人：刘建华，起止年月：2000.1-2001.12
拨款来源：国家教育部11200473 (6万) , 2000年到款6万

光学空间花样的形成及控制
负责人：庄军，起止年月：2000.1-2002.12
拨款来源：校基金(2万) , 2000年到款2万

光学二阶非线性级联效应及光子器件的研究
负责人：侯占佳，起止年月：2000.10-2002.12
拨款来源：校基金(5 万）， 2000 年到款 5 万

光致极化反转效应研究
负责人：李富铭，朱鹤元，起止年月：2000.9-2002.9
拨款来源：校基金(8 万）, 市科委基金（3 万），2000 年到款 11 万

光通信滤波片光波导热光效应及器件研究
负责人：刘丽英，张荣君，起止年月：2000.7-2002.6
拨款来源：市科委基金 00JC14029（30 万），2000 年到款 21 万

全自动椭圆光谱仪研究
负责人：陈良尧，起止年月：1999.1-2001.12
拨款来源：国家科技部(攻关)96-A23-02-07（40 万）

凝视式偏光谱仪的研究
负责人：陈良尧，起止年月：1998.1-2001.12
拨款来源：上海市科委(攻关)981411022（30 万）

无机械位移 CCD 多光栅单色仪研制
负责人：陈良尧，起止年月：1999.1-2001.12
拨款来源：上海市科委(攻关)991411057（20 万），2000 年到款 5 万

信息科学中若干新型光子器件和系统的应用
负责人：陈良尧，起止年月：1998.1-2001.12
拨款来源：国家科技部(攀登)（120 万），2000 年到款 30 万

新型凝聚态光谱研究
负责人：陈良尧，起止年月：1998.1-2000.12
拨款来源：上海市科委 98JC14005（50 万）

凝视式磁光克尔效应研究
负责人：陈良尧，起止年月：1999.1-2001.12
拨款来源：国家基金 69878003（20 万），2000 年到款 6 万

信息功能材料的物理光学特性研究
负责人：陈良尧，起止年月：1999.1-2001.12
拨款来源：国家教育部（20 万）

稀磁半导体薄膜与温度有关的磁光效应研究
负责人：郑玉祥，起止年月：1998.1-2000.12
拨款来源：国家基金 69706003（10 万），2000 年到款 3.3 万

光隔离器的研究与开发
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1. Zhiling Xu, Liying Liu, Yue Fei, Peng Yang, Zhanjia Hou, Lei Xu, Wencheng Wang，Jong Wook Lim, Mario Affatigato, Steve Feller
"Nonuniform bulk second-order optical nonlinearity in PbO/$B_2O_3$ glass"
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# 参加国际、国内会议情况
# Scientific Activities

1. Liying Liu, Zhiling Xu, Yue Fei, Peng Yang, Zhanjia Hou, Lei Xu and Wencheng Wang, Jong Wook Lim, Mario Affatigato and Steve Feller
"Nonuniform bulk second-order optical nonlinearity in $PbO/B_2O_3$ glass", (oral)
2000 OSA Annual Meeting/ILS-XVI, Providence, Rhode Island, Oct. 22-26, 2000

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The second Asian Pacific Laser Symposium (APLS'2000), Aug. 24-28, Shanghai, China

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"Magnetoresistance behavior of Co/CuMn/Co sandwich structures" , (oral)
4th International Conference on Thin Film Physics and Applications ('2000 TFPA), Shanghai, May 8-11, 2000

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"Optical limiting properties of fullerene biindene adduct in toluene solution and xerogel" , (oral)
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"Formation of metallofullerenes by laser ablation of metall-containing fullerene materials" , (oral)
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12. R.B.Lu, K.S.Xu
"Ultra-thin SiO films for the alignment of ferroelectric liquid crystals" , (oral)
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"Linear and nonlinear MOKE study of Fe film epitaxied on Co(001)" , (oral)
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“Ag基磁性基磁性颗粒膜的光学和磁光性质的尺寸效应” （分组报告）
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“磁光材料的层状结构设计” （分组报告）
第二届全国薄膜与纳米磁学学术会议(2000/5,上海)

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“合成反铁磁/铁磁结构中磁化强度反转特性研究”. （分组报告）
第二届全国薄膜与纳米磁学学术会议(2000/5,上海)

31 王松有，邓世虎，陈良尧。
“Ag的光学和磁光性质的实验研究” （分组报告）
第十届全国凝聚态光学性质学术会议（2000/8，海拉尔）

32. 陈岳立，张荣君，王松有，陈良尧。
“双重傅立叶变换的红外椭偏系统的研究” （分组报告）
第十届全国凝聚态光学性质学术会议（2000/8，海拉尔）

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“主角条件分析及其在椭圆偏振振光谱中的应用” （分组报告）
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“NixSiO2(1-x)颗粒膜的光学和磁光特性研究” （分组报告）
第十届全国凝聚态光学性质学术会议（2000/8，海拉尔）

# 人员名单
# Faculty Members

## 在研人员：Faculty members in 2000

陈良尧　教授，博士，凝聚态光学
CHEN Liangyao, Prof., Ph.D., Optical properties in condensed matter

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

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HOU Zhanjia, Lecturer, Ph.D., Optical waveguide, nonlinear optics

金庆原　教授，博士，低维磁结构磁性和光学性质
JIN Qingyuan, Prof., Ph.D., Magnetism and optical response from ultrathin multilayers

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

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，光学非线性LB膜及光波导
LIU Liying, Associate Prof., Ph.D., Optical nonlinear LB films and waveguide

罗龙根　高级工程师，激光技术
LUO Longgen, Senior engineer, Laser techniques

吕瑞波　讲师，博士，信息光学和铁电液晶器件
LU Ruibo, Lecturer, Ph.D., Optical information processing, Ferroelectric liquid crystal display device

陆兴泽　教授，博士，光学非线性LB膜，表面、界面的超快非线性过程
LU Xingze, Prof., Ph.D., Optical nonlinear LB films, Ultra-fast optical nonlinear processes at surfaces and interfaces

孙迭篪　教授，超短光脉冲和超快现象
SUN Diechi, Prof., ultra-short optical pulse generation and ultra-fast phenomena

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

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

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

王文澄　教授，光学非线性LB膜及光波导
WANG Wencheng, Prof., Optical nonlinear LB films and waveguides

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

徐建华　副教授，博士，光学非线性LB膜
XU Jianhua, Associate Prof., Ph.D., Optical nonlinear LB films

徐克璹　教授，信息光学和铁电液晶器件
XU Keshu0.
, Prof., Optical information processing, Ferroelectric liquid crystal display device

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

夏绍丰　教授，电子学
XIA Shaofeng, Prof., Electronics

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

叶衍铭　高级实验师，激光医学
YE Yanming, Senior engineer, Laser application in medicine

应萱同　教授，博士，金刚石薄膜的研制、测试与分析
YING Xuantong, 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　讲师，博士，凝聚态光学
ZHANG Rongjun, Lecturer, Ph.D., Optical properties in condensed matter

郑玉祥　副教授，博士，凝聚态光学

ZHENG Yuxiang, Associate Prof., Ph.D., Optical properties in condensed matter
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

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

邬建根　副教授
WU Jiangen, Associate Prof.

赵衍盛　研究员
ZHAO Yansheng,

戴祝萍　工程师　　DAI Zhuping, Engineer

胡谊梅　工程师　　HU Yimei, Engineer

莫应安　工程师　　MO Yingan, Engineer

钱红声　实验师　　QIAN Hongsheng, Engineer

吴善亮　实验师　　WU Shanliang, Engineer

邢中菁　实验师　　XING Zhongjing, Engineer

徐新民　技师　　XU Xinmin, Technician

张敏毅　工程师　　ZHANG Minyi, Engineer

王祺　工程师　　WANG Qi, 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

章志鸣 教授，激光物理、非线性光学
ZHANG Zhiming, Prof., Laser physics, Nonlinear optics.

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

## 博士后: Postdoctoral fellows

杜戈果(DU Geguo), 王韬(WANG Tao), 张斌(ZHANG Bin), 李晶(LI Jing)

高艳霞(GAO Yanxia), 贾宏志(JIA Hongzhi), 秦宗益(QIN Zongyi)

## 博士生: Ph.D. candidates

98级 朱九皋(ZHU Jiugao), 王文军(WANG Wenjun)
杨炜东(YANG Weidong)，申作成(SHEN Zuocheng )

99级 孙剑(SUN Jian), 李合印(LI Heyin), 朱晓松(ZHU Xiaosong)

2000级 叶明新(YE Mingxin)

## 硕士生: M.S. students

98级 吴剑峰(WU Jianfeng)，陈杰(CHEN Jie)，姜永强(JIANG Yongqiang)
黄金荣(HUANG Jinrong)，刘秀(LIU Xiu)，施磊(SHI Lei)
张彦东(ZHANG Yandong ), 邓世虎(DENG Shihu)

99级 骆金龙(LUO Jinlong)，梁建中(LIANG Jianzhong)，曹嵘(CAO Rong)
李毅刚(LI Yigang )，卢永雄(LU Yongxiong )，施维(SHI Wei)
郑锐之(ZHENG Ruizhi)，奚衍罡(XI Yangang)，凌浩(LING Hao)
刘铸(LIU Zhu)

2000级 王昕(WANG Xin), 刘言军(LIU Yanjun), 高春雷(GAO Chunlei),
赵元(ZHAO Yuan), 沈宏(SHEN Hong), 徐炯(XU Jiong),
凌涛(LING Tao), 李淑红(LI Shuhong), 王贤江(WANG Xianjiang),
阎结昀(YAN Jieyun), 于世瑞(YU Shirui), 巨晓华(JU Xiaohua),
许旭东(XU Xudong), 韩涛(HAN Tao), 周鹏(ZHOU Peng)

# 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.钟业华, 男, 49岁, 美国西北大学材料系 (1999.12.—2000.11.)　8万
“薄膜淀积技术和表面化学研究”

2.陈叔琦, 男, 60岁, 香港浸会大学 (1999.11.—2000.10.)　6万
“用脉冲放电方法制备氮化物纳米材料”

3.钱列加, 男, 34岁, 中科院上海光学精密机械研究所 (1999.12.—2000.11.) 5万
“飞秒时域的非线性光学研究”

4.蒋仕彬, 男，35岁，美国亚里桑那大学 (2000.7.—2001.6.)　8万
“掺稀土玻璃材料超短激光脉冲材料表面改性”

5.徐永兵，男，35岁，英国剑桥大学卡文迪西实验室 (2000.8.—2001.7.)　8万
“超薄膜磁性及同步辐射研究”

6.周筑颖，女，57岁，复旦大学现代物理所 (2000.7.—2001.6.)　4万
“优质氮化物薄膜制备”

二．部分来室访问及作报告的学者

2000.4.3.　范滇元 工程院院士　中科院上海光学精密机械研究所
报告：“激光核聚变驱动器的发展与展望”

2000.5.11. 邱建荣 工学博士　日本科学技术厅，科学技术振兴事业团
报告：“飞秒激光与玻璃相互作用”

2000.6.13.-15. 美国西北大学材料系钟业华教授
报告：”Thin-film synthesis by CVD and PVD techniques” (6.13.)；“Synthesis and characterization of coatings for tribological applications”(6.15.)

2000.9.15.-18. 沈元壤教授Prof.Y.R.Shen，美国加州大学伯克利分校
报告：“Forty years of excitement in laser science” (9.15.)；
“Surface melting of ice” (9.18.)

2000.10.24. 徐永兵博士英国剑桥大学卡文迪西实验室
报告：“英国剑桥大学卡文迪西实验室磁学研究概况”

2000.12.26. Dr.Ye jun 美国标准局
报告：“Modern laser spectroscopy: Ultrafast, Ultrastable and ultrasensitive-precision control of light field and matter”

2000.12.28. Charles K.Rhodes 教授，美国伊利诺斯大学芝加哥分校物理系
报告：“Ultrabright kilovolts X-ray sources”

2000.7.30.-8.5. Frank w.wise 副教授，美国康耐尔大学应用与工程物理学院
小范围研讨会“光孤子物理若干问题”

2000.6.15. 越南科学院来室参观

2000.6.27. 德国路尔大学来室参观

2000.7.11. 英国物理学会，物理学杂志主编R.G.W Brown布朗教授来室参观

2000.8.25. KOTI韩国光通信，代表理事吴永焕来室参观

2000.12.12. Dr.G.Sundrarajan 印度粉末冶金和新材料国际研究中心主任，
Dr.D.Banerjee 印度国防冶金研究室主任来室参观

# 附录：发表文章首页
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