

InGaN 基 LED 中极化效应对发光特性的影响

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摘要: 主要利用电致发光的实验手段, 研究了极化效应对 InGaN 基 LED 器件发光特性的影响。实验中发现, InGaN 基 LED 器件的峰位随注入电流的增加产生了先蓝移后红移的现象, 蓝光和绿光 LED 分别蓝移 3 nm 和 8 nm; 而 AlGaInP 基红光 LED 器件的峰位仅红移。进一步研究发现, InGaN 基 LED 的外量子效率在注入电流为 50 mA 处开始剧烈下降, AlGaInP 基 LED 的外量子效率在 100 mA 处才开始缓慢下降, 并且两者呈现不同的下降规律。通过与模拟结果对比发现, InGaN 基 LED 的效率在下降开始阶段与俄歇复合引起的效率下降规律类似。以上实验结果表明, InGaN 基 LED 器件中存在极化电场, 且该极化电场会对 LED 器件的效率衰减产生促进作用。

关键词: InGaN; 电致发光; 峰位; 相对外量子效率; 极化效应; 俄歇复合

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Influence of Polarization Effect on the Luminescence

Properties of InGaN Based LEDs

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Abstract: The influence of polarization effect on the luminescence characteristics of InGaN based LEDs was researched by the experimental means of electroluminescence. It is found that the peak position of the InGaN based LED has a blue shift before a red shift with the increase of the injection current, while the peak position of the AlGaInP based red LED only has a red shift. The peak positions of the blue and green LEDs are blue shifted by 3 nm and 8 nm, respectively. By further study, it is found that the external quantum efficiency of the InGaN based LED decreases drastically at the injection current of 50 mA, and the external quantum efficiency of the AlGaInP based LED begins to decrease slowly at 100 mA. They show different decrease trends. Compared with the simulation results, it is found that the InGaN based LED exhibits an efficiency decline trend similar to the Auger recombination induced efficiency droop at the beginning of the efficiency decline. The experimental results show that the polarization electric field exists in the InGaN based LED and can promote the efficiency droop in the InGaN based LEDs.

Key words: InGaN; electroluminescence; peak position; relative external quantum efficiency; polarization effect; Auger recombination

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聚硅氮烷旋涂介电材料研究进展

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摘要: 聚硅氮烷作为旋涂介电层的基础材料, 可通过旋涂法、特定条件下转化来制备 SiO₂ 介电层, 工艺简单, 介电层性能优异, 有望克服传统化学气相沉积方法的缺点, 在微电子领域具有重要的应用价值。系统总结分析了聚硅氮烷分子结构、基材表面处理方式、聚硅氮烷-二氧化硅转化方法以及旋涂层后处理方法等对所制备介电层性能的影响。发现采用全氢聚硅氮烷 (PHPS) 为原料, 基体表面经亲水化处理, 利用紫外-高温结合的转化方式, 并结合等离子后处理工艺可以得到高质量的 SiO₂ 介电层。简述了该旋涂介电材料在晶体管 and 低 k 多孔材料等领域的应用。基于以上分析, 聚硅氮烷在旋涂介电层方面有巨大的潜力, 对其分子结构的精细化控制、转化工艺的深入研究、应用领域的进一步拓宽是未来该材料的发展方向。

关键词: 聚硅氮烷; 旋涂介电层; 浅沟槽隔离 (STI); 二氧化硅; 微电子

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Research Progress of Polysilazane Based Spin on Dielectric Materials

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Abstract: With polysilazane as the fundamental material of spin on dielectrics, the silica dielectric layers are prepared by the spin coating method and the conversion process under proper conditions. Due to advantages of simple process and outstanding electrical properties, it is helpful to overcome the shortcoming of the conventional chemical vapor deposition methods and polysilazane can be extensively applied in the microelectronic field. The effects of critical factors (such as molecular structure of polysilazane, surface treatment of substrate, conversion methods of polysilazane silica and post treatment of the spin on layers) on the dielectric properties are systematically summarized and analyzed. It demonstrates that high quality silica dielectric layers can be obtained by the perhydropolysilazane (PHPS) as raw material, the hydrophilization process of substrate surface, the combination of ultraviolet and high temperature conversion process and the plasma post treatment technology. The applications of the spin on dielectric materials in the transistors and low k porous materials are summarized. Based on the above analyses, the polysilazane has enormous potential applications in spin on dielectrics. The precise control of the molecular structure, the intensive investigation of conversion process and further expansion of application areas will be the future development directions of polysilazane.

Key words: polysilazane; spin on dielectric; shallow trench isolation (STI); silica; microelectronic

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喷墨打印 C8 BTBT 薄膜中的衬底
效应及其 OTFT 器件

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摘要: 以喷墨打印制备的共轭有机小分子 2,7 二辛基 [1] 苯并噻吩并 [3,2 b] 苯并噻吩 (C8 BTBT) 作为有机薄膜晶体管 (OTFT) 的有源层, 分别采用紫外臭氧处理、旋涂聚 (4 乙烯基苯酚) (PVP) 薄膜、自组装苯乙基三氯硅烷 (PETS) 单分子层和苯基三氯硅烷 (PTS) 单分子层四种衬底修饰方法, 分析有机小分子薄膜生长过程中的衬底效应, 及其对 OTFT 器件性能的影响。其中 PVP 或 PETS 修饰衬底具有疏水及低表面粗糙度的特性, 在其上喷墨打印沉积的 C8 BTBT 单线条薄膜具有均匀性好、覆盖率高且有序堆积的结晶形貌, 基于这种高质量薄膜制备的 OTFT 器件性能最优, 饱和场效应迁移率达到 $1 \text{ cm}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$ 左右, 开关比超过 106。结果表明, 对打印衬底进行疏水性处理及降低表面粗糙度是制备高性能共轭小分子 OTFT 器件的有效途径。

关键词: 有机薄膜晶体管 (OTFT); 喷墨打印; 2,7 二辛基 [1] 苯并噻吩并 [3,2 b] 苯并噻吩 (C8 BTBT); 衬底效应; 迁移率

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Substrate Effect in Inkjet Printed C8 BTBT Films and
the OTFT Devices

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Abstract: With inkjet printed 2,7 dioctyl [1] benzothieno [3,2 b] [1] benzothiophene (C8 BTBT) as the active layer of organic thin film transistors (OTFTs), the substrate effect in film growth of organic small molecules and its influence on the performances of the OTFT devices were analyzed by the four methods of the substrate modification, including UV ozone treatment, spin coated poly 4 vinyl phenol (PVP) thin film, self assembled monolayer of phenethyltrichlorosilane (PETS) and that of phenyltrichlorosilane (PTS). The C8 BTBT single line films deposited by the inkjet printing on the PVP or PETS modified substrates have good uniformity, high coverage and orderly crystalline morphologies because of substrates with properties of hydrophobicity and low surface roughness. The OTFT devices prepared based on the high quality films have the best performances. The saturation field effect mobility reaches about $1 \text{ cm}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$, and the on/off ratio is more than 106. The results reveal an effective way for preparing high performance OTFT devices of conjugated small molecules by combining hydrophobic treatment with decreased surface roughness for printing substrates.

Key words: organic thin film transistor (OTFT); inkjet printing; 2,7 dioctyl [1] benzothieno [3,2 b] [1] benzothiophene (C8 BTBT); substrate effect; mobility

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用于促黄体生成素快速检测的
电化学免疫传感器

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摘要: 研制了一种用于促黄体生成素(LH)检测的电化学免疫传感器, 实现了促黄体生成素的高灵敏度和快速检测需求。采用纸基免疫传感器作为基底材料, 氨基化石墨烯(NH₂ G)/硫堇/纳米金复合物修饰的丝网印刷工作电极(SPWE)作为检测系统的工作电极。该免疫传感器的检测原理是: 电化学物质硫堇通过电极表面氧化还原反应产生电化学电流, 抗原抗体的特异性结合会影响电化学电流的释放, 导致电流下降, 并且检测电流与抗原的浓度呈反比。实验结果表明: 对于促黄体生成素在 1~100 mIU · mL⁻¹ 内该传感器具有很好的检测结果, 检测的最低限为 1 mIU · mL⁻¹, 检测的线性系数为 0.991, 并且检测时间可以控制在 10 min。因此该传感器可用于促黄体生成素的快速和高灵敏度检测需求, 这对于性激素水平的动态监测, 进而实现不孕不育疾病个性化诊断治疗以及指导备孕都有着重要的意义。

关键词: 电化学免疫传感器; 纸基免疫传感器; 促黄体生成素(LH); 丝网印刷; 快速; 高灵敏度

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An Electrochemical Immunosensor for Rapid Detection of
Luteinizing Hormone

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Abstract: An electrochemical immunosensor for detection of luteinizing hormone (LH) antigen was developed to realize the high sensitive and rapid detection. With the paper based immunosensor as the base material, the screen printed working electrode (SPWE) was modified by the amino functional graphene (NH₂ G)/thionine/gold nanoparticles. The detection principle of the immunosensor is that the electrochemical material thionine produces the electrochemical current through the redox reaction of the electrode surface, and the specific binding of the antigen antibody will affect the release of the electrochemical current to decrease the current. The detect current is inversely proportional to the concentration of the antigen. The experimental results show that the sensor has good test results for luteinizing hormone (LH) in the range of 1-100 mIU · mL⁻¹, the lowest limits is 1 mIU · mL⁻¹, the linear coefficients is 0.991, and the detection time can be controlled within 10 min. Therefore, the immunosensor can be used for rapid and high sensitivity detection of luteinizing hormone. Thus, it has an important significance to dynamically monitor the sex hormone levels, then realize personalized diagnosis and treatment of infertility disease and guide the preparation for pregnancy.

Key words: electrochemical immunosensor; paper based immunosensor; luteinizing hormone (LH); screen printing; rapid; high sensitivity

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一种 MEMS 陀螺仪温度漂移误差补偿方法

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摘要: 为了降低温度对 MEMS 陀螺仪测量的影响, 提高自制惯性测量系统的测量精度, 研究了三轴 MEMS 陀螺仪的零偏、比例因子、安装误差等参数受温度影响的特性, 建立了带有温度参数的三轴 MEMS 陀螺仪误差模型。在该模型的基础上进行了全温区 (-20~60 °C) 的温变实验, 拟合出三轴 MEMS 陀螺仪各个参数与温度的关系, 确定了模型中的相关参数, 并通过此模型对不同温度下的陀螺仪输出结果进行误差补偿。实验结果表明, 该三轴 MEMS 陀螺仪温度漂移误差补偿模型能够有效地抑制陀螺仪测量误差, 补偿后, 测量误差可控制在 $0.05^{\circ}/s \sim 1^{\circ}/s$, 具有一定的工程应用价值。

关键词: 惯性测量; 微电子机械系统 (MEMS); 三轴陀螺仪; 温度漂移; 误差补偿

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A Compensation Method for Temperature Drift

Error of MEMS Gyroscopes

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Abstract: In order to reduce the influence of temperature on the MEMS gyroscope measurement and improve the measurement accuracy of the self-made inertial measurement system, the characteristics of the parameters of a three-axis MEMS gyroscope including the zero bias, scale factor, installation error and other parameters affected by temperature were researched, and the error model of the three-axis MEMS gyroscope with the temperature parameters was established. The temperature change experiments in a full temperature zone (from -20 °C-60 °C) were completed based on the model. Then the relations of the various parameters of the three-axis MEMS gyroscope and the temperature were fitted. Finally, the related parameters in the model were determined, and the output results of the gyroscope under different temperatures were compensated for error by this model. The experimental results show that the temperature drift error compensation model of the three-axis MEMS gyroscope can effectively suppress the measurement error of the gyroscope, and the measurement error can be controlled within $0.05^{\circ}/s \sim 1^{\circ}/s$ after the compensation, which has a certain engineering application value.

Key words: inertial measurement; micro electromechanical system (MEMS); three-axis gyroscope; temperature drift; error compensation

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直流辉光放电对石墨烯氮掺杂的制备与特性

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摘要: 在原子层沉积 (ALD) 的腔室内, 采用直流辉光放电技术, 以 N₂ 等离子体作为掺杂源制备了氮掺杂石墨烯, 考察了电场方向和掺杂时间对石墨烯的掺杂特性影响。喇曼光谱和高分辨率 X 射线光电子能谱 (XPS) 测试表明, 随着掺杂时间的延长, 氮的掺杂量逐渐提高, 并且负电场较正电场具有更高的掺杂效率, 在 -800 V 电场、N₂ 等离子体掺杂 2 h 的条件下, 石墨烯中氮与碳的原子比达到 9.5%。同时, 采用 Comsol Multiphysics 软件模拟了腔室内正负电场情况下的等离子体分布, 结果表明电极盘为负电时, 腔室内的放电区域更加发散, 有利于掺杂离子与自由基到石墨烯表面的扩散。

关键词: 直流辉光放电; 氮掺杂石墨烯; 等离子体; 多物理场耦合分析; 原子层沉积 (ALD)

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Preparation and Properties of N Doped Graphene by the Direct Current Glow Discharge

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Abstract: With N₂ plasma as the doping source, the N doped graphene was prepared in a chamber of atomic layer deposition (ALD) by the direct current glow discharge technology. The effects of the electric field direction and doping time on the doping property of graphene were investigated. The results of the Raman spectrum and high resolution X ray photoelectron spectroscopy (XPS) indicate that the N doping amount is improved with the increase of the doping time, and the doping efficiency of the negative electric field is higher than that of the positive electric field. The atomic ratio of N and C in graphene reaches 9.5% under the electric field with the voltage of -800 V and the nitrogen plasma doping for 2 h. Meanwhile, the plasma distribution in the chamber with the positive and negative electric fields was simulated by the software of Comsol Multiphysics. The results show that the discharge area is more dispersive when the electrode plate is cathode, which promotes the diffusion of doping ions and excited radicals to the surface of graphene.

Key words: direct current glow discharge; N doped graphene; plasma; Comsol Multiphysics; atomic layer deposition (ALD)

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基于 SEM 图像的自动对焦技术

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摘要: 针对扫描电子显微镜 (SEM) 自动对焦技术对噪声敏感, 计算量大, 从而影响 SEM 自动对焦的准确性和实时性, 提出一种基于 SEM 图像的自动对焦技术。该技术采用基于拉普拉斯高斯算子和局部方差相结合的对焦评价函数 FGLOG 描述 SEM 的对焦状态; 采用显著区提取和凸包法相结合的方法, 自动提取 SEM 图像感兴趣区域 (ROI)。实验结果表明, 与 5 种典型的对焦评价函数对比, 提出的对焦评价函数 FGLOG 可以有效抑制噪声。在较少幅的帧平均情况下, 仍然可以正常工作, 可以提高自动对焦效率。针对不同的 IC 图形, 采用 ROI 选取技术可以改善对焦评价函数曲线的灵敏度。尤其针对 IC 孤立线条, 灵敏度得到有效提高。

关键词: 自动对焦; 评价函数; 扫描电子显微镜 (SEM); 感兴趣区域 (ROI); 显著区

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Auto Focusing Technology Based on SEM Images

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Abstract: The scanning electron microscope (SEM) auto focusing technique is sensitive to noise and has amount of calculation, which will affect the accuracy and real time performance. An auto focusing technique based on SEM images was proposed. The focusing evaluation function (FGLOG) based on Laplace of Gaussian and local variance was used to describe the SEM focusing state, and the automatic extraction method based on salient region and convex hull was used to select the region of interest (ROI) of SEM images. The experimental result show that the proposed focusing evaluation function (FGLOG) has better anti noise performance than those of five typical focusing evaluation functions. It can work with SEM images averaged out with less frames, and the auto focusing can be improved. By using the proposed ROI extraction technology, the sensitivity of the focusing evaluation function can be improved for different IC patterns. Especially for the IC isolated lines, the sensitivity can be improved effectively.

Key words: autofocus; evaluation function; scanning electron microscope(SEM); region of interest (ROI); salient region

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多层铜布线 CMP 后 BTA 去除和铜表面腐蚀抑制

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摘要:有机残余(主要是苯并三氮唑(BTA))和铜表面腐蚀是多层铜布线化学机械抛光(CMP)后晶圆缺陷中的两个重要问题,针对 BTA 去除和铜表面腐蚀抑制提出了一种新的碱性清洗剂。该清洗剂主要由 FA/O 螯合剂和 FA/O 表面活性剂组成。FA/O 螯合剂对于去除 BTA 起主要作用,FA/O 表面活性剂不仅能抑制腐蚀而且促进了 BTA 的去除。通过接触角测量、扫描电镜(SEM)、金相显微镜、静态腐蚀速率(SER)等实验及线上测试研究了该清洗剂的性能,结果表明清洗剂能有效去除 BTA 且在抑制铜表面腐蚀方面效果明显,有效解决了极大规模集成电路(GLSI)多层铜布线 CMP 后清洗中的多项技术难题。

关键词:化学机械抛光(CMP)后清洗;苯并三氮唑(BTA)去除;铜腐蚀;螯合剂;表面活性剂

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Benzotriazole Removal and Inhibition of Cu Surface Corrosion on Multilayer Copper Wirings After CMP

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Abstract:Organic residual (mostly benzotriazole (BTA)) and Cu surface corrosion are two important problems in the defects of the wafer after the multilayer copper wiring chemical mechanical polishing(CMP). According to BTA removal and Cu surface corrosion inhibition, a novel alkaline cleaning solution was proposed. The cleaning solution mainly consists of the FA/O chelating agent and FA/O surfactant. The FA/O chelating agents play an important role in the process of removing BTA. The FA/O surfactant can inhibit corrosion and improve the removal effect of BTA. The performances of the cleaning solution were researched using the contact angle measurement, scanning electron microscope (SEM), metallurgical microscope, static etching rate (SER). The cleaning solution was measured for the actual production line. The results demonstrate that the novel cleaning solution can effectively remove BTA and inhibit the Cu surface corrosion, and effectively solve several technical problems of the multilayer copper wiring in great large scale integration (GLSI) after CMP cleaning.

Key words:post chemical mechanical polishing(CMP) cleaning; benzotriazole (BTA) removal; copper corrosion; chelating agent; surfactant

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一种改进的穿硅电容三维互连技术

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摘要: 针对硅通孔(through silicon via, TSV)背面通孔外露工艺复杂度与成本较高、易遗留工艺隐患的问题, 提出一种改进的穿硅电容(through silicon capacitor, TSC)三维互连技术。首先, 介绍 TSC 结构特点与工艺制作方法。其次, 通过电磁仿真分析 TSC 互连电容耦合特性, 结合传统收发电路与 HSPICE 仿真验证 TSC 互连在高频信号传输应用中的可行性。分析与仿真结果显示: TSC 省去 TSV 背面通孔外露工艺可进一步降低成本及复杂工艺引入的可靠性隐患。采用孔半径 $2.5 \mu\text{m}$ 、孔高 $50 \mu\text{m}$ 单根 TSC 通道可实现 15 Gbps 高频信号传输, 功耗约为 0.045 mW/Gbps 。研究表明, TSC 互连是一种高可靠、低成本的三维互连结构, 为实现高频三维集成电路(3D IC)提供一种可行的互连技术方案。

关键词: 三维集成电路(3D IC); 三维互连; 硅通孔 (TSV); 电容耦合互连(CCI); 硅通孔 (TSV) 背面通孔外露工艺

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An Improved 3D Interconnection Technology of

Through Silicon Capacitors

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Abstract: To overcome high complexity, high cost and hidden trouble caused by the backside via reveal process of through silicon via (TSV), an improved 3D interconnection technology called through silicon capacitor (TSC) was proposed. The structural feature and fabrication process of TSC were introduced firstly. Then, the capacitive coupling characteristic of the TSC interconnection was analyzed by the electromagnetic simulation. Based on the traditional transceiver circuit, the feasibility of high frequency signal transmission for the TSC interconnection was verified by the HSPICE simulation. The results of analysis and simulation indicate that without the adoption of TSV backside via reveal process, the cost and hidden trouble of the TSC can be further reduced. A TSC channel with the radius of $2.5 \mu\text{m}$ and height of $50 \mu\text{m}$ can achieve the high frequency signal transmission of 15 Gbps and the power consumption of about 0.045 mW/Gbps . The researches show that the TSC interconnection is a 3D interconnection structure with high reliability and low cost, and provides a feasible interconnection technology for high frequency 3D ICs.

Key words: three dimensional integrated circuit (3D IC); three dimensional interconnection; through silicon via (TSV); capacitive coupling interconnection (CCI); through silicon via (TSV) backside via reveal process

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石墨烯湿法转移过程工艺优化

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摘要: 石墨烯的转移过程决定着石墨烯的品质, 进而对石墨烯基器件的性能有重要的影响。针对化学气相沉积(CVD)法生长的石墨烯在湿法转移过程中存在的问题, 在常规湿法转移的基础上进行了优化研究。实验结果表明: 基体背面石墨烯的刻蚀工艺可以有效解决铜箔残留问题; 采用二次涂胶工艺可以大幅降低石墨烯的裂痕破洞密度; 超声波处理有效提升了石墨烯表面残胶的去除效率。优化后的转移工艺可以明显降低石墨烯产品中的杂质数量和缺陷密度, 提升石墨烯的表面洁净度, 显著地提高石墨烯质量。

关键词: 石墨烯; 湿法转移; 刻蚀; 涂胶; 超声处理

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Optimization of the Wet Transfer Technique of Graphene

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Abstract: The transfer process of graphene plays an important role in determining the quality of graphene, which further exerts an important influence on the performances of graphene based devices. For resolving the problem in the wet transfer process of graphene grown by the chemical vapor deposition(CVD) method, the optimized procedure was researched based on the conventional wet transfer of graphene. The experimental results show that the residue of copper is effectively eliminated by an extra etching of the graphene deposited on the back of copper. The densities of surface cracks and holes are largely reduced with the two step coating process. The removal efficiency of the residual polymer on the surface of graphene is significantly enhanced by the ultrasonic treatment. The optimized transfer procedure can obviously reduce the amount of impurities and defect density of graphene and significantly improve the surface cleanliness and quality of graphene.

Key words: graphene; wet transfer; etching; coating; ultrasonic treatment

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深度等离子体反应刻蚀技术制备擒纵机构

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摘要: 采用磁控溅射法在单晶硅基片上制备铝膜, 并结合光刻技术将擒纵机构图形转移到铝膜。利用铝膜不与刻蚀气体反应的特性, 将其取代光刻胶作为深度等离子体反应刻蚀制备擒纵机构时硅基片的掩蔽层, 并且采用干氧的方法在擒纵机构表面生成一层 SiO₂ 薄膜。详细研究了深度等离子体反应刻蚀的刻蚀宽度对擒纵机构的影响, 并对擒纵机构表面进行了详细的 SEM 分析和 EDS 能谱分析。研究表明, 采用铝膜作为掩蔽层能够对擒纵机构的表面和断面起到很好的保护作用, 擒纵机构获得优良的表面质量, 且在刻蚀窗口宽度为 75 μm 时, 获得最优的擒纵机构零件。

关键词: 单晶硅; 深度等离子体反应刻蚀; 擒纵机构; 微机械加工; 光刻

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Preparation of Escapement Using Deep Plasma Reaction Etching Technology

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Abstract: The Al film was prepared on the monocrystalline silicon substrate by the magnetron sputtering method, and the escapement pattern was transferred to the Al film using the lithography technique. Based on the characteristic of the Al film not reacting with the etching gas, the Al film instead of photoresist was used as the masking layer of the silicon substrate when the escapement was fabricated using the deep plasma reaction technology, and a SiO₂ film was formed on the surface of the escapement by the dry oxygen method. Meanwhile, the effect of the etching width of the deep plasma reaction etching on the escapement was studied in detail, and the surface of the escapement was analyzed by SEM and EDS energy spectrum. The results show that the Al film as a masking layer can protect the surface and cross section of the escapement, and the escapement has excellent surface quality. When the width of the etching windows is 75 μm, the optimal parts of the escapement are obtained.

Key words: monocrystalline silicon; deep plasma reaction etching; escapement; micromachining; lithography

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镀 Ni 超细孔径多孔阳极氧化铝模板的合成和特性

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摘要: 采用电沉积法制备的镀 Ni 超细孔径(5 nm)的多孔阳极氧化铝(PAA)薄膜系列, 显示出鲜艳而多样的结构色。Ni 沉积在超细孔径的多孔阳极氧化铝(UPAA)模板的表面上, 形成了孔隙率很大的网状镀层。Ni 层是由疏松的纳米点组成。这些纳米点平均长度约为 46 nm, 纵横比小于 2。Ni 纳米点吸收和散射了来自 UPAA/Al 界面反射的自然光, 从而提高了 UPAA 模板的结构色饱和度。通过改变 UPAA 薄膜的厚度, 可在自然光范围内精细调控样品的结构色。Ni/UPAA 复合薄膜的矫顽力和方形度高达 810 Oe 和 0.61。沉积的 Ni 层呈面心立方相和磁各向异性, 其矫顽力基本符合一致转动模型。Ni/UPAA 复合薄膜可应用于装饰、液体传感器、显示器和多功能防伪领域。

关键词: 结构色; 磁性能; 多孔阳极氧化铝(PAA)模板; 薄膜; 光学性能; 磁记录

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Synthesis and Properties of Ni Coated Porous Anodic Alumina
Templates with Ultrafine Pore Diameter

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Abstract:The Ni coated ultrafine porous anodic alumina(PAA)films (the pore diameter of 5 nm) with colorful and varied structural colors were prepared by the electrodeposition method. Ni was deposited on the surface of the ultrafine pore diameter PAA (UPAA) template, forming a netlike coating with a high porosity. The Ni layer is composed of loosen nanodots. The average length of the nanodots is about 46 nm and the aspect ratio is less than 2. The Ni nanodots absorb and scatter part of the reflected natural light from UPAA/Al interface to enhance the structural color saturation of the UPAA template. The structural color of the sample can be precisely tunable in the range of natural light by adjusting the thickness of the UPAA thin film. The values of the coercivity and squareness ratio of the Ni/UPAA composite thin films are as high as 810 Oe and 0.61, respectively. The deposited Ni layer presents face centered cubic phase and magnetic anisotropy, and the coercivity is basically in agreement with the coherent rotation model. The Ni/UPAA composite thin films can be used in many areas, including decoration, liquid sensor, display and multifunctional anti counterfeiting technology.

Key words:structural color; magnetic property; porous anodic alumina (PAA) template; thin film; optical property; magnetic recording

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