

Analysis and Optimization of the Voltage Temperature  
Coefficient of a Thermodiode Uncooled Infrared

Focal Plane Array

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**Abstract:** Sensitivity is an important performance index of the thermodiode uncooled infrared focal plane array (IRFPA). The voltage temperature coefficient (VTC) of diode structures has a strong impact on the sensitivity. The influences of the design and process parameters on the VTC of the diode structure were analyzed. The simulation result shows that the number of series diodes and pn junction area are two key factors influencing the VTC. Therefore, the diode structure with six series "well" shape pn junctions was designed. The thermodiode IRFPA with this structure was fabricated. The test results show that under the forward bias current of  $10\ \mu\text{A}$ , the VTC of the diode structure is  $8.2\ \text{mV/K}$ , and the sensitivity of a single pixel is  $19.1\ \mu\text{V/K}$ . And the test results of structures with different junction areas show that increasing the junction area can effectively enhance the VTC and sensitivity of the diode structure.

**Key words:** voltage temperature coefficient (VTC); pn junction diode; infrared focal plane array (IRFPA); sensitivity; micro electro-mechanical system (MEMS)

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非制冷热敏二极管型红外焦平面阵列电压

温度系数的分析与优化

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**摘要:**灵敏度是非制冷热敏二极管型红外焦平面阵列(IRFPA)的一项重要性能指标。二极管结构的电压温度系数(VTC)对灵敏度有很大的影响。分析了二极管结构的设计参数和工艺参数对其电压温度系数的影响,仿真结果表明二极管的串联个数和pn结结面积是两项重要因素。因此,设计出6个串联“阱”形pn结的二极管结构,并对具有该结构的热敏二极管型红外焦平面阵列进行了流片。测试结果表明,在 $10\ \mu\text{A}$ 正向偏置电流下,二极管结构的电压温度系数为 $8.2\ \text{mV/K}$ ,单个像素的灵敏度为 $19.1\ \mu\text{V/K}$ 。不同结面积结构的测试结果表明,增加结面积能有效提升二极管结构的电压温度系数和灵敏度。

**关键词:**电压温度系数(VTC); pn结二极管; 红外焦平面阵列(IRFPA); 灵敏度; 微电子机械系统(MEMS)

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不同退火温度下 Mo/4H SiC 肖特基接触  
势垒不均匀及 XRD 分析

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摘要: 为探究退火温度对 Mo/4H SiC 肖特基接触势垒不均匀程度的影响, 对在不同退火温度下形成的 Mo/4H SiC 肖特基接触进行了不同测试温度下的电流-电压(I-V)及电容-电压(C-V)测试, 运用 Tung 理论模型和“T0 反常”中的 T0 值评价势垒不均匀程度, X 射线衍射(XRD)分析肖特基接触的物相组成。分析结果表明, 测试温度升高时 I-V 测试提取的势垒高度接近于 C-V 测试提取的势垒高度, 退火温度 500 °C 及以上时 Mo 与 4H SiC 发生反应, 且导致较低的势垒高度。退火温度为 600 °C 时, 肖特基接触具有最低的势垒不均匀程度, 且此退火温度下势垒高度相对 500 °C 及 700 °C 时较高, 物相组成为 Mo<sub>2</sub>C 及 Mo<sub>4</sub>Si<sub>3</sub>C<sub>6</sub>。

关键词: 4H SiC; 肖特基接触; X 射线衍射(XRD); 势垒不均匀; 退火温度

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Analysis of the Inhomogeneous Barrier and XRD of Mo/4H SiC

Schottky Contacts Formed at Different Annealing Temperatures

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Abstract: In order to investigate the effect of annealing temperature on the degree of barrier inhomogeneity of Mo/4H SiC Schottky contacts, the current-voltage (I-V) and capacitance-voltage (C-V) characteristics of the Mo/4H SiC Schottky contacts formed at different annealing temperatures were measured at different testing temperatures. The degree of barrier inhomogeneity was evaluated with Tung theoretical model and T0 value of "T0 anomaly", and the phase components of the Schottky contacts were analyzed by X-ray diffraction (XRD). The analysis result shows that the barrier height obtained from the I-V test at high testing temperatures is close to the barrier height obtained from the C-V test, and Mo reacts with 4H SiC at the annealing temperature of 500 °C and above, leading to the low barrier height. The Schottky contact has the lowest degree of barrier inhomogeneity at the annealing temperature of 600 °C, and the barrier height at the annealing temperature of 600 °C is relatively higher than those at the annealing temperature of 500 °C and 700 °C. The phase components are Mo<sub>2</sub>C and Mo<sub>4</sub>Si<sub>3</sub>C<sub>6</sub>.

Key words: 4H SiC; Schottky contact; X-ray diffraction (XRD); barrier inhomogeneity; annealing temperature

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纳米氧化铜尺寸效应对其湿度传感特性的影响

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摘要: 通过水热法制备 3 种尺寸的氧化铜(CuO)片状纳米结构, 采用介电泳方法将所制备纳米结构定位到预先设计的 Ti/Au 电极上, 以此为基础来构建湿度传感器并进行传感特性测试。实验结果表明: 氧化铜纳米结构尺寸为 4, 3 和 1  $\mu\text{m}$ , 相对应所构建的湿度传感器的灵敏度分别为 0.436, 0.665 和 0.891  $\text{k}\Omega/\text{RH}\%$ 。发现氧化铜纳米结构的尺寸越小, 以之为敏感元件的湿度传感器的灵敏度越高。结合多层吸附理论模型, 深入讨论了纳米结构尺寸对湿度传感特性的影响。分析结果表明, 通过对依赖于纳米结构尺寸的比表面积和表面原子活性的调控, 可以有效改善纳米湿度传感器灵敏度等性能。

关键词: 湿度传感器; 氧化铜纳米结构; 水热合成法; 比表面积; 传感特性

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Influence of the Size Effect of Nanometer CuO on  
Its Humidity Sensing Property

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Abstract: Three sizes of CuO sheet nanostructures were fabricated using the hydrothermal method. Three humidity sensors were fabricated through assembling the prepared CuO nanostructures on the predesigned Ti/Au electrodes using the dielectrophoresis method, and the sensing properties were tested. The experimental results show that the sizes of CuO nanostructures are 4, 3 and 1  $\mu\text{m}$ , and the corresponding sensitivities of the humidity sensors are 0.436, 0.665 and 0.891  $\text{k}\Omega/\text{RH}\%$ , respectively. It is found that the smaller the size of the CuO nanostructure is, the higher the sensitivity of the humidity sensor with the CuO nanostructure as the sensitive element is. Combing the multilayer humidity adsorption theoretical model, the effect of the nanostructure size on the humidity sensing property was discussed. The analysis results show the sensitivity of the nanometer humidity sensor is improved by adjusting the specific surface area and surface atomic activity depending on nanostructure size.

Key words: humidity sensor; CuO nanostructure; hydrothermal method; specific surface area; sensing property

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基于 SOI 岛膜结构的高温压力传感器

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摘要: 针对绝缘体上硅 (SOI) 压力传感器平模结构下压敏电阻所在区域应力跨度过大而导致的线性度降低问题, 采用了岛膜结构改善敏感膜片表面的应力分布, 使压敏电阻能够完全布置在应力集中区, 从而提高传感器的灵敏度和线性度。使用有限元分析软件对岛膜结构进行力学性能分析, 根据敏感膜片表面应力分布情况确定压敏电阻最优的位置分布, 并完成敏感芯片的制备。对完成的敏感芯片进行封装并进行温度-压力的复合测试, 测试结果表明在 19~200 °C、量程 2 MPa 范围内, 该传感器有较高的灵敏度 (0.055 mV/kPa) 和线性度 (0.995)。

关键词: 绝缘体上硅 (SOI); 压敏电阻; 岛膜结构; 压力传感器; 有限元分析

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High Temperature Pressure Sensor Based on

SOI Island Film Structure

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Abstract: In order to resolve the problem of linearity decrease caused by excessive stress span in the region where the varistor was located under the flat mode structure of silicon on insulator(SOI) pressure sensors, the island film structure was used to improve the stress distribution on the sensitive film surface, then the varistor was completely arranged in the stress concentration area, thus the sensitivity and linearity of the sensor were improved. The finite element analysis software was used to analyze the mechanical properties of the island film structure, the optimal position distribution of the varistor was determined according to the stress distribution on the sensitive film surface, and the fabrication of the sensitive chip was completed. Encapsulation and temperature pressure composite test of the fabricated sensitive chip were carried out. The test result shows that the sensor has high sensitivity (0.055 mV/kPa) and linearity (0.995) at 19-200 °C within the range of 2 MPa.

Key words: silicon on insulator(SOI); varistor; island film structure; pressure sensor; finite element analysis

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基于微流控芯片的 SAW 分选技术研究现状

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摘要: 声表面波 (SAW) 分选技术因其无接触性、生物相容性好等特点, 在生物医学、诊断学等领域有着广阔的应用前景。概述了声表面波分选芯片的基本结构组成、叉指换能器 (IDT) 的基本结构及工作原理, 分析了行波声表面波 (TSAW) 和驻波声表面波 (SSAW) 进入流体后产生的复杂的声流效应。根据声表面波分选技术的分选机理不同, 将声表面波分选技术分为驻波声表面波分选技术和行波声表面波分选技术。分别讨论了声表面波分选技术的分选原理和研究现状, 指出了声表面波分选技术相对于其他分选技术的优势, 并综合国内外研究现状分析了研究过程中存在的问题, 提出了声表面波分选技术今后的研究方向。

关键词: 声表面波 (SAW); 分选技术; 微流控芯片; 叉指换能器 (IDT); 驻波声表面波 (SSAW); 行波声表面波 (TSAW)

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Research Status on the SAW Sorting Technology

Based on Microfluidic Chips

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Abstract: Due to the surface acoustic wave (SAW) sorting technology with non contact, good biocompatibility and other characteristics, it has broad application prospects in biomedicine, diagnostics and other fields. The basic structure of the SAW sorting chip, the basic structure and working principle of the interdigital transducer (IDT) are overviewed, and the complicated acoustic flow effect caused by travelling surface acoustic wave (TSAW) and standing surface acoustic wave (SSAW) entering fluid is analyzed. According to the different sorting mechanisms of the SAW sorting technology, the SAW sorting technology is divided into SSAW sorting technology and TSAW sorting technology. The sorting principle and research status of the SAW sorting technology are discussed, the advantages of SAW sorting technology over other sorting technologies are pointed out. The existing problems in the research process are analyzed by integrating the research status at home and abroad, and the research direction of the SAW sorting technology in the future is presented.

Key words: surface acoustic wave (SAW); sorting technology; microfluidic chip; interdigital transducer (IDT); standing surface acoustic wave (SSAW); travelling surface acoustic wave (TSAW)

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## RF MEMS 开关的研究进展及其应用

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**摘要:** 射频微电子机械系统 (RF MEMS) 开关是射频电子系统中的关键器件, 首先简要介绍了 RF MEMS 开关的结构特点及分类方式, 综述了 RF MEMS 开关的发展现状, 列举了国内著名科研机构具有代表性的成果, 并对比了其结构特点及性能参数, 指出国内 RF MEMS 开关正向着小体积、宽频化、低驱动电压、高性能指标的方向发展。此外, 还阐述了 RF MEMS 开关在多位移相器、可调滤波器、可重构天线等方面的应用, 其在与多器件的集成和联合运用中潜力巨大。最后, 分析了现有的 RF MEMS 开关的发展瓶颈, 并展望了其以设计新结构、探寻新材料、探索新工艺、多种驱动方式相结合、多器件相集成为未来发展新方向。研发制作新的 RF MEMS 开关及其功能系统必将会对射频微波领域造成巨大影响。

**关键词:** 射频微电子机械系统 (RF MEMS) 开关; 移相器; 可调滤波器; 可重构天线; 微波  
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### Research Progresses and Applications of RF MEMS Switches

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**Abstract:** Radio frequency (RF) micro electromechanical system (MEMS) switches are the key components in RF electronic systems. The structural characteristics and classification of the RF MEMS switches are firstly introduced in brief, and the development status of the RF MEMS switches is reviewed. The representative achievements of famous domestic scientific research institutions are listed, and their structural characteristics and performance parameters are compared. The domestic RF MEMS switches are developing towards the direction of small volume, broadband, low drive voltage and high performance. Besides, the applications of the RF MEMS switches in multibit phase shifters, tunable filters and reconfigurable antennas are elaborated, RF MEMS switches have unlimited potential in the integration and combination with multiple devices. Finally, the development bottleneck of the existing RF MEMS switches is analyzed, and their future development new direction is prospected, i.e. designing new structures, searching new materials, exploring new manufacture technology, combining various driving modes and integrating multiple devices. The research and development of the new RF MEMS switches and their functional systems will have great influence on the fields of radio frequency and microwave.

**Key words:** radio frequency micro electromechanical system (RF MEMS) switch; phase shifter; tunable filter; reconfigurable antenna; microwave

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### 三种平面被动式微混合器的对比

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摘要: 主要通过数值模拟对比研究流率比和雷诺数的变化对 Circle, Spiral 和 Tesla 三种平面被动式微混合器混合效率的影响。通过混合指数、阻力系数及涡量等分析三种微混合器间的差异, 发现 Tesla 模型的混合效果最好, 而同为非对称分离-聚合结构的 Circle 模型却没有明显的混合优势, 通道宽度和通道方向不断变化的 Spiral 模型在高雷诺数条件下反而取得了很好的混合效果, 三种模型的数值模拟结果通过荧光实验得到有效验证。最后结合 Spiral 与 Tesla 模型的研究结果, 将 Tesla 模型改为单通道结构并进行数值模拟, 发现改进的 Tesla 模型的混合效果比 Tesla 模型更好。若在微通道内部能够产生足够强度的扰动, 溶液间的扩散对流效应将因此加强, 从而有效提高混合效率, 研究结果对于微混合器在制药或食品工业等相关领域的实际应用具有一定的指导意义。

关键词: 平面被动式微混合器; 微通道; 混合效率; 涡量; 扩散对流效应

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Comparison of Three Kinds of Planar Passive Micromixers

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Abstract: By the numerical simulation, the effects of various flow rate ratios and Reynolds numbers on the mixing efficiency of three kinds of planar passive micromixers were compared and investigated, i.e. Circle, Spiral and Tesla micromixers. The mixing indexes, friction coefficients and vorticities of the three micromixers were analyzed. It is found that Tesla model has the best mixing efficiency, while the Circle model with the same asymmetrical split recombine structure has no obvious advantage on mixing, but the Spiral model with constantly changing channel width and channel direction has good mixing efficiency under high Reynolds number. The numerical simulation results were effectively verified by the fluorescence experiment. Finally, the Tesla model was modified into single channel structure by combining the study results of Spiral and Tesla models. The numerical simulation of the modified Tesla model was carried out. The result shows that the modified Tesla model has better mixing efficiency than the Tesla model. The diffusion and advection effect was enhanced with sufficient disturbance existing in the microchannel, thus the mixing efficiency was effectively enhanced. The research results have a certain guiding significance for practical applications of micromixers in the pharmaceutical and food engineering and other fields.

Key words: planar passive micromixer; microchannel; mixing efficiency; vorticity; diffusion and advection effect

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基于移动 X 射线光刻工艺的采血微针阵列的制备

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摘要: 为了降低传统采血对人体的疼痛感和损伤, 制备了采血微针阵列结构。该微针阵列结构是采用日本立命馆大学的同步辐射光源 AURORA 进行两次移动 X 射线光刻, 在聚甲基丙烯酸甲酯(PMMA)光刻胶上得到与光刻、电铸和注塑(LIGA)掩膜版图形相似的曝光能量分布图, 再利用显影技术获得了断面形状与 LIGA 掩膜版图形相似的 PMMA 微针阵列结构, 密度为 1 024 针/cm<sup>2</sup>, 微针尖端直径达到 300 nm。通过采用不同的掩膜版图形, 获得了形状各异的微针阵列结构。并且进行了采血实验, 通过毛细效应, 测试液在流入沟槽后被提取并保持, 拔出的微针且不受损伤, 1 cm<sup>2</sup> 微针阵列可以提取 0 5 μL 测试液。最后, 针对光刻过程中微针阵列结构的侧面形状发生畸变的情况, 对移动 X 射线光刻建立了仿真预测, 并且对 LIGA 掩膜版进行补偿, 增强了采血微针阵列强度。

关键词: 采血微针阵列; 移动 X 射线光刻; 毛细效应; 光刻、电铸和注塑(LIGA)

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Preparation of the Blood Extraction Microneedle Array

Based on the Moving X Ray Lithography

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Abstract: In order to decrease pain and damage of the traditional blood extraction on the human body, the blood extraction microneedle array structure was prepared. Two time moving X ray lithography process was carried out by using the synchrotron radiation source AURORA of Japan's Ritsumeikan University, and the exposure energy distribution pattern of the microneedle array was obtained on the polymethyl methacrylate(PMMA) photoresist plate, which was similar to the lithographic, galvanofornung and abformung(LIGA) mask pattern. PMMA microneedle array was obtained by the developing technology, whose cross section shape was similar to the LIGA mask pattern. The density of the microneedle array was 1 024 needles/cm<sup>2</sup>, and the diameter of the microneedle tip was 300 nm. The different microneedle array structures were fabricated using different mask patterns. In addition, the blood extraction experiment was carried out. By the capillary effect, the test liquid was extracted and maintained after flowing into the grooves, and the extracted microneedle was not damaged, 0 5 μL test liquid was extracted in 1 cm<sup>2</sup> microneedle array. Finally, in order to resolve the problem of the section shape distortion of the microneedle array structure, the simulation prediction was established for the moving X ray lithography. Besides, the LIGA mask plate was compensated to enhance the strength of the extraction microneedle array .

Key words: blood extraction microneedle array; moving X ray lithography; capillary effect; lithographic, galvanofornung and abformung(LIGA)

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## 新型 5×5 分束达曼光栅的设计与制作

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摘要: 基于理论设计了一种面内旋转对称的新型 5×5 分束达曼光栅, 研究并优化了光栅制作中曝光、显影及深刻蚀等关键工艺参数。采用接触式曝光和感应耦合等离子体 (ICP) 刻蚀技术, 在石英基底上制作出达曼光栅结构。实验中通过优化石英基底上接触式曝光时间和显影时间, 较好控制了曝光图形失真; 进一步通过控制 ICP 刻蚀工艺参数, 获得了刻蚀深度为 (750±10) nm 的石英衬底, 实现了达曼光栅器件的制备。通过衍射光学特性评测得到了理论设计的零级衍射场均匀分布的 5×5 点阵, 总的衍射效率达到 53%, 不均匀性仅为 0.19%。实验证明了理论设计与工艺技术的可靠性, 为达曼光栅器件的集成光学系统应用奠定基础。

关键词: 达曼光栅; 二元光学; 光刻; 邻近效应; 深刻蚀

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Design and Fabrication of a Novel 5×5 Beam Dammann Grating

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Abstract: A novel 5×5 beam Dammann grating with in-plane rotational symmetry was designed in theoretically. Taking account in the requirement, the key process parameters for fabricating the Dammann grating were studied and optimized, involving the exposure, developing and deep etching. By using the contact exposure and inductively coupled plasma (ICP) etching technique, a Dammann grating structure was fabricated on the quartz substrate. In the experiment, the distortion of the exposure pattern was effectively controlled by optimizing the contact exposure time and developing time on the quartz substrate. Furthermore, the quartz substrate with the etching depth of (750±10) nm was obtained by controlling the ICP etching parameters, and the Dammann grating device was prepared. Through evaluating the diffraction optical properties, the theoretically designed 5×5 spots array with evenly distributed zero order diffraction field was obtained. The total diffraction efficiency reaches 53%, and the heterogeneity is only 0.19%. The experimental results demonstrate that the theoretical design and technology are reliable, laying a foundation for the integrated optical system application of the Dammann grating device.

Key words: Dammann grating; binary optics; photolithography; proximity effect; deep etching

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## 金刚石 NV 色心磁力计极限灵敏度优化方法

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**摘要:** 光探测磁共振 (ODMR) 信号作为氮空位 (NV) 色心磁力计进行磁检测的主要手段, 其主要受到微波功率强度和激光功率强度的影响。对金刚石 NV 色心磁力计展开研究, 根据其检测原理, 探究其极限灵敏度优化方法。搭建了 ODMR 信号的检测系统, 对 ODMR 信号的激发功率进行了探究。实验结果表明在该实验系统下, 微波功率约为 60 mW、激光功率约为 10 mW 是最优的 ODMR 信号激发功率, 可以使磁力计灵敏度达到最优, 得到其理论值为  $17 \sim 80 \text{ nT/Hz}^{1/2}$ 。为金刚石 NV 色心磁力计灵敏度的进一步提高提供了改进方法。

**关键词:** 金刚石氮空位 (NV) 色心; 光探测磁共振 (ODMR) 信号; 微波; 激光; 极限灵敏度; 磁力计

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Optimization Method of the Limit Sensitivity for the Diamond NV  
Color Center Magnetometer

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**Abstract:** The optical detection magnetic resonance (ODMR) signal is a main method for magnetic testing of the nitrogen vacancy (NV) color center magnetometer, and is mainly affected by the microwave power intensity and laser power intensity. The diamond NV color center magnetometer was researched, and the optimization method of the limit sensitivity for the diamond NV color center magnetometer was studied by testing principle. The ODMR signal detection system was built to investigate the excitation power of the ODMR signal. The experiment results show that with the experimental system, the microwave power of about 60 mW and the laser power of about 10 mW are the optimal excitation powers of the ODMR signal, and the theoretically optimal limit sensitivity of the magnetometer of  $17 \sim 80 \text{ nT/Hz}^{1/2}$  can be obtained. The measured results indicate that the optimum proposal is capable of developing the sensitivity of the diamond NV color center magnetometer.

**Key words:** diamond nitrogen vacancy (NV) color center; optical detection magnetic resonance (ODMR) signal; microwave; laser; limit sensitivity; magnetometer

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气溶胶喷墨打印工艺参数对图案精度的影响

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摘要: 以商业纳米银颗粒墨水为打印材料, 以钠钙玻璃为衬底材料, 采用气溶胶喷墨打印工艺在衬底上打印形成银线。在搭建的气溶胶喷墨打印平台上, 通过改变工艺参数探究不同工艺参数对银线线宽的影响规律。通过激光共聚焦显微镜对打印图案进行测量与观察发现: 增大环绕气体流量、减小输送气体流量可以降低银线线宽; 增大气体流量比可以在减小打印线宽的同时减小铺展现象, 但会出现卫星液滴问题与沉积空洞现象; 提高打印速度也可以有效抑制铺展现象; 最后在钙钠玻璃衬底形成了平均电阻率为  $24 \sim 93 \mu\Omega \cdot \text{cm}$  的导电金属电极图案。

关键词: 气溶胶喷墨打印; 超声波雾化器; 纳米银颗粒; 银线线宽; 金属电极

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Influences of Aerosol Inkjet Printing Process

Parameters on the Pattern Accuracy

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Abstract:With the commercial silver nanoparticle ink as the printing material and sodium calcium glass as substrate material, the silver line was printed on the substrate by the aerosol inkjet printing process. On the aerosol inkjet printing platform, the influence rules of different process parameters on the width of the silver line were explored by changing printing process parameters. The printed pattern was measured and observed by the laser confocal microscope. The result shows that the width of the silver line can be reduced by increasing the surrounding gas flow and decreasing the transportation gas flow. Besides, the printing line width and spreading phenomenon can be reduced at the same time by increasing the gas flow ratio, but the satellite droplet problem and deposition hole phenomenon will appear. Increasing the printing speed can also effectively inhibit the spreading phenomenon. Finally, the conductive metal electrode pattern with a mean resistivity of  $24 \sim 93 \mu\Omega \cdot \text{cm}$  was formed on the calcium sodium glass substrate.

Key words:aerosol inkjet printing; ultrasonic atomizer; silver nanoparticle; silver line width; metal electrode

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圆片级封装用玻璃通孔晶片的减薄工艺

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摘要: 对圆片级封装用玻璃通孔(TGV)晶片的减薄加工工艺进行了研究并最终确定出工艺路线。该减薄加工工艺主要包括机械研磨及化学机械抛光(CMP)过程。通过机械研磨, 玻璃通孔晶片的残余玻璃层及硅层得到有效去除, 整个晶片的平整度显著提高, 用平面度测量仪测试该晶片研磨后的翘曲度与总厚度变化(TTV)值分别为  $7.149 \mu\text{m}$  与  $3.706 \mu\text{m}$ 。CMP 过程使得 TGV 晶片的表面粗糙度大幅度降低, 经白光干涉仪测试抛光后 TGV 晶片的表面粗糙度为  $4.275 \text{ nm}$ 。通过该减薄工艺加工的 TGV 晶片能够较好满足圆片级封装时的气密性要求。

关键词: 玻璃通孔(TGV)晶片; 机械研磨; 化学机械抛光 (CMP); 平整度; 粗糙度

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Thinning Process of the TGV Wafer Used in the

Wafer Level Packaging

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Abstract: The thinning process of the through glass via (TGV) wafer used in the wafer level packaging was explored and finally determined. The thinning process mainly consists of mechanical lapping and chemical mechanical polishing(CMP). The residual glass layer and silicon layer on the TGV wafer were removed effectively, and the flatness of the whole wafer was improved significantly after the mechanical lapping process. The warp and total thickness variation (TTV) of the wafer after mechanical lapping measured by the flatness measuring instrument were  $7.149 \mu\text{m}$  and  $3.706 \mu\text{m}$ , respectively. The surface roughness of the TGV wafer was decreased greatly through the CMP process. The surface roughness of the polished TGV wafer was  $4.275 \text{ nm}$  measured by the white light interferometer. The TGV wafer after the thinning process can meet the requirement of air tightness in the wafer level packaging.

Key words: through glass via (TGV) wafer; mechanical lapping; chemical mechanical polishing(CMP); flatness; roughness

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