高质量金刚石助力极窄带深紫外光探测

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大多数基于厚金刚石单晶的光电探测器由于金刚石的高迁移率和载流子陷阱效应而表现出宽带响应。因此，调节光谱响应的另一个关键参数—载流子寿命被认为是实现窄带光电探测的关键。对金刚石的光电特性进行详细分析对于实现光电操纵至关重要。

中山大学郑伟课题组在深紫外窄带探测器方面取得重要进展，所研究的三种不同位错密度的金刚石单晶分别被命名为金刚石 A，B 和 C，这三种金刚石的位错密度依次增加。有趣的是，基于金刚石 A，B 和 C 的器件的外量子效率（EQE）光谱显示出截然不同的形状，其半高宽（FWHM）分别为 8 nm，31 nm 和 52 nm。基于低位错密度金刚石 A 的器件的 EQE 光谱具有极窄带响应，其中心约在 228 nm 处。该器件表现出极低的暗电流，高的比探测率（~1013 Jones）和大的线性动态范围（LDR~118 dB）。所制备的窄带探测器可用于分辨不同光源的成像。

所研究的金刚石 A 基光电探测器具有目前为止最短的探测波长和最窄的 EQE 峰，其应用潜力已通过初步成像演示得到证明。未来可通过制作面阵器件和优化器件结构进一步提高该探测器的实用性能。另一方面，金刚石 A 的窄带响应将其与其他金刚石区分开来，表明金刚石的光谱响应测试是辨别其质量的一种可行方法。

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High-quality diamonds empower narrowband deep ultraviolet photodetection

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Most photodetectors based on thick single-crystal diamond exhibit broadband responses due to the high mobility of carriers in diamond and carrier trapping effects. Therefore, another critical parameter for tuning the spectral response is carrier lifetime, which is considered essential for achieving narrowband photodetection. Detailed analysis of the optical and electrical properties of diamond is crucial for achieving precise photomanipulation.

Recently, the research group led by Professor Zheng Wei at Sun Yat-sen University has made significant progress in the field of deep ultraviolet narrowband photodetectors. The three different single-crystal diamonds studied they reported are named Diamond A, Diamond B, and Diamond C, with their dislocation densities increasing sequentially. Interestingly, devices based on Diamond A, B, and C exhibit markedly different shapes in their external quantum efficiency (EQE) spectra, with full width at half maximum (FWHM) values of 8 nm, 31 nm, and 52 nm, respectively. Devices based on Diamond A, characterized by its low dislocation density, display an extremely narrowband response with a peak centered at approximately 228 nm. These devices demonstrate exceptionally low dark current, high detectivity (1013 Jones), and a large linear dynamic range (LDR~118 dB).

The reported Diamond A-based photodetector boasts the shortest detection wavelength and the narrowest EQE peak to date. Its potential applications have been demonstrated through preliminary imaging. In the future, the practical performance of this detector can be further improved by fabricating array devices and optimizing the device structure. On the other hand, Diamond A's narrowband response sets it apart from other diamonds, indicating that spectral response testing of diamonds is a feasible method for discerning their quality.

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