深紫外 LED 高效消杀人类呼吸道 RNA 病毒

DOI: 10.12086/oee.2024.241006.h01

深紫外光照是一种通过破坏病毒基因组来灭活病毒的有效方法。基于 AlGaN 的深紫外 LED 通常在 AlN/蓝宝石模板上异质外延生长。然而，高温热退火 AlN/蓝宝石模板通常表现出较强的压缩应力，这会显著影响上部 AlGaN 的质量。

中国科学院长春光学精密机械与物理研究所黎大兵、孙晓娟研究团队与武汉大学病毒学国家重点实验室徐可研究团队合作，进行了强压应力 AlN/蓝宝石模板衬底上外延 AlGaN 基深紫外 LED 的应力工程、器件制备，以及器件对人类呼吸道 RNA 病毒消杀效率的研究。研究发现，通过在强压应力 AlN/蓝宝石衬底与 AlGaN 外延层之间插入超晶格结构，能有效缓解衬底对外延层的强压应力，使得 AlGaN 外延层位错密度相比直接外延方式降低一个数量级以上，并且具有原子级平整的表面，可以显著提升外延 LED 界面质量。同时，研究团队在相同的光功率密度（0.8 mW/cm^2）下，对不同波长对人类呼吸道 RNA 病毒 SARS-CoV-2、IAV 和人类副流感病毒（HPIV）的消杀效果进行了研究。结果表明，当病毒浓度为 3.8×10^5 PFU/mL 时，所有波长 LED 在 60 s 内均能 100% 消杀 SARS-CoV-2 和 IAV。其中，256 nm-LED 更是能在 10 s 内 100% 消杀 SARS-CoV-2 和 IAV，展现出相比长波长 LED 更高的消杀效率。

Opto-Electronic Advances, 2023, **6**(9): 230004.
https://www.oejournal.org/article/doi/10.29026/oea.2023.230004.

Rapid inactivation of human respiratory RNA viruses by DUV LEDs

DOI: 10.12086/oee.2024.241006.h01

DUV light irradiation is an effective virus inactivation method through damaging viral genomes. AlGaN-based DUV LEDs are usually heteroepitaxially grown on AlN/Sapphire template since AlN single-crystal substrates are too expensive.

The research group of Prof. Dabing Li and Xiaojuan Sun from Changchun Institute of Optics, Fine Mechanics and Physics, CAS, cooperated with the research group of Prof. Ke Xu from Wuhan University, have carried out researches on the stress engineering, device preparation, and their inactivation efficiency on human respiratory RNA viruses by epitaxial AlGaN-based DUV LEDs on SCS AlN/sapphire template substrates. It is found that by inserting a superlattice structure between the SCS AlN/sapphire substrate and the AlGaN epitaxial layer, the SCS of the epitaxial layer of the substrate can be effectively relieved, so that the dislocation density of the AlGaN epitaxial layer is reduced by more than an order of magnitude and atomic level flat surface can be obtained, improving the quality of the epitaxial LED interface. Based on this method, the research team prepare AlGaN based DUV LEDs with different peak wavelengths such as 256, 265, and 278 nm, corresponding to optical power of 6.8, 9.6 and 12.5 mW at 100 mA. At the same time, the research team studied the disinfection and sterilization effect of different wavelengths on human respiratory RNA virus SARS-CoV-2, IAV and human parainfluenza virus (HPIV) under the same optical power density (0.8 mW/cm^2).

Opto-Electronic Advances, 2023, **6**(9): 230004.
https://www.oejournal.org/article/doi/10.29026/oea.2023.230004.