

13TH INTERNATIONAL CONFERENCE ON

ADVANCED MATERIALS AND NANOTECHNOLOGY

OCTOBER 26-28, 2017 OSAKA, JAPAN

High performance of patterned sapphire substrate light-emitting diodes with embedded air void by textured Si₃N₄ intermediate layer**Shih-Chieh Hsu, Chao Szu Han and Ying-Hui Luo**
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We use Patterned Sapphire Substrate (PSS) to obtain the completed mesa-type Light-Emitting Diode (LEDs). It can reduce the threading dislocation densities. In addition, we use textured silicon nitride (Si₃N₄) to replace silicon dioxide (SiO₂), which is commonly used, as a barrier to form a patterned sapphire substrate. After re-growing, we observe that the air voids exist on the top of the textured Si₃N₄ intermediate layer. The air voids help more light be extracted to the outside due to the total reflection and thus enhance the light extraction efficiency of light-emitting diodes. Additionally, we use temperature dependent PL results to estimate the Internal Quantum Efficiency (IQE) of PSS-LED and that of PSS-LED with embedded air void. While the IQE of PSS-LED is 8.87%, the other present is 11.29 % and the PL intensity of PSS-LED with embedded air voids is 1.27 times higher than PSS-LED. Finally, we performed optical simulation by TracePro. It also reveals that the Light Extraction Efficiency (LEE) of PSS-LED with embedded air voids is 1.44 times better than that of the PSS-LED.

Biography

Shih-Chieh Hsu has completed his PhD from National Central University and Postdoctoral studies from RCAS, Sinica. He is the Associate Professor of department of chemical and materials engineering at Tamkang University. His work focuses on optoelectronic devices, semiconductor and light-emitting diodes. He has published more than 23 papers in reputed journals and has been serving as an Editorial Board Member of reputed.

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