

Highly controlled luminescence angle-profile from light-emitting diodes with super-periodic photonic-crystal patterns on the PMMA film

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A super-periodic photonic-crystal light-emitting diode (super-PhC LED) exhibiting highly-controlled luminescence angle-profile is proposed for applications which require vertical light extraction with such special beaming profiles. A highly directional profile and a side-illuminating profile are investigated and fabricated to confirm the basic idea. The prototype LED with the PhC-patterned PMMA film, instead of the PhC-patterned semiconductor surface [1], on the semiconductor epitaxy structure is supposed to show the extraction efficiency that is much higher than the ones without the film. Two specific designs are proposed, which were guided by the basic convolution principle in the two-dimensional discrete-Fourier transform technique on defect-localized eigen-fields and have been confirmed by the three-dimensional finite-difference time-domain simulation.

The super-PhC patterns are generated on the PMMA film by the e-beam lithographic process. The far-field pattern from the prototype LED is measured under optical pumping. Electric injection is being investigated and is expected to give similar results. **This research was supported in part by the MIC, Korea, under the ITRC program supervised by the IITA.**

[1] Chan M. Lim and G. Hugh Song, *33rd International symposium on compound semiconductor*, 213-214 (2004).