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Light extraction efficiency enhancement for fluorescent SiC based white light-emitting diodes

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Abstract

Fluorescent SiC based white light-emitting diodes(LEDs) light source, as an innovative energy-efficient light source, would even have longer lifetime, better light quality and eliminated blue-tone effect, compared to the current phosphor based white LED light source. In this paper, the yellow fluorescent Boron-Nitrogen co-doped 6H SiC is optimized in terms of source material, growth condition, dopant concentration, and carrier lifetime by using photoluminescence, pump-probe spectroscopy etc. The internal quantum efficiency is measured and the methods to increase the efficiency have been explored. At a device level, the focus is on improving the light extraction efficiency due to the rather high refractive index of SiC by nanostructuring the surface of SiC. Both periodic nanostructures made by e-beam lithography and nanosphere lithography and random nanostructures made by self-assembled Au nanosphere mask and a thin layer of Al film have been investigated and all of them showed much enhanced extraction efficiency. All these good results pave the way to a very promising fluorescent SiC based white LED light source.