Fabrication and characterization of near ultraviolet light-emitting diode with self-assembled InGaN quantum dots

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We report on the fabrication and characterization of the ultra-violet light-emitting diode (UV LED) using self-assembled InGaN quantum dots (QDs) grown via a strain-induced Stranski-Krastanov growth mode. Structural characterizations by atomic force microscopy and transmission electron microscopy showed that the InGaN QDs have vertical thickness of 1.35 nm and diameter of 52 nm, and the density and size of the QDs increase with increasing the growth time. The temperature and excitation power dependent photoluminescence (PL) study showed that the InGaN QDs have large thermal activation energy for carrier escape and negligible piezoelectric field effect which are beneficial for the efficient light emitters. Electroluminescence spectra of the LED showed peak at 400 nm and it was redshifted with increasing an input current due to a Joule heating effect, indicating negligible piezoelectric field effect in the InGaN QDs as shown in the PL study. The output power of the LED increased linearly with increasing an input current up to 60 mA due to the thermally stable potential wells for carriers and the enhanced exciton binding energy in the InGaN QDs. These results indicate that the InGaN QDs are expected as promising light-emitting sources for the highly efficient UV LEDs.