Luminescence from site-controlled InGaN/GaN quantum dots

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The fabrication of InGaN quantum dots (QDs) at precisely controlled sites is important for a number of applications. We have fabricated such dots using arrays of selectively grown InGaN/GaN micro-pyramids. This work describes the growth of these structures, and presents evidence confirming the existence of the QDs, obtained using high spatial resolution spectroscopic measurements.

The pyramids were formed by MOCVD growth through an array of holes lithographically patterned into a silica mask on a sapphire substrate. The resultant hexagonally-symmetric structures exhibit sharp apices, allowing the formation of quantum dots during the subsequent growth of InGaN quantum wells (QWs) on the top surface. Data from single and five period quantum well structures will be presented.

Low temperature micro-photoluminescence (μPL) measurements on single pyramids showed narrow spectral lines, consistent with the emission characteristics of self-assembled InGaN QDs reported in the literature. The emission of a single quantum dot has been examined spectrally and temporally. Linewidths down to 650μeV were observed, broadening linearly with both laser power and temperature, with the peaks no longer observable above ~70 K. Time resolved μPL measurements give radiative lifetimes in the region of ~500 ps for the InGaN quantum dots.

Cathodoluminescence spectrum imaging was employed to examine sub-micron spatial variations in the emission properties of the structures. This showed the expected QW luminescence emitted from the side facets, and additionally an intense, longer wavelength (~530 nm) peak emanating only from the apex regions.