Optimized Relaxed, Graded Ingap and Alingap Transparent Substrates for Green Light Emitting Devices

Personnel

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In an effort to advance the state of light emitting devices, we examine the microstructure and defect behavior of the AlInGaP materials system, as grown by OMCVD. Perhaps the most important product of our microstructural studies is the ability to produce low-defect-density, relaxed, compositionally graded InGaP and AlInGaP buffers. This knowledge has been applied to a novel epitaxial-transparent-substrate LED design. A high-quality relaxed —x(InxGa1-xP) buffer, where x grades from 0 to 0.24, acts as a virtual substrate for a strained InxGa1-xP [0.45>x>0.30] quantum well device. Uniform In0.24Ga0.76P layers clad the quantum well active region. Because InxGa1-xP has an indirect bandgap for x<0.27 and a direct bandgap for x≥0.27, the active region is the only direct bandgap material in the device. Modeling predicts that these devices may emit light in the range of 540 nm to 590 nm. Using this structure, we have observed 569 nm (yellow-green) emission from an undulated quantum well. Introduction of Al to create an AlInGaP graded-buffer virtual substrate and cladding will enhance confinement and ensure that the structure is entirely transparent to the active region emission; this should lead to improved internal and extraction efficiencies. Forthcoming materials and device optimization utilizing the described structure will be aimed at production of high-brightness, fully-transparent green InGaP LEDs on GaP, and, ultimately, to the development of green InGaP lasers on GaP.

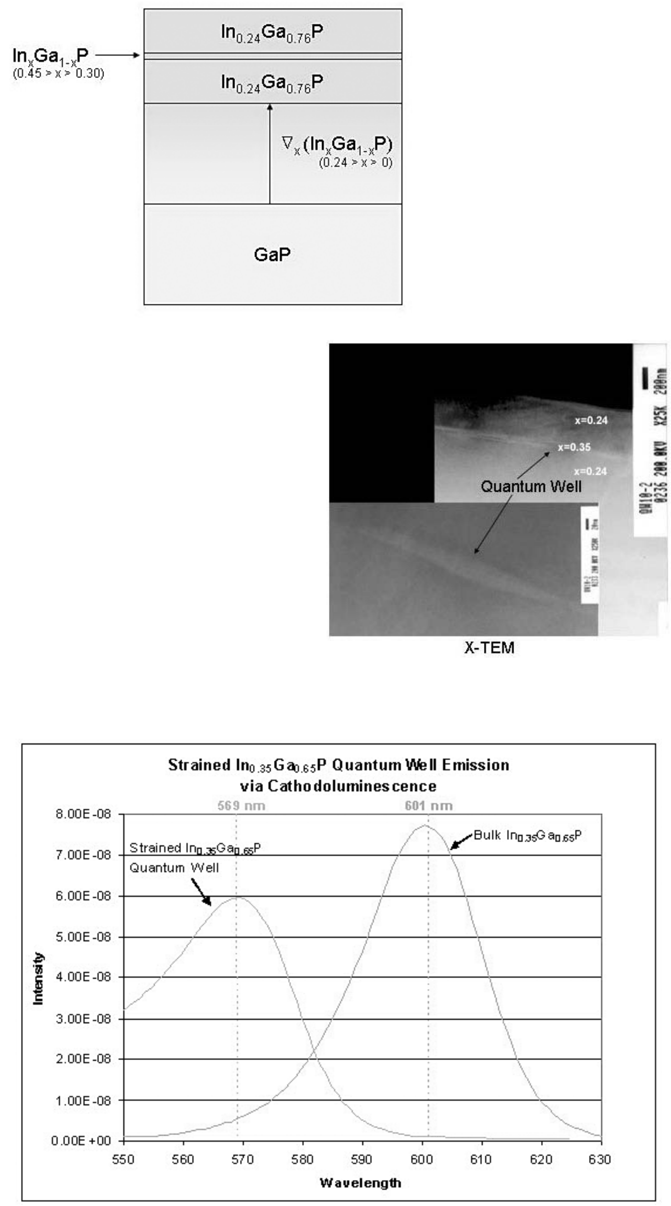

Fig. 49. Novel epitaxial-transparent-substrate InGaP QW LED design.