Solid State UV Light Emitters

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Ultraviolet (UV) light emitting diodes and lasers are expected to find numerous applications in biotechnology, medicine, dentistry, home security, food and air safety technology, short-range covert communications and solid state lighting. We report on three complementary approached for developing visible, near UV, and deep UV LEDs: strain energy band engineering (SEBE); pulsed atomic layer epitaxy (PALE), and the use of bulk AlN substrates. The SEBE approach relies on using ternary compounds and/or strain compensating superlattice structures for controlling strain and increasing the Al molar fraction for obtaining a shorter wavelength emission. The PALE process allows for the deposition of high quality layers of GaN and GaN/AlGaN and $Al_xIn_yGa_{1-x-y}N$ short period superlattices at temperatures significantly lower that the temperatures required for conventional MOCVD growth. The PALE approach allows the layer thickness and the alloy composition to be precisely controlled by the number of unit growth-cell repeats and the number of precursor pulses. Bulk AlN substrates allow for growing improved quality LED structures that can emit at wavelengths as short as 258 nm. The combination of these approaches has led to the demonstration UV LEDs with the emission peak in the range from 340 to 280 nm.