III-Nitride Deep Ultraviolet Light Sources

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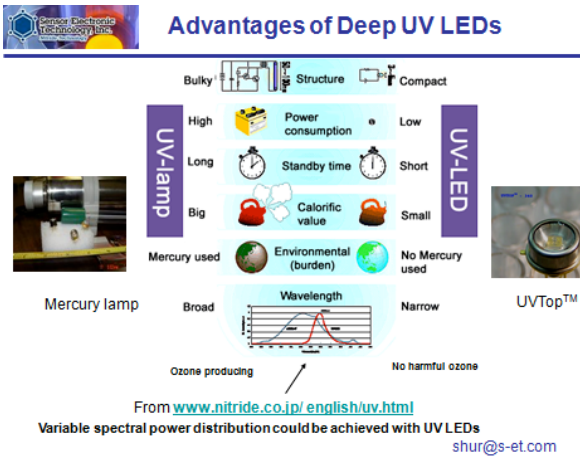
Ultraviolet radiation finds numerous applications for water and air purification, sterilization, biological threat identification, in medicine, biology, industrial processes, defense, and homeland security. Conventional ultraviolet Hg vapor, Xenon and Deuterium lamps are bulky, contain mercury, produce ozone, require high voltages, slow to turn on, and have a limited set of available wavelengths. III-Nitrides Deep UV (DUV) LEDs are environmentally friendly and compact sources consuming low power. Sensor Electronic Technology, Inc. has developed superior DUV LEDs based on innovative materials growth and device design.

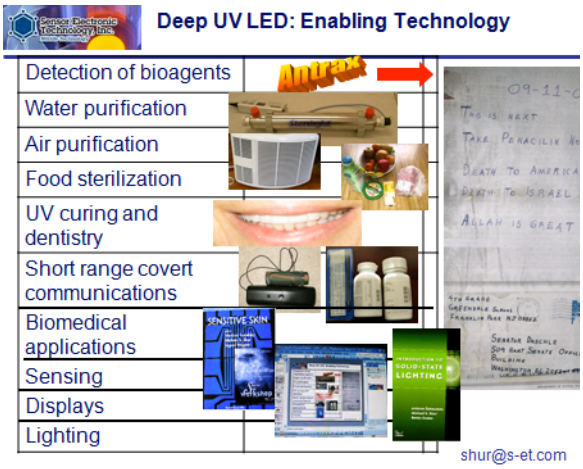
Novel MEMOCVD® technique [1] allows us to grow high quality, thin (thinner than 2 nm) quantum wells with sharp heterointerfaces, large composition variations, and low dislocation density. This has been achieved by overlapping precursor pulses, optimizing precursor waveforms and lowering the growth temperature compared to the conventional MOCVD growth.

The band bending across such thin and deep quantum wells (QWs) is very small, even for strong polarization fields and the ground state is higher in energy than the band bending energy range. This leads to an improved overlap between electron and hole wavefunctions.

Multiple QW active region of DUV LEDs embedded into a potential well with the depth exceeding the energy of optical phonon [2] increases efficiency of hot electron cooling and capture into QWs and allows us to eliminate or reduce "blocking layer."

These approaches have led to a high internal quantum efficiency of our DUV LEDs (estimated to and ensured high power output (with the maximum CW optical power of 30 mW and 6mW was achieved for large area devices emitting at 273 and 247 nm, respectively.)





[1] R. Gaska, J. Zhang, and M. Shur "Nitride-based light emitting heterostructure", US Patent 7,326,963, Feb. (2008)
[2] Q. Fareed, R. Gaska and M. S. Shur, Methods of Growing Nitride-Based Film Using Varying Pulses, US patent 7192849, March 20 (2007)