SESSION 9b:
LED OUTLOOK & TECHNOLOGY
Chairs: Ruediger Schreiner, *Aixtron SE*
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Manufacturing of Light Emitting Diodes (LEDs) has a long tradition within the semiconductor industry reaching back more than 35 years. The range of available wavelengths and applications, however, has been accelerating incredibly over the last 5 to 10 years. This session will provide an outlook on some further aspects for LED manufacturing including cost reduction, improved performance, and new applications. The first contribution, an invited paper presented by Sir Colin Humphreys from Cambridge University, will describe the technology and cost advantages and challenges of GaN-based LEDs on 6 inch silicon substrates. Following this path, silicon-based processing and automation can provide a significant improvement regarding achievable yields and related cost reduction in comparison to the use of sapphire and SiC substrates. As the second invited contribution on this subject, Philippe Roussel from Yole will compare different paths to overcome challenges that have to be faced considering the growth of GaN-on-Si LED-structures by MOCVD. This includes the stress management between GaN and Silicon, materials of different lattice parameters and thermal expansion coefficient, the use of patterned silicon substrates, as well as the application of nanoscale LED formation, including benefits and drawbacks for each of those approaches. A deeper insight into the potential from epitaxial growth of GaN-related LEDs on patterned sapphire substrates (PSS) versus flat ones will be given by the presentation of H. Ogiya from Samco. Precise and reproducible formation for the requested hill-like pattern can be achieved using the plasma dry-etch process versus wet etching. Selection of appropriate preparation and fixture of the silicon substrate for the dry-etch process step as well as proceeding from micro- to nano-patterning (for example, from 1.8 µm to 200 nm pattern-/hill-height) allows one to significantly increase the total internal and external efficiency. The session will be concluded by a student presentation provided by Mong-Kai Wu from the University of Illinois. Hetero-junction bipolar light-emitting transistor (HBLET) demonstrates a unique three-terminal device that can simultaneously produce both electrical and optical output. The quantum wells (QWs) inserted in the base region remove slow carriers enabling high speed modulation up to 7 GHz. This paper reports about details on the further development of this device to a resonant cavity light-emitting transistor (RCLET), adding distributed Bragg Reflectors to sandwich the QWs which narrows the spectra and allows enhanced spontaneous emission.