Fabrication and Evaluation of porous SiC

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START AT	SUBJECT	View All	NUM.	ADD
10:15	Fabrication and Evaluation of porous SiC intentional doped B-N		D.11.6	☆

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Resume : White LEDs with high color rendering index (CRI) are greatly demanded in general lighting applications. However, current major white LEDs composed of blue LED and yellow phosphor still have insufficient CRI, because of the lack of green and red color components. In this study, we present a new solid state phosphor material, porous SiC, which contains donor and acceptor impurities to create donor-acceptor-pair (DAP) recombination. Since this material can emit continuous visible spectrum similar to sun light, it is possible to fabricate high quality white LEDs with high CRI. Recently, we confirmed that DAP emission is enhanced and the peak wavelength is shifted to green-blue side due to the quantum size effect in porous SiC from a commercial n-type 6H-SiC substrate containing N (donor) and B (acceptor). In addition, it was reported that a non-radiative surface recombination was inhibited by specific surface passivation on porous SiC, while it has wider surface with problematic non-radiative surface recombination [1]. However, emission efficiency of such porous SiC is still low because of low B concentration of approximately 1x10^17 cm-3. In this study, we investigate an impact of doping concentrations of N and B on emission efficiency of porous SiC. As a method fabricating porous SiC, SiC samples are etched by anodic oxidation technique with a hydrofluoric acid solution. Moreover, as a passivation technique, Al2O3 deposited by atomic layer deposition (ALD) technique and annealed at a low temperature. The porous SiC after Al2O3 passivation has a broad blue-green light PL emission with a peak wavelength of 507nm, and the full width half maximum (FWHM) of 138.6nm. Compared with the porous SiC from commercial n-type substrate, the sample produced from intentionally codoped SiC has 2.63 times larger PL intensity. The result may show that the porous SiC with a combination of the bulk N and B codoped SiC is a promising candidate to generate high quality white light with a high CRI. References [1] Weifang Lu, et al. ”Photoluminescence enhancement in porous SiC passivated by atomic layer deposited Al2O3” CLEO 6-192 (2016).