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Structural and optical properties of Si_3N_4-doped AlN as UV emitters

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AlN has been regarded as promising material for UV applications due to its wide band gap (6.2 eV), high thermal conductivity, high stability, and chemical inertness. It can emit ultraviolet emissions (UV) not only around 210 nm (near band edge emission) but also 300-400nm (defect related emission). It has been reported that the oxygen-related defect in AlN crystal structure enhances near-UV luminescence [1]. Here, we have also found that Si doping enhances UV emission of AlN.

In this experiment, we have added different concentrations of Si_3N_4 into AlN powder and annealed them at 1950℃ for 4 hours under a nitrogen gas pressure of 0.92 MPa. Scanning electron microscopy (SEM) and cathodoluminescence (CL) were used to characterize these powders. As shown in the figure, the CL spectra reveal that the UV luminescence intensity increases after Si doping, and defects-related UV emission of AlN vary from 300 to 400 nm as Si concentration. Below 1.6%, the dominant peak is at 350nm, and above it at 380nm (Fig. 1). The SE images show a variation of the particle shape and size according to the Si concentration. It has been found that the concentration between 1.6 and 2.0 % have a strong influence on AlN crystal structure (Fig. 2).

In summary, we have confirmed that Si doping into AlN could improve both UV emission and particle distribution. The chemical and structural properties will be discussed by electron spin resonance (ESR), X-ray diffraction (XRD) and transmission electron microscopy (TEM) in the presentation.

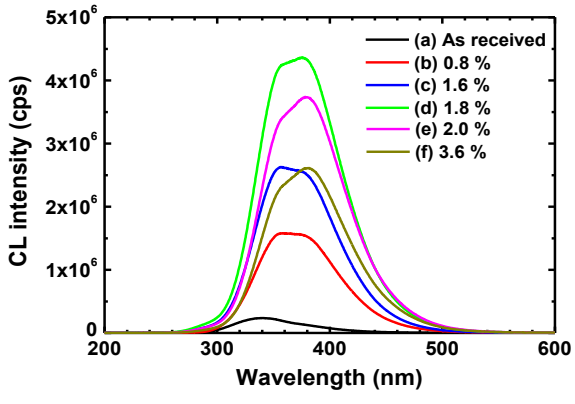

Fig.1. CL spectra of (a) as received AlN, and Si_3N_4-doped AlN powders synthesized at (b)0.8 (c)1.6 (d)1.8 (e) 2.0 and (f)3.6%

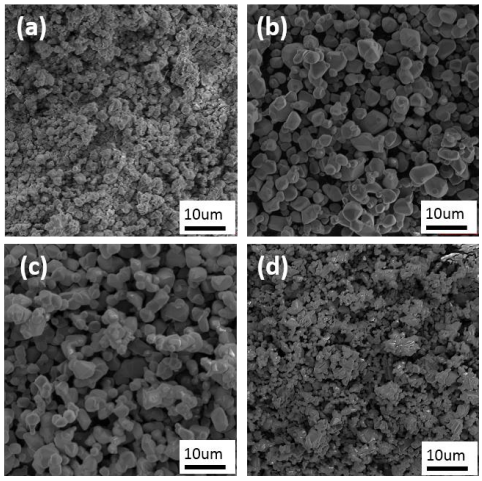

Fig.2. SE images of Si_3N_4-doped AlN powders synthesized at (a)0.8 (b)1.6 (c)2.0 and (d)3.6%

[1] R. A. Youngman et al., J. Am.Ceram. Soc. **73**, 3238, 1990