Influence of Si-doping on the luminescence and defect evolution of AlN

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Aluminum nitride (AlN) has significant potential as ultraviolet (UV) emitting powder without rare-earth doping. In our previous study, it was found that Si doping clearly improves the UV emission of AlN powder. The UV luminescence of AlN mainly consists of 2 bands around 3.26 and 3.54 eV, whose ratios vary with the Si concentration [1]. The dominant peak is at 3.54 eV below 1.8 %, while 3.26 eV above it (Fig. 1). Those emissions are attributed to the defects in AlN [2]. However, their origins have not been clarified yet. In this study, we measured electron spin resonance (ESR) measurements in order to identify these defects.

AlN powders doped with Si from 0 to 4 at. % were prepared using high temperature and gas-pressure sintering. Fig. 2 shows the ESR signals of Si-doped AlN powders. The broad and sharp signals with g=2.005 and 1.999 coexist, and the whole signal intensity decreases until 2.0%, then increases again. Fig 3 shows the variation of the ESR signal. The broad signal (g=2.005) is dominant below 1.2 %, while the sharp one (g=1.999) above it. The former may correspond to 3.54eV emission while the latter to 3.26eV.

In summary, we could get the highest UV emission and lowest ESR signal at 2.0 Si %. The CL intensity and ESR signal had a similar tendency. We will discuss the origin of these defects in the presentation.

**Fig.1.** CL intensity of Si-doped AlN powder with different Si concentration.

**Fig.2.** ESR signals of Si-doped AlN powder synthesized at
(a) 0.0 % (c) 0.8 % (e) 1.6 % (d) 2.0 %
(e) 2.8 % and (f) 4.0 %.

**Fig.3.** ESR signal quantities changes of Si-doped AlN powders with different Si

[1] The 74th JSAP conference, 17a-D7-4