TEM and CL analysis of Si-doped AlN powders

NIMS[1], Tsukuba Univ.[2] °Y. Cho[1, 2], D. Tang[1], B. Dierre[1], K. Takahashi[1], T. Takeda[1], N. Hirosaki[1], T. Sekiguchi[1, 2]

E-mail: CHO.Yujin@nims.go.jp

AlN has been attracting much attention for UV application. We are trying to utilize AlN powder for UV fluorescent material. However, it originally contains plenty of defects which adversely affect high-purity sintering. Recently, we have found that Si-doping is an effective way to control the defects of AlN powders. Proper amount of Si% (<2.0%) has suppressed the oxygen impurities in AlN and yields new emission bands at 280 nm. Cross-sectional CL image at 280 nm has shown a different luminescence distribution between the core and shell of the particles. On the other hand, high amount Si doping (>3.0%) has yielded a 460 nm emission band with elongated non-luminescent patches [1]. Now, it is necessary to correlate these emissions to a certain structure or part of AlN powders. For this purpose, we have investigated the localized structure of those Si-AlN particles by TEM and CL.

Fig.1 shows high-resolution TEM images of 4.0% Si-AlN particle and their SAD patterns. It has been found that the particle consist of 2 different parts as Fig.1 (b) and (c). The (b) part shows the HCP patterns that corresponds to Sialon single phase, while the (c) part shows twins with irregular intervening layers. CL spectra of (b) part (points 3 and 4) show a strong emission at 460 nm with a peak at 385 nm. On the other hand, the (c) part (point 1 and 2) has weak emission at both 385 nm and 460 nm shoulder (Fig.2). It suggests that the origin of 460nm peak is from Sialon phase while darker elongated patches correspond to twins.

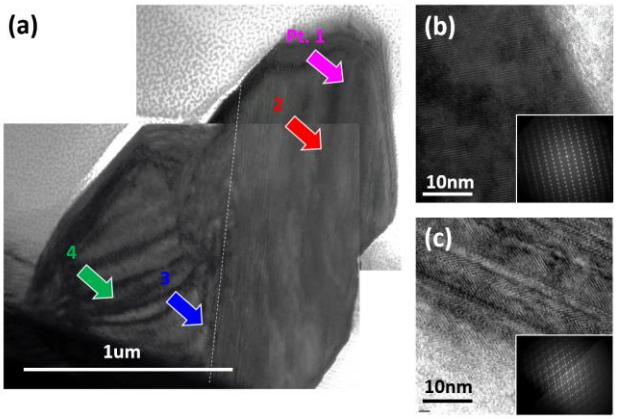

Fig. 1. (a) High-resolution TEM image of 4.0% Si-AlN particle. (b), (c) Magnified images of left and right side, respectively, and their corresponding SAD patterns.

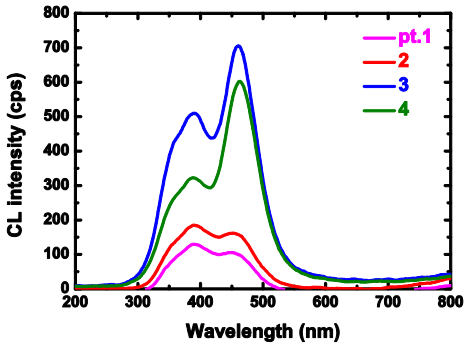

Fig. 2. CL spectra taken from the marked in Fig. 1(a).

[1] Y. Cho et al., Appl. Phys. Exp. 7 115503 (2014)

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