CaAlSiN$_3$:Eu^{2+}発光セラミックスの作製

Preparation of CaAlSiN$_3$:Eu^{2+} Phosphor Ceramics

物材機構[1]，上海セラミック研究所[2] ○解栄軍[1]，李淑星[2]，Yujin Cho[1]，武田隆史[1]，広崎尚登[1]
NISM[1], SICCAS[2], °ROng-Jun Xie[1], Shuxing Li[2], Yujin Cho[1], Takashi Takeda[1], Naoto Hirosaki[1]
E-mail: Xie.Rong-Jun@nims.go.jp

As a blue-light excitable and efficient red phosphor, CaAlSiN$_3$:Eu^{2+} plays a major role in high color rendering white light-emitting diodes (wLEDs) or wide color gamut LED backlights, but it cannot be used in high-power blue laser diode-driven displays and lighting due to the low thermal performance of the phosphor/silicone resin mixture. To apply CaAlSiN$_3$:Eu^{2+} in solid state laser lighting devices, a bulk ceramic form is thus required to suffer from thermal attacks and high-flux density irradiation. However, the preparation of highly dense CaAlSiN$_3$:Eu^{2+} luminescent ceramics still remains an unsolved great challenge due to the intrinsic low diffusion rate and high vapor pressure of the nitride host. Here, for the first time, optically translucent CaAlSiN$_3$:Eu^{2+} ceramics with an interesting composite microstructure, where red-emitting phosphor particles with a core-shell structure are uniformly embedded in a non-luminescent α-Sialon matrix, are successfully synthesized by using Si_3N_4 and SiO_2 as sintering additives. The luminescence ceramic is superior to the corresponding powder phosphor in terms of enhanced thermal stability (15% increase at 300°C) and thermal conductivity (4 Wm^{-1}K^{-1}). It has a high external quantum efficiency of 60% (87% of the powder phosphor) upon 450 nm excitation, and a luminous efficiency of 10.6 lmW^{-1} when irradiated under a blue laser flux density of 0.75 Wmm^{-2}. The red-emitting translucent CaAlSiN$_3$:Eu^{2+} ceramic is thus supposed to be a potential color converter for use in emerging laser lighting and display technologies.

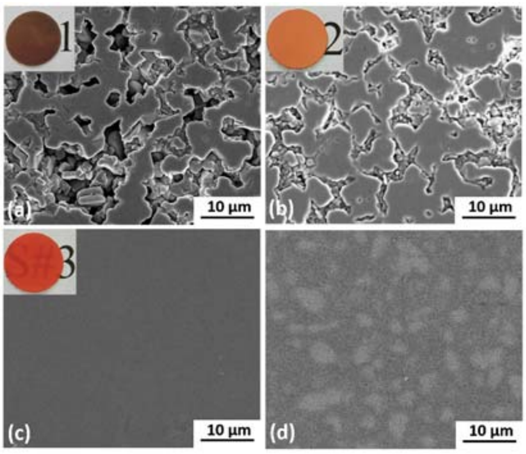

Figure 1 SEM images of CaAlSiN$_3$:Eu^{2+} samples with varying sintering additives, where (a) S1 (no additives, (b) S2 (SiO_2), and (c) S3 (Si_3N_4 +SiO_2), show obvious differences in levels of densification. The backscattered electron (BSE) image (d) of S3 reveals that CaAlSiN$_3$:Eu^{2+} particles with a high contrast are homogenously distributed in a matrix.