B06　気相−固相反応拡散で生成したケイ酸ランタンオキシアパタイトの一軸配向組織

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【Introduction】 Crystal-aligned ceramics consisting of grains with highly anisotropic properties often show significantly improved performance as compared with the corresponding ceramics with random grain orientation. We have reported two successful applications of the solid-state reactive diffusion technique to readily fabricate the highly grain-aligned polycrystalline materials of lanthanum silicate oxyapatite (LSO) and sodium titanogallate (NTGO). Since these polycrystals were highly grain-oriented along the directions of easy ionic conduction, they showed the much higher conductivities of oxide-ions for LSO and Na^+-ions for NTGO as compared with the relevant randomly grain-oriented polycrystals. In the present study, we have successfully prepared the highly grain-aligned LSO polycrystal by reactive diffusion between solid La_2SiO_5 and gases [$SiO + 1/2O_2$]. We have categorized the reaction regions of grain-aligned LSO polycrystals into three regions from the viewpoints of grain sizes and orientation degrees of the constituent crystal grains. These differences in microtexture would be caused by the distinct growth mechanisms of the LSO crystals.

【Experimental】 The polycrystalline LSO was characterized using optical microscopy, scanning electron microscopy, and X-ray diffractometry (XRD). The external shape line information on individual crystal grains were extracted from the backscattered electron image on the section surface of the polycrystal. We collected the electron backscatter diffraction (EBSD) patterns and XRD patterns to determine, respectively, the crystallographic orientations of individual grains and orientation degrees of the LSO polycrystal. The reaction area was consequently categorized, based on the differences in grain-size distribution and orientation degree, into three distinct regions.

【Results and Discussion】 We characterized the microtexture of LSO polycrystal that was formed by the reactive diffusion between solid La_2SiO_5 and gases [$SiO + 1/2O_2$]. Based on the grain size and orientation degree, we categorized the LSO region into three; (i) $|z/\mu m| \leqq 70$, (ii) $704 < |z/\mu m| \leqq 84$, and (iii) $84 < |z/\mu m| \leqq 106$ (Fig. 1). The innermost region (i) with the layer thickness of about 140 μm was composed relatively large and the elongated crystal grains. The individual crystal grains were aligned almost along their *c*-axes, with their *a*-axis directions being randomly distributed around the common *c*-axis. The prismatic LSO crystal was probably built up of faces {001}, {304}, and {100}. On the other hand, there were much smaller and rounded crystal grains in the regions (ii) and (iii); the maximum grain size of region (ii) was ~100 μm^2, and that of (iii) was ~110 μm^2. The LSO polycrystal of region (ii) showed the lowest orientation degree among those of the three regions. The polycrystal of region (iii) was predominantly composed of the crystal grains with the relatively high in orientation degree as compared with that of the other regions (i) and (ii). The differences in microtexture among the three regions would be caused by the distinct growth mechanisms of LSO polycrystal.

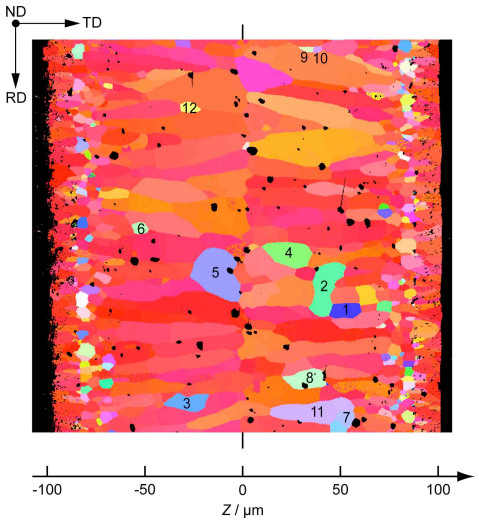

Fig. 1 An inverse pole figure map of LSO crystal grains.