トピックス

Plate-like Host Particles for Perovskite-type ceramics with a Preferred Orientation

Electrical & Magnetic Materials Lab. Tsuguto Takeuchi

配向セラミックス用異方形状粒子の合成

電磁気材料研究室　竹内嗣人

Many kinds of perovskite-type materials have been known to have various electrical functions such as ferroelectricity, piezoelectricity, pyroelectricity, and dielectricity. It is considered that the electrical properties could be enhanced by the crystallographic orientation of the ceramics, however, the pseudo-isotropic lattice nature prevented the fabrication of texture. We proposed the novel fabrication method for the perovskite-type ceramics with a preferred orientation by the use of a heteroepitaxial template and a reactive grain growth. $Bi_{1/2}(Na, K)_{1/2}TiO_3$ (BNKT) ceramics with a preferred {100} orientation were fabricated by the use of $Bi_4Ti_3O_{12}$ (BIT) plate-like host particles as the template[1, 2]. The extension of this method to the other compositional systems or the other type of preferred orientation requires the preparation of the other plate-like host particles with a conformable composition and with a similar lattice structure, such as BIT for BNKT. In this work, various kinds of the host particles were prepared by a molten salts synthesis method for textured perovskites.

Table 1 lists the lattice structures, compositions and developed planes of the selected host materials and templated planes of the perovskite-type structure. Oxide or carbonate powders as raw materials of the host were mixed with KCl and NaCl. The mixtures were heated in a Pt crucible at 1000-1400 °C and then washed by hot deionized water several times to remove the salts. The morphology and the crystalline phases of obtained particles were examined by scanning electron microscopy (SEM) and by X-ray diffraction analysis (XRD).

Table 1 Host materials.

Specimen	Composition	Crystal Structure	Developed plane	Templated plane*
ST	$Sr_3Ti_2O_7$	RP**-type structure	{001}	{100}
CT	$Ca_3Ti_2O_7$	RP-type structure	{001}	{100}
SN	$Sr_2Nb_2O_7$	$Sr_2Nb_2O_7$ structure	{010}	{110}
SF	$SrFe_{12}O_{19}$	Magnetoplumbite	{001}	{111}

*Templated plain of the perovskite-type structure (Indices are given as cubic), **RP = Ruddlesden-Popper

The particles prepared at optimized conditions had plate-like morphologies. The particles of $Sr_3Ti_2O_7$ (ST), $Sr_2Nb_2O_7$ (SN) and $SrFe_{12}O_{19}$ (SF) had rectangular plate-like, blade-like and hexagonal plate-like morphologies, respectively, as shown in Fig. 1. $Ca_3Ti_2O_7$ (CT) also had a plate-like morphology. The XRD results revealed that the developed plane of ST, CT, SN and SF corresponded to the {001}, {001}, {010} and {001} plane, respectively, of each structures. The formation of these morphologies would be caused by the anisotropy of the lattice structures. It was considered that the main surfaces consisted of the faces with minimum interfacial energy of each structures. The atomic configurations on the developed planes of the host materials were similar to the configurations in the {100},{110} or {111} plane of the perovskite-type structure. These plate-like particles would be used as the templates of perovskite-type materials for the fabrication of textured bulk ceramics.

References

1) Tani, T. : J. Korean. Phys. Soc., **32**(1998), S1217
2) Tani, T. : TCRD R&D Rev. **33**-1(1998), 82

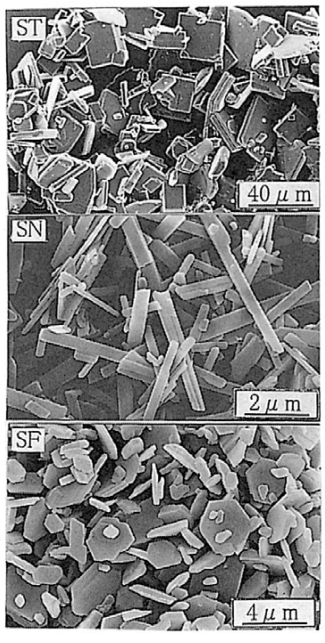

Fig. 1 SEM images of the plate-like particles prepared by the molten salts synthesis method.