Poster Presentation

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Fabrication of Barium Titanate Based Ferroelectrics by Containerless Processing

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Lead-free ferroelectric materials are desired in our lives owing to the environmental problem, and are anticipated to replace conventional ferroelectrics such as $Pb(Zr,Ti)O_3$ (PZT) ceramics. Many researchers have attempted to develop lead-free ceramics whose ferroelectric properties would surpass those of PZT ceramics. Recently, it has been reported that oxygen-deficient hexagonal-$BaTiO_3$ which is metastable state of perovskite-$BaTiO_3$ exhibits giant dielectric constants over the wide temperature range. Such a metastable material has capability as a lead-free dielectric material with high performance. The containerless processing has an advantage over the other conventional methods in synthesizing metastable materials. It can suppress heterogeneous nucleation from the container wall, and produce the undercooled state below the solidification point of the metastable phase, which is lower than that of the stable phase. The purpose of this study is to synthesize barium titanate based ferroelectrics by the containerless processing as lead-free metastable materials. We developed the aerodynamic levitation furnace which enables us to levitate and melt a sample about 1-3 mm in diameter in containerless condition. Figure 1 shows a schematic view of the aerodynamic levitation furnace. The samples are levitated by the gas jet nozzle, and are melted using the CO_2 laser radiation. The metastable crystals of the barium titanate based ferroelectrics were fabricated by the aerodynamic levitation furnace. The crystal structure is demonstrated by analyzing high energy synchrotron radiation powder diffraction data. We discuss the prospects of the ferroelectricity on the basis of the determined crystal structure.

Keywords: Containerless processing, Synchrotron radiation powder diffraction, Structure analysis