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Domain formations in heteroepitaxial lead titanate films fabricated by hydrothermal epitaxy below Curie temperature

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The +c-mono domain and a-domain formation in heteroepitaxial PbTiO3 films fabricated by hydrothermal method at 200℃ below Curie temperature (=490℃) were observed. At the early stage of the growth (≤ 1h synthesis time), the islands with only the +c- mono domain with flat surface were formed. However, after this time, the islands were coalesced each other, and finally turned into the continuous film with thickness of ~500nm. This continuous film had a small volume fraction of a-domains within the +c-mono domain matrix. It also had many small pyramids at the surface. The formation of the +c- mono domain shows that the positive polarization charges were strongly screened by the negatively charged surface layer at the film surface. It seems that the a-domains were formed as a result of the twinning of the tetragonal film that relaxes the strain energy due to both the thermal expansion coefficient, and lattice mismatch between the film and the substrate during cooling from 200℃. With finite element method (FEM) simulation, we will discuss the origin of the +c-mono domain formation and the mechanism of a-domain formation.

Keywords: ferroelectric domain formation, hydrothermal epitaxy

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Synthesis of $MoSi_2$ and Mo_5Si_3 Intermetallic Compound by Mechanical Alloying

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Molybdenum silicides has come to be recognized as an attractive candidate material for high temperature structural applications. In this study, we applied mechanical alloying process to produce molybdenum silicides $MoSi_2$ and Mo_5Si_3 using a mixture of elemental molybdenum and silicon powders at room temperature. The intermetallic compound $MoSi_2$ have been obtained by ball milling of $Mo_{33}Si_{67}$ mixture powders for 100 h, which is transformed to sinlgle $MoSi_2$ phase by subsequent heat treatment up to 725℃. The grain size of the $MoSi_2$ powders thus obtained was 19 nm, being approximately four times smaller than that of the commercial alloy. The intermetallic compound Mo_5Si_3 with grain size of 30 nm have been also obtained by ball milling of $Mo_{62}Si_{38}$ mixture powders for 500 h, which is transformed to single Mo_5Si_3 phase by heating up to 1000℃. The finer grain size in the ball-milled molybdenum silicides powders is expected to improve room-temperature mechanical properties for high-temperature structural materials.

Keywords: mechanical alloying, molybdenum silicide, intermetallic compound, crystal structure, finer grain size, X-ray diffraction