INVESTIGATION OF THIN PEROVSKITE La:$BaSnO_3$ FILMS' PROPERTIES USING DIFFERENT SUBSTRATES

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Wide bandgap La-doped $BaSnO_3$ (LBSO) has attracted increasing attention as one of the transparent conducting perovskite semiconductors as its bulk single-crystal carrier mobility reached 320 $cm^2\ V^{-1}s^{-1}$ with a high carrier concentration ($10^{20}\ cm^{-3}$) at room temperature [1]. Many researchers have fabricated LBSO epitaxial films thus far, but the obtainable carrier mobility is substantially low compared to that of single crystals due to the formation of the lattice/structural and/or nonstoichiometric defects. Thin film electrical properties (mainly carrier mobility) are highly dependent on film morphology, structure and inherently to the selected substrate lattice mismatch. Therefore, in this work thin La-doped $BaSnO_3$ films have been deposited using pulsed injection metal organic chemical vapor deposition (PI-MOCVD) method on multiple substrates and using different stoichiometric ratios of Sn/(Ba+La). In order to investigate different film/substrate lattice mismatch related to stoichiometry on LBSO properties, pseudocubic $LaAlO_3$, cubic $SrTiO_3$ and cubic MgO substrates were selected respectively.

Surface morphology of LBSO films obtained using the same metalorganic vapor phase composition was highly dependent on the selected substrate (Fig. 1). Here we report different thin film stoichiometry ratios related to most homogeneous surface structure. Optimal thin films stoichiometry has been determined to achieve the most homogeneous surface structure on each substrate at specific Sn/(Ba+La) ratio of the film. La-doped film carrier mobility and carrier concentration were determined using Hall measurements. Largest mobility values were achieved on $SrTiO_3$ substrates.

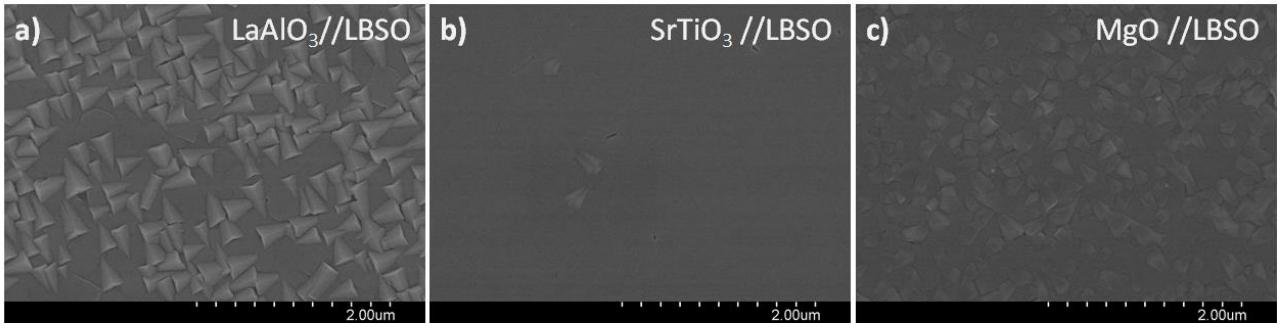

Fig. 1. Scanning electron microscopy (SEM) image of characteristic surface of near-stoichiometric LBSO films deposited on different substrates: a) $LaAlO_3$, b) $SrTiO_3$, c) MgO.

[1] William Shepherd et al., Accurate control of stoichiometry and doping in barium stannate perovskite oxide nanoparticles, Chemical Communications **55** (79) 11880-11883, (2019).