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PHASE TRANSITION PECULIARITIES IN $BaTiO_3$-BASED PEROVSKITE SUPERLATTICES

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In the last decades, artificial ferroelectric superlattices (SLs) have attracted great attention in fundamental research and opto- and microelectronics industry due to their unique properties that are different from their bulk analogues (the great permittivity that possesses the weak dependence on temperature over a wide range, the nonlinear electric properties, and the particular phase states) [1]. Strain caused by a structural mismatch of lattices with different parameters in the plane of conjugation of epitaxial layers favors high polarization and piezoresponse [1] that can exceed values typical of materials composing SLs. The unique characteristics of SLs can even be enhanced via the component's thickness variation in such structures, which alters the strain of layers [1].

The present work aims at discussing phase transition peculiarities in BaTiO3-based artificial superlattices by examples of BaTiO3/(Ba,Sr)TiO3 superlattices (BT/BST SLs), grown onto (001) single-crystal MgO substrates via the pulsed laser deposition by the alternating focus of a laser beam on BT, BST, and ST targets. The total thickness of heterostructures is 1 μm. The sequence of phase transitions in superlattices was monitored via the room-temperature Raman spectroscopy in "side-view" backscattering geometries in order to observe the manifestation of the E(1TO) soft mode component. The interest to this soft mode component is owing to its sensitivity to internal strains that arise between the constituting layers because of the lattice parameter mismatch between BT and BST layers.

The Raman spectra were processed using various functions (Lorentz, oscillator, relaxor) to clarify the soft-mode E(1TO) component sensibility to each of chosen function and to compare the fitting results. The results for BT/BST SLs were compared with data gathered on the other $BaTiO_3$-based perovskite structures, such as PLD-produced $BaTiO_3/SrTiO_3$ (BT/ST) SLs with a variable modulation period [2]. A comparative analysis of polarized Raman spectra for the indicated systems reveals that the E(1TO) soft mode frequency increases almost three times in BT/BST SLs, as compared to pure BT films, at varying only stroichiometry (Ba/Sr content ratio) and keeping constant the modulation period, while for BT/ST superlattices the change in modulation period leads to less pronounced soft-mode position uphift. In this connection, the artificial variation of stoichiometry of the constituting layers in SLs allows one to more efficiently tune the ferroelectric properties of these structures in comparison to those controlled through the modulation period, and to design the materials with the set properties.

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