Poster

In-situ characterization of the epitaxial growth of $BaTiO_3$ thin films by pulsed laser deposition using synchrotron radiation

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Thin films of perovskites such as $BaTiO_3$ show different, exceptional behaviour compared to their bulk counterparts [1-5]. The understanding of property changes during the growth process itself is highly desirable. Here we focus on the *in-situ* characterization of $BaTiO_3$ thin films during the epitaxial growth by pulsed laser deposition (PLD) on different substrates. $SrTiO_3$, $LaAlO_3$ and MgO with a (0 0 1) crystal surface and $GdScO_3$ with a (1 1 0) crystal surface were used as substrate materials. *In-situ* X-ray diffraction (XRD) measurements were carried out using synchrotron radiation, in order to elucidate the growth process of $BaTiO_3$ thin films. In addition, the XRD experiments were simulated based on kinematic diffraction theory. The simulation results and the generated reciprocal space maps provide a deep insight into the crystal structure and the relaxation processes of $BaTiO_3$ thin films during the growth process. X-ray reflectometry measurements verify the results of the XRD measurements. The determined critical thickness of $BaTiO_3$ on a $SrTiO_3$ substrate is 65 Å. The critical thicknesses of $BaTiO_3$ on the $LaAlO_3$ and MgO substrates were estimated to be less than 16 Å and 36 Å, respectively. The critical thickness was found to be greater than 830 Å for the $GdScO_3$ substrate. A rich phase behaviour of $BaTiO_3$ thin films is observed, that differs strongly from that of bulk $BaTiO_3$.

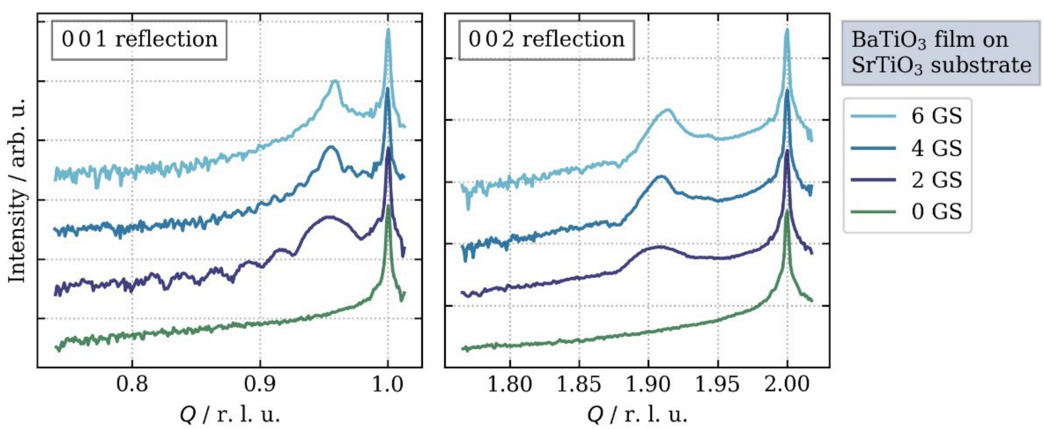

Figure 1. XRD pattern of thin $BaTiO_3$ films deposited on a $SrTiO_3$ substrate. The diffraction intensity is shown as a function of the scattering vector (in units of the reciprocal lattice of $SrTiO_3$). With each growth step (GS) of the PLD process, the film reflections become more intense and sharper and thus characterise the growing $BaTiO_3$ film. The change in the position of the film reflections indicates ongoing relaxation.

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