

STUDIES of STRONTIUM TITANATE THIN FILMS by X-RAY METHOD

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SrTiO₃ (STO) films have attracted much attention in recent years, because of their potential applications for various microelectronic devices. In this paper, a STO thin film grown on Si substrate with Sr buffer layer, was fabricated by laser molecular beam epitaxy (L-MBE), we studied the structural characterization of this thin film, including the crystalline quality, preferred orientation, texture, lattice strain, etc. Several techniques such as $2\theta/\omega$ scan, ω scans, ϕ scans and pole figure were used to measure the microstructure and crystallization behavior in the STO thin film. X-ray diffraction (XRD) revealed high crystallinity with FWHM of 0.3° in the STO (002) rocking curve. XRD study of the in-plane orientation clarified a cube-on-cube epitaxy in which STO [100] was rotated by 45° with respect to Si [100]. The significant utility of the X-ray reflectivity (XRR) in contrast to XRD as an important structural probe was first used to study the STO/Sr/Si heterostructure. The quantitative information on density, interface roughness and surface roughness was extracted. In addition, in order to gain a better understanding of the origins of the STO film stress, a homoepitaxial STO thin film was fabricated by pulsed laser deposition (PLD), a high resolution X-ray diffraction (HRXRD) measurement was performed by a $\omega/2\theta$ scan mode using multiple-order-reflection monochromator. HRXRD study focuses on the microscopic lattice distortion of the homoepitaxial STO thin film, The a and c lattice constants for the STO thin film without any buffer layer were found to be 0.3861nm and 0.3915 nm. Therefore, the strain was also maintained in this film due to the presence of intrinsic stress. The aim of this paper is to investigate the effects of stress in biaxial textured or epitaxial STO thin film. The strategies for lattice constant measurement of epitaxial films were carefully described here.

Keyword: strontium titanate (SrTiO₃), Sr buffer layer, epitaxial film, X-ray reflectivity (XRR), and high resolution X-ray diffraction (HRXRD)

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