Stroncio titanato plonųjų sluoksnių auginimas impulsinio lazerinio nusodinimo metodu

Growth of Strontium Titanate film by Pulsed Laser Deposition

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Thin films of the metallic perovskite oxide are one of the most frequently studied samples. This dominance is primarily related to the unique diversity and correlation of electronic, magnetic, and optical phenomena observed in this class of materials. One of the solid candidate from that list is a Strontium Titanate oxide (STO). Strontium Titanate is a centrosymmetric paraelectric material with a cubic perovskite-type structure. It brings great attention because of possible applications in high-frequency agile devices, such as phase shifters, filters, delay lines, and tunable oscillators.

Properties of that kind of film depend heavily on the microstructure, epitaxial strain, and crystalline quality imposed by the underlying substrate. One of the best matches for STO film is Strontium ruthanate (SRO). SRO has a slight lattice mismatch with $SrTiO_3$ film (STO a = 3.905Å, SRO a = 3.93Å) [1], but also the fact that $SrRuO_3$ has become the standard electrode material in a broad range of all-oxide devices, especially for use in new data-storage technologies, bring us to using it as an electrode in our structure.

Both of these films were prepared by the Pulsed Laser Deposition technique (PLD). Pulsed laser deposition (PLD) is a PVD technique wherein a high-power pulsed laser beam is focused inside a vacuum chamber to hit a target of the material to be deposited. This material is vaporized from the target (as a plasma plume) and is then coated as a thin layer on a substrate.

To test STO film planar capacitor structure was planned and prepared. SRO film was deposited on a cleaned STO substrate (100). Then on top of our bottom contact, STO film was coated. Top contact was made by the thermal evaporation of silver through the mask. The scheme of the prepared sample is a view in Fig. 1.

Fig. 1. Scheme of the structure (not in scale)

Fig. 2a shows a cross-sectional scanning electron microscope (SEM) image and fig. 2b energy-dispersive spectroscopy (EDS) was used to estimate the thickness of the film. The overall thickness of these 2 films is around 300 nm by detection of Ru element, which cannot be observed in STO film or substrate on its own. The detailed intensity of the elements that clarify the approximate thickness of films was plotted in Fig. 2b. The thickness of the STO and SRO films that was measure by SEM-EDS is around 170 nm and 130 nm accordingly.

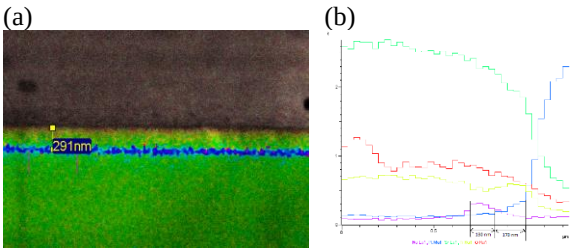

Fig. 2. SEM cross-section image of the sample with inset of EDS intensity of elements

The structural properties of the films were characterized by x-ray diffraction (XRD) using a Rigaku 9KW diffractometer with Cu Kα radiation. According to θ-2θ scan, STO film is polycrystal with the strongest peak on (111) and (110) position which can be explained by preferential growth of STO film in this direction on a way from amorphous to single-crystal film [2]. The polycrystallinity of this film was caused by poor crystallinity of SRO with an observed peak 2θ = 54.41 Å, which corresponds to peak (116) (Fig. 2). Also, a small (100) peak on that scan was attributed to our STO substrate.

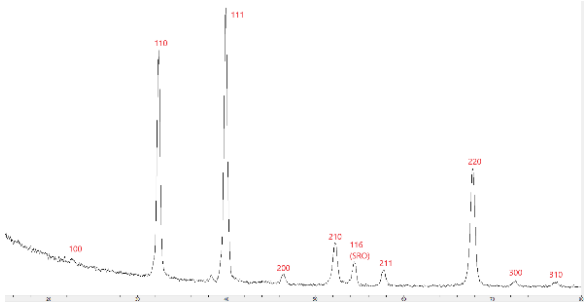

Fig. 2. θ-2θ scan of the STO films on SRO film.

Keyword: Ferroelectric films; $SrTiO_3$; $SrRuO_3$; PLD.

Literature

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