Fe-doped SrTiO3 thin films: An approach to understand their unusual electrochemical behaviour

Wednesday, 11th July - 16:10 - Symposium C - Defects & Functional Oxides - Panopticum Green Room - Oral

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Pulsed laser deposition (PLD) is one of the most commonly used methods for metal oxide thin film preparation. The process is known for its technical simplicity and its ease with which the deposited material can be switched during the process. However, the properties of PLD prepared films may drastically differ from bulk properties. For Fe-doped $SrTiO_3$(Fe:STO), for example, the conductivity of thin films (300 °C -700 °C) corresponds to purely intrinsic STO.[1] Other studies showed that deviations from stoichiometry and structural changes need to be considered for epitaxial layer growth of STO thin films on STO substrate material.[2]A detailed understanding of the correlations between functional properties and film structure as well as composition, however, is largely missing.

In this contribution, electrochemical and analytical investigations are combined for slightly Fe:STO thin films deposited on Nb:STO single crystals. The film properties are systematically modified by target composition variations (A:B site ratio) and laser frequency. The electrochemical characterisation was performed by means of electrochemical impedance spectroscopy (EIS). Measurement parameters like temperature, partial pressure and bias voltage were systematically varied to gain a deeper insight into the electrochemical behaviour of STO thin films. For structural and chemical film analysis, high resolution X-ray diffraction measurements (HRXRD) and inductively coupled plasma optical emission spectroscopy (ICP-OES) were performed, the latter with particular emphasis on the exact cation ratio in the thin films. This combination of electrochemical, structural and chemical thin film characterisation increases the understanding of structure-property-relations and helps unravel the reasons behind the dopant independence of the measured conductivity of STO films.

[1] Kubicek, M.; Taibl, S.; Navickas, E.; Hutter, H.; Fafilek, G.; Fleig, J., *J. Electroceramics* **2017**, 39,1-4, 197-209.

[2] Wicklein, S.; Sambri, A.; Amoruso, S.; Wang, X.; Bruzzese, R.; Koehl, A.; Dittmann, R., *Appl.Phys. Lett.* **2012**, *101*, 131601.