Fe-doped $SrTiO_3$ thin films: An approach to understand the origin of their changed electrochemical behaviour

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In the field of electroceramics, metal oxides such as perovskites exhibit many interesting properties. $SrTiO_3$ as a promising candidate and model material for several novel technologies, is one of the most discussed material in this field of research. Thus, numerous investigations over the last few years gave insight in the defect chemical nature of undoped and doped $SrTiO_3$ bulk material.[1],[2] Unfortunately, the knowledge gained on bulk material cannot be directly transferred to thin films and nanosized particles. For example, it was shown that space charge layers at interfaces, grain boundaries and dislocations can have a tremendous effect on the electrical and electrochemical behaviour. Especially in the field of resistive switching the role of higher dimensional defects is quite controversially discussed. Thus, further clarification of the defect chemical properties of nanosized materials is desirable.

In this contribution, electrochemical as well as analytical investigations on slightly Fe-doped $SrTiO_3$ thin films deposited on Nb-doped single crystals are presented. The electrochemical characterization was performed by means of electrical impedance spectroscopy (EIS) and DC measurements. Parameters like temperature, partial pressure and bias voltage were systematically varied to gain a deeper insight into the electrochemical behaviour of the $SrTiO_3$ thin films. Furthermore, high resolution X-ray diffraction measurements (HRXRD), inductively coupled plasma optical emission spectroscopy (ICP-OES) and ^{18}O tracer exchange experiments were performed. The results are critically discussed in terms of microstructural effects and their potential influence on the electrochemical performance of these $SrTiO_3$ thin films.

[1] R.A. De Souza, J. Fleig, R. Merkle, J. Maier, Z. f. Metallkunde. 94 (2003) 218–225.

[2] R. Merkle, J. Maier, Phys. Chem. Chem. Phys. 4 (2002) 4140–4148.