Correlation between charge transport and photoelectrochemical performance of TiO_2 thin films

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Fast charge transport plays a decisive role in the subsequent performance of photoelectrochemical systems based on TiO_2 photoanodes. The conduction mechanism of transition metal oxides is governed by excitation of charge carriers over the mobility edge into the nonlocalized or extended states [1]. This report concentrates on the temperature dependence of the electrical resistivity. Measurements of this resistivity are performed over the range extending from 15 K to 300 K in the CIP geometry. Thin films of TiO_2 were deposited onto transparent electrodes by means of the dc-pulsed reactive sputtering under optically controlled technological conditions. Performed measurements prove that the transport properties of the considered system depend on film morphology, microstructures and stoichiometry of the samples. Activation energy E_a dependence of the preexponential factor σ_0 in the Arrhenius relation

$$\sigma = \sigma_0 \exp\left(-E_a/k_B T\right),$$

follows the Meyer-Neldel rule. Current-voltage characteristics of TiO_2 based photoelectrochemical cells were shown to be affected by the charge transport mechanism.

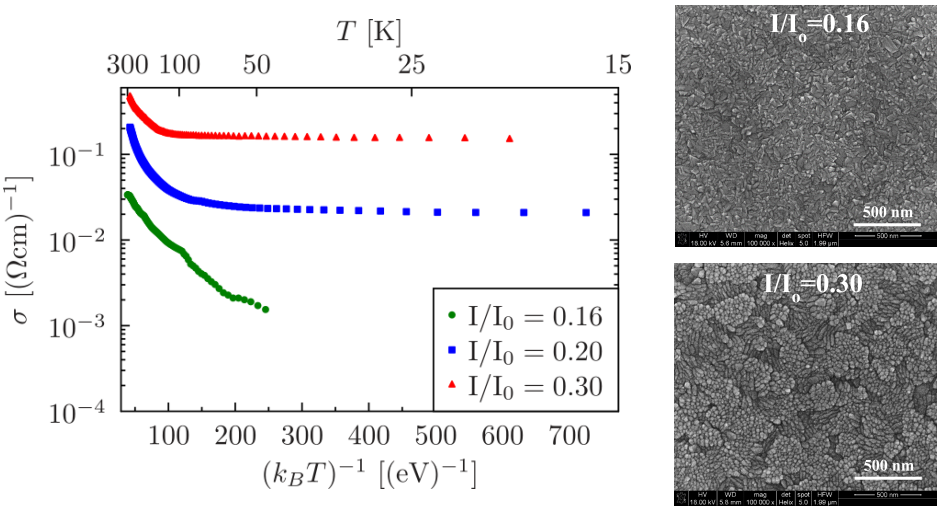

Figure 1: Temperature dependence of the electrical conductivity and SEM top surface images for thin films of TiO_2. The ratio I/I_0 corresponds to the deviation from stoichiometry: higher I/I_0 indicates more oxygen deficient compositions.

[1] D. Mardare, A. Yildiz, R. Apetrei, P. Rambu, D. Florea, N. G. Gheorghe and D. Luca, *J. Mater. Sci.* **27**, 2271 (2012).

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