Spectroscopic Modeling of Photoelectrochemical Water Splitting

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Abstract

Photoelectrochemical (PEC) cell is an alternative device for electrolysis of water, and it is currently under extensive research. PEC cell both absorbs solar energy and uses the photogenerated charge carriers to drive in situ splitting of water. Hence, the PEC cell integrates together solar cell and electrolyzer functionalities in one device, which is forecast to bring technical and economic advantages as compared to direct coupling of the electricity from the grid to the electrolyzer. However, the integrated nature of PEC cells brings also bottlenecks of contradictory physical requirements for the practical device (light absorption, stability and charge transport).
Aim of our work is model based understanding and matching of the various physical and electrochemical requirements in the PEC cells [1]. In this contribution, a model of charge transport in semiconductor and across its interfaces is studied with the photoelectrochemical impedance spectroscopy. A procedure for extracting rate constant for water oxidation and recombination lifetime from impedance measurements is discussed.

Reference

[1] P. Cendula et al., J. Phys. Chem. C 118, 29599–29607 (2014)

Figures used in the abstract

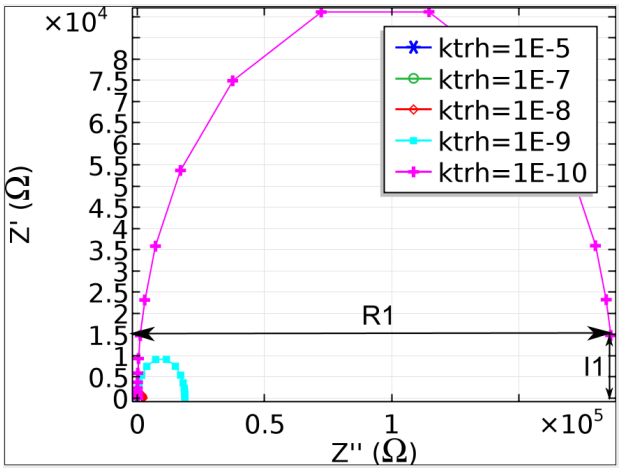

Figure 1: Nyquist plot of impedance under illumination for various values of k_trh and fixed potential 0.7 V vs. RHE.

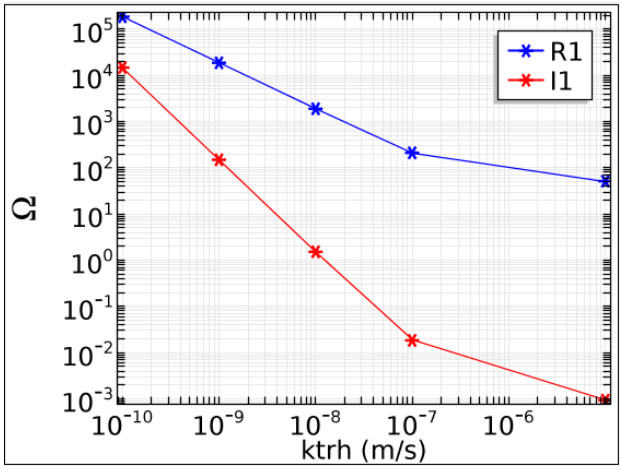

Figure 3: Dependence of the lowest frequency impedance for 0.7 V vs. RHE on rate of water oxidation k_trh.