

Oxygen surface exchange kinetics of mixed ionic-electronic conducting oxides

Prof. Henny J. M. BOUWMEESTER

*Electrochemistry Research group, Membrane Science and Technology,
Department of Science and Technology, MESA+ Institute for Nanotechnology,
University of Twente, P.O. Box 217, 7500 AE, Enschede, The Netherlands
e-mail: h.j.m.bouwmeester@utwente.nl
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High-temperature electrochemical devices such as solid oxide fuel cells, solid oxide electrolysis cells, oxygen separation membranes and membrane reactors based upon fast oxygen ionic conducting oxides have the potential to provide great economic and ecological benefits. One of the challenges of researchers in this field is to develop materials showing fast oxygen ionic transport and fast surface exchange kinetics under given operating conditions. It is therefore important to gain a fundamental understanding of the factors controlling oxygen surface exchange, such as defect chemistry and defect-related properties, degree of oxygen non-stoichiometry, surface composition and grain boundary properties.

Main characterization techniques used to determine the oxygen surface exchange kinetics of fast ionic conducting oxides include ^{18}O – ^{16}O isotopic exchange depth profiling method (IEDP), ^{18}O – ^{16}O isotopic exchange gas phase analysis (IE-GPA), ^{18}O – ^{16}O isotopic exchange pulse technique (PIE), electrical conductivity relaxation (ECR), electrochemical impedance spectroscopy under controlled atmosphere (humidity and $p\text{O}_2$). Data from, e.g., low energy ion scattering (LEIS) and X-ray photo electron spectroscopy (XPS) is used to relate the observed oxygen exchange kinetics to the surface and near-surface composition of the materials.

Major aim of my lecture is to present recent progress and challenges of studies towards understanding the oxygen surface exchange kinetics of single-phase and composite mixed ionic-electronic conducting oxides.

Biosketch. Prof. Henny J.M. BOUWMEESTER is a renowned scientist in the field of (solid state) electrochemistry, thermodynamics, ionic transport and interfacial/ electrode kinetics, closely related to applications such as oxygen transport membranes and solid oxide fuel cells. He heads the Electrochemistry Research group, part of the Membrane Science Technology cluster, at the University of Twente, Enschede, The Netherlands. In 2012, he was appointed as part-time Professor at the University of Science and Technology (USTC) in Hefei, China. He is co-editor of the CRC's *Handbook of Solid State Electrochemistry*, and has authored and co-authored several book chapters and more than 150 research papers (h-index 50 Web of Science). He serves and served as a member of the board or council of several societies and international conferences, and is topical editor of the *Journal of Solid State Electrochemistry*.

