ICMOL | Universitat de València

Supported by Excelencia María de Maeztu | Generalitat Valenciana Conselleria d'Innovació, Universitats, Ciència i Societat Digital

Serhiy Cherevko

Helmholtz-Institute Erlangen-Nürnberg for Renewable Energy

Talk: Accelerating Electrocatalysts' Activity and Stability Assessments

February, 5th 10:00h Assembly Hall

Accelerating Electrocatalysts' Activity and Stability Assessments

Abstract

The standard approach to new electrocatalysts development and testing is prohibitively slow. Moreover, it fails to meet the complexity of real devices. As a rule, it consists of routinely repeated steps, including synthesis, physicochemical characterization, and electrochemical measurements. The latter is typically based on the application of rotating disk electrodes (RDE) as conductive solid support to carry electrocatalysts and bulk electrochemical cells with liquid electrolytes as the reaction media.

The current talk will contain two main parts presenting our recent approaches to tackling the abovementioned limitations of the classical electrochemical test systems. As a representative example, oxygen evolution reaction (OER) electrocatalysis in electrolytes of different pH is taken. The main focus is on the stability of different OER catalysts in water electrolysis (both acidic and alkaline) and electrochemical CO2 reduction reaction technologies. It will be shown that bearing in mind the intrinsic limitations of the aqueous mode systems (AMSs), significant acceleration of electrocatalysts' activity and stability measurements can be achieved by using coupled techniques based on different scanning flow cells.1, 2 This approach is ideal for quick multidimensional parameter space screening.

However, further tests in real systems are necessary after identifying promising candidates. It will be shown that also this step can be accelerated using model gas diffusion electrode (GDE)-based setups.3-5 Moreover, qualitatively different information, e.g. electrocatalyst dissolution assessment, can be achieved using GDE setups coupled to external analytics like inductively coupled plasma mass spectrometry (on-line ICP-MS). While it will be shown that using two approaches, facile screening and real-device level proof tests, are feasible, limitations and challenges will also be discussed, together with further directions to develop these techniques.

References:

1. A. Kormányos, K. J. Jenewein and S. Cherevko, Trends in Chemistry, 4, 475 (2022).
2. K. J. Jenewein, G. D. Akkoc, A. Kormányos and S. Cherevko, Chem Catalysis, 2, 2778 (2022).
3. Y.-P. Ku, K. Ehelebe, A. Hutzler, M. Bierling, T. Böhm, A. Zitolo, M. Vorokhta, N. Bibent, F. D. Speck, D. Seeberger, I. Khalakhan, K. J. J. Mayrhofer, S. Thiele, F. Jaouen and S. Cherevko, Journal of the American Chemical Society, 144, 9753 (2022).
4. K. Ehelebe, J. Knoppel, M. Bierling, B. Mayerhofer, T. Bohm, N. Kulyk, S. Thiele, K. J. J. Mayrhofer and S. Cherevko, Angew Chem Int Ed Engl, 60, 8882 (2021).
5. M. Geuß, M. Milosevic, M. Bierling, L. Löttert, D. Abbas, D. Escalera-López, V. Lloret, K. Ehelebe, K. J. J. Mayrhofer, S. Thiele and S. Cherevko, Journal of The Electrochemical Society, 170, 114510 (2023).

Biography

2016 / Group Leader, Electrocatalysis group of Helmholtz Institute Erlangen-Nürnberg for Renewable Energy (Erlangen, Germany)

2011-2015 / Postdoctoral Research Fellow, Department of Interface Chemistry and Surface Engineering, Max-Planck Institut für Eisenforschung (Düsseldorf, Germany)

2009-2011 / Postdoctoral Research Fellow (Chemical Engineering division), Sungkyunkwan University (Suwon, Korea)

2005-2009 / Ph.D. degree in Nanoscience at the Sungkyunkwan University, Interdisciplinary Program in Nanoscience and Nanotechnology, Sungkyunkwan Advanced Institute of Nanotechnology (SAINT), (Suwon, Korea)

2004-2005 / Research Engineer at the Institute for Single Crystals of National Academy of Sciences of Ukraine (Kharkiv, Ukraine)

1999-2004 / B.Sc. and M.Sc. degrees in Physics at the V.N. Karazin Kharkiv National University, Physical department, division of Solid State Physics (Kharkiv, Ukraine)