

## Topical Symposium on Sustainable Surface Engineering Room Town & Country B - Session TS1-3-TuM

### Coatings for Batteries and Hydrogen Applications III

**Moderators:** Nazlim Bagcivan, Schaeffler Technologies GmbH & Co. KG, Germany, Chen-Hao Wang, National Taiwan University of Science and Technology, Taiwan

8:00am **TS1-3-TuM-1 Oxygen Vacancy in Atomic Metal Oxide Clusters Demonstrate Outstanding Electrochemical Activity**, *Tsan-Yao Chen (chencaeser@gmail.com)*, National Tsing Hua University, Taiwan; *K. Wang*, National Central University, Taiwan

**INVITED**

Hierarchical structured heterogeneous catalyst comprising atomic metal oxide clusters with high contents of oxygen vacancy ( $O^V$ ) and the carbon or Co oxide supported metal / oxide nanoparticle (NPs) is developed for electrocatalytic application. Such a catalyst processes a collaboration between  $O^V$ s and the neighboring atoms in the electrochemical reaction. With this characteristic, the reaction kinetics of all steps are simultaneously operated consequent leading to a quantum leap on the current density and stability of the redox reaction. Apart from using noble metals, atomic scaled Co oxide clusters ( $CoO_x$ ) were employed. Those clusters are decorated in surface defect regions of Co oxide supported Pd nanoparticles (CoOx-Pd) by using self-aligned nanocrystal growth followed by ultra-high-speed quench reaction with strong reduction agent. The decorated  $CoO_x$  localize electrons from the neighboring atoms and thus boost the activity of CoOx-Pd in ORR. With a proper reaction time and loading control, the CoOx-Pd enhance its mass activity by 340 times as compared to that of commercial Pt catalysts in an alkaline electrolyte of 1.0M KOH.

8:40am **TS1-3-TuM-3 Grazing Magnetron Sputtering of  $Cu_xO-MoS_2$  Electrodes for Hydrogen Production**, *J. Castro, D. Cavaleiro*, University of Coimbra, Portugal; *M. Lima*, University of Minho, Portugal; **Albano Cavaleiro (albano.cavaleiro@dem.uc.pt)**, *S. Carvalho*, University of Coimbra, Portugal

The world energy grid faces a big issue in transit forward clean energy. Enlarging the possibilities to advance in cleaning the energy grid, humanity has made bids in several technologies, contemplating using Hydrogen as a sustainable and clean fuel. However, their production has important issues to overcome, such as the employment of expensive materials, which are non-abundant and challenging to obtain and process. Decreasing the manufacturing cost of electrodes used for producing Hydrogen could be a determinant to scale up this technology with competitive prices and, simultaneously, reduce the carbon footprint through affordable and environmentally friendly processes.

Copper is well known for its electrical properties; compared to other metals, it is cheaper and abundant. Recently,  $MoS_2$  has been demonstrated to favour the Hydrogen Evolution Reaction (HER). The present work presents the first insight into mixing these two materials using the grazing magnetron sputtering technique in a reactive atmosphere. C sheets and copper (sheets and foam) were used as substrates. SEM and EDS were used to determine the sample's morphologies and their chemical composition. Besides, several electrochemical techniques were employed to determine the electrochemically active surface area – ECSA, via linear sweep (LSV) and cyclic voltammetry (CV) and its electrochemical behaviour via electrochemical impedance spectroscopy (EIS). The results showed that including oxidised copper species together with  $MoS_2$  decreased the overpotential to start the HER at 10 mA/cm<sup>2</sup> current density (~12% vs. the  $MoS_2$  overpotential). On the other hand, the sample with copper oxidised in a zig-zag configuration showed the highest double-layer capacitance and, hence, the highest ECSA, meaning that the obtained morphology during the deposition, influenced the electrochemical activity significantly.

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