

## EPFL Valais/Wallis SEMINAR

17. 02. 2020, 10:30 - 11:30, EPFL Valais/Wallis in Sion, 4<sup>th</sup> floor, Zeuzier Room

### **Spatially Resolved Electrochemical Microscopy: Scanning Electrochemical Cell Microscopy on Energy Functional Materials**

**Prof. Akichika KUMATANI**

WPI-Advanced Institute for Materials Research (AIMR), Tohoku University,  
2-1-1 Katahira, Sendai, Japan

Recent progress of electrochemical based energy harvesting or storing electrodes is remarkable. In particular, a size control with nanometer/atomic scale of those materials is essential to enhance their electrochemical activities. Whereas, for evaluation of their electrochemical performance a conventional analytical technique is conducted in bulk. In other words, there is an issue to understand their local electrochemical properties such as ion transport in lithium-ion batteries and electrocatalytic reactions. In comparison with electronic conduction analysis by scanning probe microscopies such as scanning tunneling microscopy, it is still required to develop a spatially resolved electrochemical analysis with high sensitivity in ionic conduction. To overcome it, we have worked on variety of electrochemical microscopies. In this seminar, a self-assembled scanning electrochemical cell microscopy with a single barrel nanopipette (SECCM) is introduced for visualizing electrochemical reaction as electrochemical imaging [1]. The size controllable pipette (e.g. 50 nm) is filled with electrolyte and a quasi-counter/reference electrode, which is specialized to detect ionic current through a meniscus created between the pipette and sample surface. The SECCM can utilize in any electrochemical activities. For battery analysis, it can be applicable to investigate local lithium ion activities on electrodes [2]. Further, hydrogen evolution reaction on two dimensional materials such as graphene is visualized [3].

#### References:

- [1] Y. Takahashi et al., Nat. Commun., 5, 5450 (2014).  
[2] (a) A. Kumatani et al., Surf. Interface Anal., 51, 27 (2019). (b) H. Inomata, et al., Chem. Comm., 55, 545 (2019).  
[3] (a) A. Kumatani et al., Adv. Sci., 6, 1900119 (2019). (b) Y. Takahashi et al., Angew. Chem. Int. Ed., published.



CV: Prof. Akichika Kumatani

Dr. Akichika Kumatani is an Associate Professor (LEADER program) in Quantum Materials and Spintronics Laboratory at WPI-Advanced Institute for Materials Research (WPI-AIMR), Tohoku University (Japan). He received M. Eng. (1st Class Honours) from King' College London in 2004 (UK) and Ph. D. from University College London (UK) in 2009. After working in National Institute for Materials Science (NIMS), he joined to WPI-AIMR and Graduate School of Environmental Studies in Tohoku University. His research interests are surface and analytical science. In particular, he applied to study high-resolution electrochemical imaging technique for energy functional materials in secondary batteries and electrocatalysts including two dimensional materials.