In situ X-ray Absorption Spectroscopy Investigation of Silver-Copper Nanoparticles for the Oxygen Reduction Reaction

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The electrochemical conversion between O_2 and H_2O is a key process gating the wider deployment of a variety of renewable energy technologies. In particular, the slow kinetics and limited selection of suitable catalysts for the oxygen reduction reaction (ORR) are main impediments to the expansion of critical clean-energy technologies such as hydrogen fuel-cell vehicles or grid-scale energy storage. While Pt-based catalysts are the conventional choice for acidic electrolytes, favorable oxygen reduction kinetics and stability considerations that occur in alkaline electrolytes provide possibility for using non-platinum group metal catalysts, including silver. In particular, bimetallic or alloyed systems of silver and copper have been predicted by theory to be active for the ORR [1]. While these two metals have a large miscibility gap in the bulk, it has been shown that small nanoparticles can support intermixing of the silver and copper in a stable or metastable phase [2]. In addition, we have shown that co-sputtering silver and copper as both thin films and nanoparticles results in ORR catalytic activity that surpasses that of either metal on its own. In this work we investigate these bimetallic catalysts using in situ x-ray absorption spectroscopy (XAS) in order to help understand the activity enhancements seen when combining copper and silver for the ORR.

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1. K. Shin, D.H. Kim, and H.M. Lee. ChemSusChem (2013), 6: 1044-1049.
2. P. Grammatikopoulos, J. Kioseoglou, A. Galea, J. Vernieres, M. Benelmekki, R.E. Diaz, and M. Sowwan. *Nanoscale* (2016), 8: 9780-9790