In situ Stress and Nanogravimetric Measurements during De-alloying of PtCu Thin-film Electrode

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Enhanced catalytic activity of de-alloyed PtCu electrodes towards oxygen reduction reaction had been demonstrated in thin-film and core-shell geometries.[1-5] The enhancement in catalytic activity is typically attributed to strained Pt layer (in thin-film electrodes) and Pt shell (in core-shell electrodes). The magnitude and the nature (compressive/tensile) of the strain on de-alloyed Pt were estimated thus far using lattice-constant measurements (*via* X-ray diffraction) on de-alloyed electrodes. In this work, we report real-time stress and nano-gravimetric measurements made during de-alloying of thin-film PtCu electrodes. *In situ* stress measurements were made using cantilever-deflection method, and gravimetric measurements were made using an electrochemical quartz crystal nanobalance.

Upon de-alloying *via* successive voltammetric sweeps between 0.05 V and 1.15 V *vs.* SHE, compressive stresses develop in thin-film PtCu electrodes. *In situ* and *ex situ* gravimetric measurements indicate 0.5% (by *wt.*) of Cu removal from PtCu electrode; this corresponds to 1 nm or less of a Pt-enriched surface on the PtCu electrode. These measurements indicate a Pt enriched surface under a compressive stress of 1.5-2GPa.

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References

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