Electrochemistry in High Magnetic Fields

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Introduction

The primary step in electrosynthesis is the generation of hydrogen ions. In electrochemical systems this process occurs at a surface, with one component determining the ultimate efficiency being the electronic structure of the metallic electrocatalyst. Using NHMFL-scale magnetic fields to Zeeman-split extended electronic states, we can modify the chemical potential reversibly, (e.g. d-band center). The electrical conductivity, screening, and susceptibility (dielectric constant) can be measured and correlated with specific catalytic action via cyclic voltammetry and electrochemical impedance spectroscopy. From this, routes to electronic structure to improve efficiency can be obtained. Thus the broader impact of this work will be development of new tools to improve the efficiency of electrochemical energy storage.

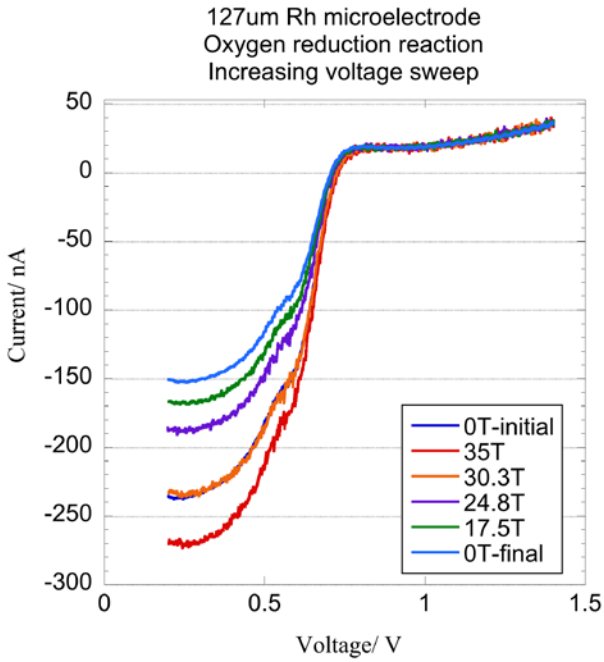

Figure 1. This data set shows a trend in both limiting current and half wave potential as the magnetic field is decreased from 35T to 0T.

Experimental

Using the Tallahassee 35T magnet, we performed a second set of high field electrocatalysis measurements. Many successful improvements were made from the previous study to reduce temperature fluctuations and noise. Cyclic volt-ammetry measurements were made using Pt and Rh catalysts and sulfuric acid to 35T, the first time such measurements were made in magnetic fields of this strength..

Results and Discussion

In **Figure 1** we show a typical I-V curve. The final response at 0T is offset from the initial response at 0T by a significant magnitude. It was expected that any influence of the magnetic field on kinetic or transport processes would be completely reversible. We do not yet have an explanation for the observed shift.

Conclusions

Extensive analysis of the large amount of data collected must be made before conclusions are drawn about the science. We not that whatever those are, they will be definitive because of the excellent data and high fields.

Acknowledgements

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References

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