**Project title:** Electrochemical testing of microcapsules in a battery

**Advisor:** Lihong Zhao (PhD student in MatSE), Prof. Scott R. White (AE)

**Project description:**

Chemical corrosion is one of the causes for degradation of Li-ion battery featuring LiMn$_2$O$_4$ as the cathode material. Hydrofluoric acid (HF) generates naturally in the battery electrolyte via side-reactions during cycling and storage. The electrolyte additive 3-hexylthiophene (3-HT) has been reported to form a protective layer on the cathode alleviating corrosion of the cathode, and leading to the retention of capacity of Li-ion batteries. Our research group has developed encapsulation and triggering concepts for 3-HT upon exposure to HF in the battery electrolyte. As an undergraduate research assistant, your project will be to incorporate these microcapsules into cathode materials and evaluate their influence on battery performance. You will synthesize microcapsules that are responsive to HF (see Fig. 1). You will then disperse microcapsules either into the cathode or onto the cathode surface. Finally, you will measure the electrochemical performance of the cathode. The goal is to develop a smart cathode that can self-stabilize during battery cycling.

![Image of microcapsules and release behavior](image)

**Figure 1.** Morphology of HF-responsive microcapsules (left) and the release behavior in battery electrolyte at different conditions (right).

**Student background and expected research activities:**

We are seeking a driven, enthusiastic student who is interested in *smart materials, electrochemistry, and wet-fabrication of thin films*. Hands-on experience in these fields is desired, but not mandatory. The student should be able to operate manufacturing and testing equipment, follow procedures in a precise manner, and possess strong communication skills.

**Points of contact:**

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