Low Temperature Electrodeposition of Crystalline Semiconductors via ec-LLS

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The primary industrial methods for the production of fully reduced crystalline group IV and III-V semiconductor materials in many optoelectronic technologies are intrinsically simple, clean, and non-energy intensive. Electrodeposition is attractive as a low-energy input materials synthetic route but is presently under-utilized for the preparation of these semiconductors at a meaningful scale. The main drawbacks in traditional electrodeposition tactics are the reliance on non-aqueous solvents, partially reduced precursors, and low temperature electrodepositions invariably result in impure, amorphous films. Accordingly, new strategies for electrodeposition that circumvent these issues are highly desirable.

Recently, we have reported a new technique dubbed an electrochemical liquid-liquid-solid (ec-LLS) crystal growth process. In ec-LLS, the electrode is a liquid phase that acts both as a conventional electrode for electrodeposition and as a solvent for re-crystallization. In this way, electrodepositions can be realized that yield crystalline materials at low temperatures in both aqueous and non-aqueous solvents.

In this presentation, we describe how ec-LLS can be utilized and exploited as a direct means to synthesize both tailored crystalline group IV and III-V semiconductor *materials* and *devices*. Data will be presented to describe controlling factors in ec-LLS and how the technique can be leveraged and exploited as a fully ‘green’ materials synthetic strategy.