Electrochemical Liquid-Liquid-Solid Crystal Growth of Semiconductors

Stephen Maldonado
University of Michigan
930 N University, Ann Arbor, MI 48109-1055

This presentation will describe our recent and cumulative results on the use and operation of electrochemical liquid-liquid-solid (ec-LLS) processes for the preparation of crystalline semiconductor materials. Through ec-LLS, the possibility exists to prepare directly crystals of important group IV and III-V semiconductors at low, non-energy-intensive conditions.[1-3] The ec-LLS tactic combines the traditional features of electrodeposition with flux crystal growth strategies through the use of liquid metal electrodes.[1] Through judicious choice of the process conditions, control over the resultant crystalline and morphological features is possible.

The basic aspects of the ec-LLS process are described in Figure 1. The initial electroreduction of dissolved, oxidized precursors in the electroreduction defines the maximum rate of dissolution into the liquid metal electrode. The dissolution rate in turn defines the extent of saturation/supersaturation within the liquid metal, affecting subsequent nucleation and crystal growth. Data will first be presented that support the validity of this general scheme and illustrate some examples with target semiconductor materials.

The remaining emphasis of this talk will be to provide insight on how the relative rates of the involved steps impact the resultant quantity and quality of crystalline material. Results from electrochemical experiments performed in aqueous electrochemical cells under ambient conditions as well as in non-aqueous solvents under elevated pressure/temperature conditions will be detailed.

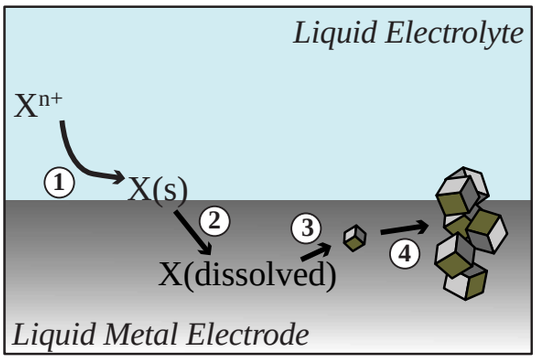

Figure 1. (a) Depiction of steps involved in ec-LLS for crystal growth: 1. Electroreduction, 2. Dissolution, 3. Saturation/ Crystallization, 4. Precipitation

References

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