

ALD for Energy Applications

There are many applications for ALD in energy-related areas. We have recently initiated projects on ALD for Li-ion batteries and ALD for semiconductor-sensitized solar energy conversion. ALD can be useful for Li-ion batteries to enhance the stability of the capacity versus number of charge-discharge cycles. The capacity of Li-ion batteries is observed to decrease with number of charge-discharge cycles as a result of electrode corrosion and the development of the solid electrolyte interphase (SEI) layer. The electrodes are composed of small particles of Li-ion absorbing materials in a matrix of polymeric binder and carbon black. ALD can coat ultrathin protective coatings on the particles.

We have recently demonstrated that thin Al_2O_3 ALD coatings can dramatically improve the stability of the capacity of LiCoO_2 particles used to make cathode electrodes. Similar improvements are observed when coating graphite anode electrodes. The ability of ALD to prevent electrode corrosion and the development of the SEI layer may facilitate the implementation of Li-ion batteries for hybrid or all-electric vehicles.

In collaboration with investigators at the National Renewable Energy Laboratory (NREL), we have also been working on ALD for semiconductor-sensitized solar conversion. ALD is used to coat nanotubes of TiO_2 with semiconductor materials. The conformal coating of semiconductor on nanotubes allows solar light to be absorbed by the semiconductor. The excited electrons are then transported in the TiO_2 nanotubes. We have recently demonstrated nano-photovoltaic (PV) devices using In_2S_3 ALD on the TiO_2 nanotubes.