Assembly of Energy Nanomaterials via Water Based Assembly

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The electrostatic assembly method enables the construction of devices with a high degree of control of ion and electron transport, and the incorporation of inorganic and organic nanomaterials. This capability allows the generation of a broad range of reactive membranes and electrochemical devices through the use of simple aqueous processing conditions, such as salt content and solution pH, to act as tools for the manipulation of ion and electron transport characteristics in the film, as well as the morphology of these unique nano-assemblies. Ultimately, the use of layer-by-layer systems has led to a range of organic and inorganic materials systems that have incorporated metal oxide nanoparticles, carbon nanotubes, and organic and inorganic polymers to yield systems of interest for solar cells, fuel cells, capacitor/battery and electrochemical energy electrode applications. We have recently introduced an automated misting approach to multilayer assembly, spray-LbL, that enables the coating of complex surfaces and porous substrates, and greatly reduces time to assembly for multilayer devices. This approach has enabled the generation of asymmetric reactive membranes, high surface area devices, and rapidly assembled electrodes.