Title: Electrodeposited high power and energy density secondary batteries based on three-dimensionally mesostructured current collectors

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Abstract: Through electrodeposition of a 3D current collector, and in some cases, also electrodeposition of the electrolytically active materials, high power density and high energy density secondary (rechargeable) batteries were fabricated. Rapid charge and discharge and high energy density are important characteristics for rechargeable battery technologies. There is always a trade-off between energy and power density due to ohmic and other losses that occur when a battery is cycled rapidly, however, by efficient design of the ion and electron transport pathways, we and others have shown it is possible to improve the power-energy relationship. We have found a particularly effective way to provide these pathways is to use a colloidal-based template to form a mesostructured 3D current collector. The electrochemically active material is then deposited on this current collector. The combination of a high surface area and short solid-sate diffusion lengths offers a number of unique opportunities for both high energy and high power chemistries. As examples, we have formed conventional form-factor and microbattery high power cells based on a lithiated manganese oxide cathode and either carbon or NiSn anodes, and high energy cells based on a silicon anode.