A general polymer-assisted solution approach to grow transition metal oxide nanostructures directly on nickel foam as anodes for Li-ion batteries

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Rechargeable lithium-ion batteries are widely used in mobile devices, hybrid, plug-in hybrid, and electric vehicles. The performance of batteries strongly depends on the electrode properties. A great effort has been made to synthesize a variety of electrode materials to improve the energy density, rate capability, and cycling stability. Recently, nanostructured materials have received much attention as battery electrodes due to the short transport lengths for both electrons and Li ions, higher electrode-electrode contact area, and better accommodation of the strain of Li insertion/extraction.

Cobalt oxide and nickel oxide have been successfully grown on nickel foam by a facile polymer-assisted chemical solution method. The carbon left from the decomposition of polymers is an effective binder between the metal oxides and nickel foam. As compared to the metal oxide powders prepared in a conventional way by using polymer binder and carbon black, these one-step direct growth electrodes showed much better Li storage properties with high capacities, stable cyclability, and rate capability: Co_3O_4 on nickel foam gave a capacity of 900 mAh/g at a current density of 1 A/g and 600 mAh/g at 4 A/g. The good performances of these electrodes could be attributed to intimate contact between the active material and nickel foam, the porosity of the current collector, and the network structure of the active materials. This general method could also be applied to other transition metal oxides.