Faster Lithium Insertion in Lithium Cobalt Oxide Cathodes by Nanostructuring

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"Closing the gap" between supercapacitors delivering very high power and lithium ion batteries storing large amounts of energy is a key challenge for today's energy demand. These two main technologies of electrochemical energy storage systems have to be combined for upcoming applications such as the storage of solar energy peaks and the fast transmission of the energy to the grid. In order to realise such high energy and high power density devices, development of materials that can incorporate and liberate a large amount of charges in very short time is necessary. Therefore, one promising strategy is nanostructuring.

In previous studies, we reported on the successful synthesis of fully crystalline, interconnected porous frameworks composed of ultrasmall titania (TiO_2) and lithium titanate ($Li_4Ti_5O_{12}$) spinel nanocrystals, which were shown to be the fastest ever-reported titanate morphologies as anode materials for lithium ion insertion by then.[1,2] Additionally, we embedded antimony-doped tin oxide nanocrystals on graphene sheets providing a composite anode material with greatly increased lithium insertion rates and high structural stability.[3] The fabrication of these very fast and efficient morphologies was achieved by using a solvothermal approach in *tert*-butanol, recently developed in our group, leading to very small, fully crystalline, and dispersible metal oxide nanoparticles.

Here, we extend our successful synthesis strategy to the development of nanostructured lithium cobalt oxide ($LiCoO_2$, LCO) via a two-step synthesis. In the first, solvothermal step, we produce easily dispersible lithium rich CoO nanoparticles. The active nanostructured LCO material is then formed in the second step by calcining coated dispersions with the addition of soft templates at a moderate temperature far away from the solid state synthesis. This nanostructured active cathode material delivers 70 mAh g^{-1} at very short charging/discharging times of 72 seconds, and 116 mAh g^{-1} at a time of 6 minutes. Over 60% of this capacity can be preserved even after 250 cycles.

References:

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