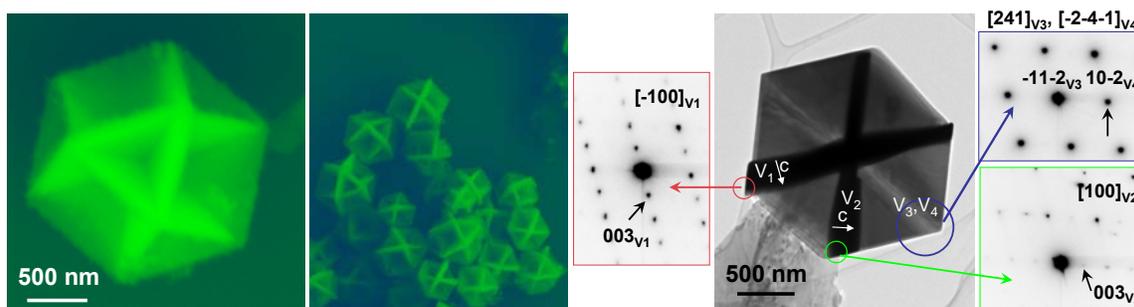
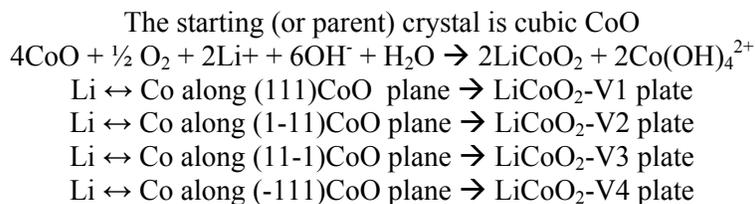
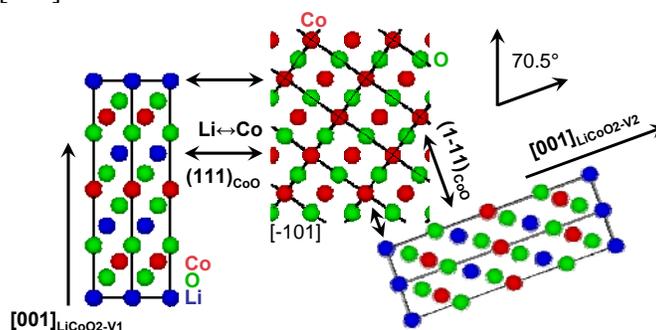


Formation mechanism of layered cathode material LiCoO₂ with concaved cuboctahedrons morphology

Morphology control of functional materials is generally performed by controlling the growth rates on selected orientations or faces. Here, we control particle morphology by “crystal templating”: by choosing appropriate precursor crystals and reaction conditions. We demonstrate that a material with rhombohedral symmetry, namely the layered cathode material LiCoO₂, can grow to form a quadruple-twinned crystal with overall cubic symmetry. The twinned crystals show an unusual, concaved-cuboctahedron morphology, with uniform particle sizes of 0.5-2 μm. On the basis of a range of synthetic and analytical experiments, including solid-state NMR, XRD, electron diffraction and space group theory, we propose that these twinned crystals form via selective dissolution and an ion-exchange reaction accompanied by oxidation of a parent crystal of CoO, a material with cubic symmetry. This template crystal serves to nucleate the growth of four LiCoO₂ twin crystals and to convert a highly anisotropic, layered material into a pseudo-3-dimensional, isotropic material.



LiCoO₂ concaved cuboctahedron consists four hexagonal plates with the angle between the plates being 70.5°. Electron diffraction analysis indicates that each plate corresponds to a twin variant. The plate normal is [001].



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