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MS-14-P-3351 Electron microscopy study of 2-dimensional lithium cobalt oxide

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Liquid exfoliation of bulk material is an efficient and scalable synthesis method to produce single- and few-layers 2-dimensional (2D) flakes of greatly improved surface area as compared to the raw material [1]. Lithium cobalt oxide ($LiCoO_2$) is the most popular material currently utilized for commercial rechargeable batteries [2]. The charge storage capacity of battery materials is proportional to the surface area of electroactive materials. Here, we investigate the possibility of improving the charge storage capability of commercially available $LiCoO_2$ (particle size in the micrometer range) by producing 2D flakes (lateral dimension of approx 400 nm) of enhanced surface area.

Commercially available $LiCoO_2$ and CoO_2 were processed by liquid phase-exfoliation in various solvents to obtain 2D flakes. A fundamental question however is whether the exfoliation procedure affects the material's electronic properties, crystal structure and stability.

The low atomic weight of lithium makes its detection and analysis by electron microscopy or spectroscopy challenging [3,4]. In order to overcome this difficulty we employ a combination of electron microscopy techniques, including high-resolution transmission electron microscopy (HR-TEM), electron diffraction, scanning transmission electron microscopy (STEM), energy dispersive X-ray spectroscopy (EDX) and electron energy loss spectroscopy (EELS), to elucidate the structure and stability of exfoliated LiCoO2 and compare this with exfoliated CoO_2. The combination of imaging and spectroscopy techniques allows us not only to assess the crystal structure and stability of these materials but also to evaluate their chemical structure. A detailed electron microscopy study of these materials will answer key questions relating to their structure, stability and potential as battery materials, as well as further our understanding of how liquid exfoliation affects materials at the atomic level.

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