NANOTECHNOLOGIES

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Phase and Composition Mapping of Polycrystalline Li-ion NCM Cathodes

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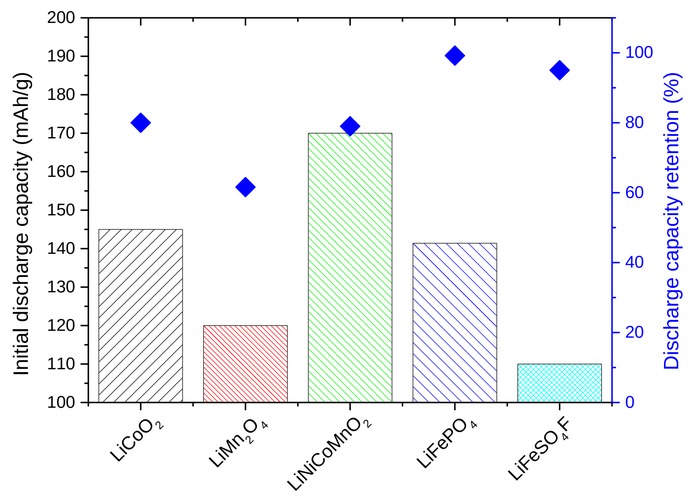
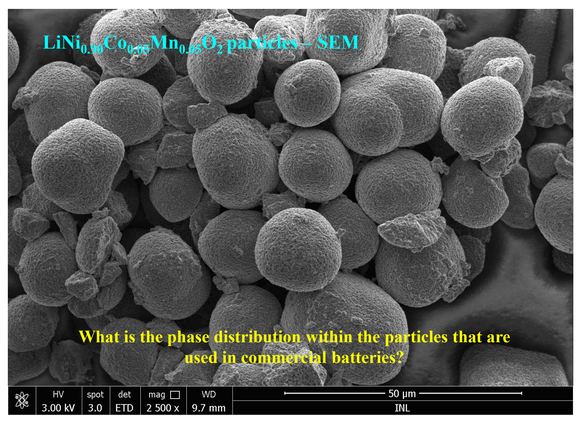
Background

$LiNi_xCo_yMn_zO_2$ (NCM), one of the most common cathode battery materials, exhibits a specific capacity and operating voltage comparable to $LiCoO_2$, while being less toxic. However, single-phase NCM particles are susceptible to phase transformations during charge/discharge due to Li mobility, which deteriorates the cycling performance of Li-ion cathodes. These layered materials exhibit a large degree of cation disorder and thus Ni exchanges with Li in the Li_2MO_3 layer, which disrupts the Li^+ pathways and creates a continuous MO_2 layer, which decreases the Li mobility and degrades the cycling performance.



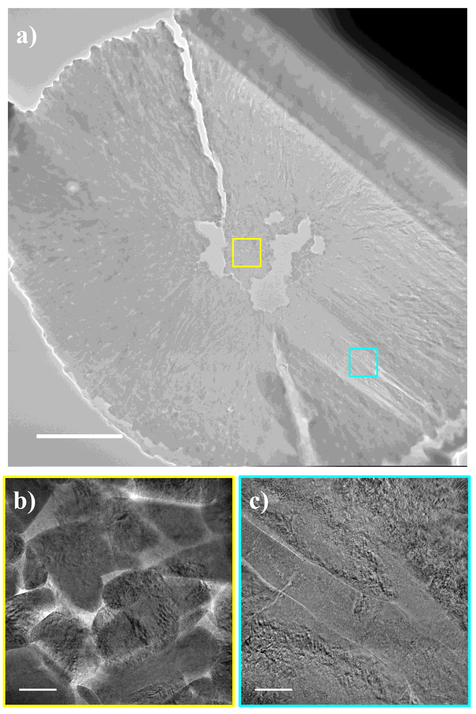
Methodology

$LiNi_{0.90}Co_{0.05}Mn_{0.05}O_2$ particles were prepared by FIB using a Helios 450S (FEI) - Dual FIB with UHRSEM. Thereafter, , the chemical composition and structure were investigated by FIB-SEM, double-corrected TEM-STEM and EDS mapping.

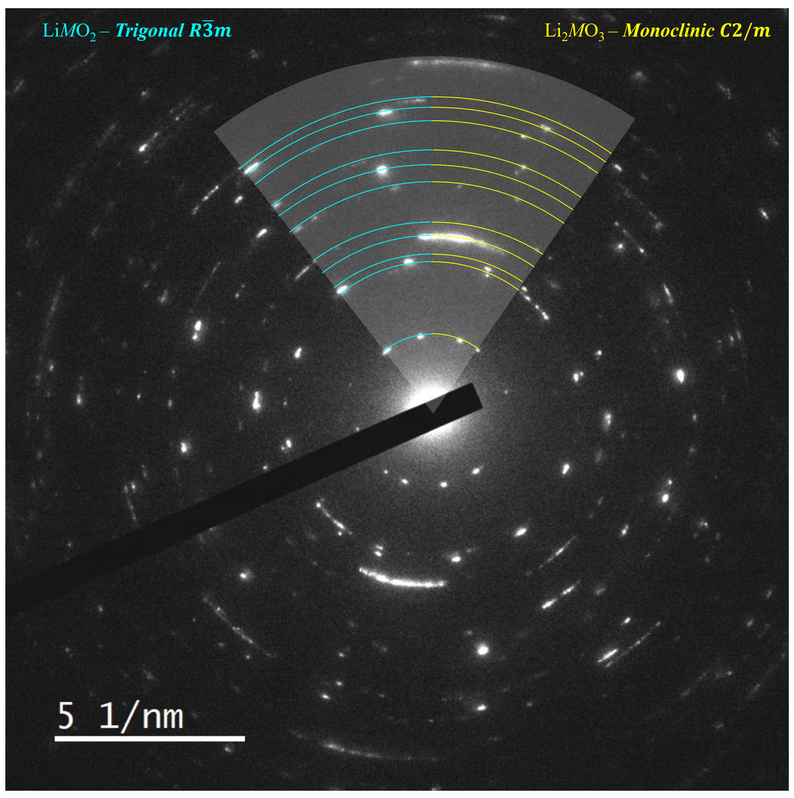


Results

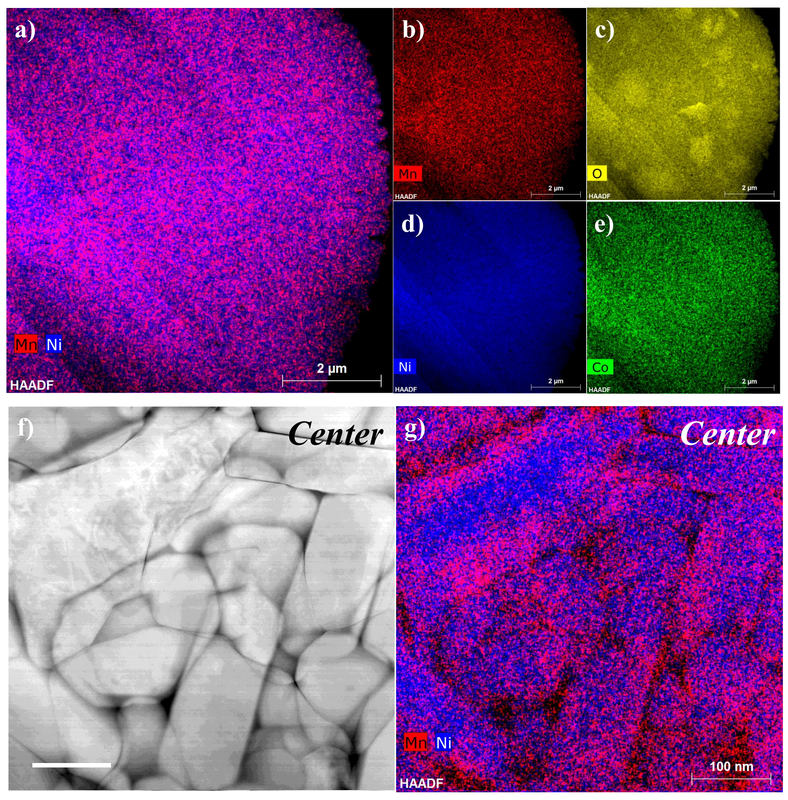
Cross section aberration-corrected TEM image: a) Entire cross section; b) Center section; and c) Surface section.



Selected area electron diffraction of the cross section TEM image.



EDS spectrum images showing the elemental distribution for the $LiNi_{0.90}Co_{0.05}Mn_{0.05}O_2$ particle: a) Mn + Ni overlay; b) Mn; c) O; d) Ni; e) Co; f) HAADF image at particle center; and g) Mn + Ni overlay at particle center.



Conclusions

STEM-EDS analysis reveals variations in chemical composition across the particle, in particular Mn-segregation at the particle center grain boundaries.

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FCT Fundação para a Ciência e a Tecnologia

TEXAS The University of Texas at Austin

INL INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

INL NanoTRAIN for Growth II

European Commission