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Multi-faceted characterization of battery reactions: the case of spinel hosts for Mg-ion batteries[1]

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Electrochemical energy storage was an important enabler of the wireless revolution and it is touted as a key component of a society that shifts away from its dependence on fossil fuels. Batteries are the primary technology when high energy devices are required. They are complex reactors in which multiple physico-chemical phenomena are concurrent in time and space. As a result, it is increasingly clear that holistic approaches to define such phenomena require a breadth of characterization tools. I will exemplify this need in the context of our quest for hosts that are able to reversibly intercalate Mg^{2+} ions. Systems based on the intercalation of multivalent ions are pushed as next generation devices because, while they can resemble systems using Li^{+} ions, they can store more charge per mol of intercalated species, and adopt metals as the anode. Using a combination of characterization tools, including X-ray diffraction, spectroscopy and scattering, electron microscopy and nuclear magnetic resonance, we ascertained that spinel oxides are able to reversibly and extensively accommodate Mg^{2+}. The mechanisms of this reaction were also elucidated. The rationale for the choice of techniques and the key pieces they provided to complete the picture will be discussed.

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