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Solid Ionic Conductors for Energy Applications: Developing a Complete Picture from Structure and Dynamics

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There has been renewed interest in solid state sodium-ion batteries (SIBs) as a safe, sustainable and cost-effective alternative system for large scale energy storage applications.[1] This, in turn, has motivated many studies on the development of materials that facilitate high ionic conductivity over multiple charge-discharge cycles. Layered sodium manganates and the NASICON family of compounds are promising candidate sodium electrode and solid-state electrolyte materials respectively. In both cases, it has been shown that the overall performance of these materials for their respective functions is significantly improved through structural modifications, including by hydration or chemical doping.[2-8] However, the characterisation of these materials are typically limited to techniques which only offer a macroscopic picture, such as electrochemical impedance spectroscopy. As such, direct links between conductivity and structure, particularly with reference to the effect of chemical doping on the microscopic properties of materials are rarely investigated.

We have selected candidate materials which have been shown to be amongst the best performing for their purpose and use high resolution diffraction data to solve their average structure. In parallel, we use quasielastic neutron scattering spectroscopy to gain insight into the diffusion mechanisms at an atomic level. We consequently aim to form a fuller picture of the effects that structural modifications have on the ionic conductivity and hence overall performance of these materials.

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Topic

Advanced Materials

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