

The Lithium Battery: The Origins and the Role of Structure and Disorder

The rechargeable lithium battery is approaching 50 years in age. The structure of the electrode materials is critical to the performance of intercalation reactions, which depend on fast ion transport. This last is in turn dependent on the presence of structural defects. This was brought to the fore by Researchers at the Ford Motor Company in 1967, who discovered the fast motion of sodium ions in the β -alumina ceramic, an important ceramic used to line glass tanks. This material was thought to be just another structural form of aluminum oxide, Al_2O_3 , until Linus Pauling solved its crystal structure and showed that it had the nominal formula, $\text{NaAl}_{11}\text{O}_{17}$. In reality it has around 20% excess sodium ions and these are critical to their high ionic mobility. All of today's battery electrodes depend on defects for their ionic motion, including the common layered oxides and sulfides. Disorder of the cations is also critical to their performance. The role of structure, non-stoichiometry and defects will be discussed.