

## **Na-ion batteries, recent advances and present challenges to become low cost energy storage systems**

Verónica Palomares,<sup>a</sup> Paula Serras,<sup>a</sup> Irune Villaluenga,<sup>a</sup> Karina B. Hueso,<sup>a</sup> Javier Carretero-González<sup>b</sup> and Teófilo Rojo<sup>\*ab</sup>

*Received 28th September 2011, Accepted 19th December 2011*

DOI: 10.1039/c2ee02781j

Energy production and storage have become key issues concerning our welfare in daily life. Present challenges for batteries are twofold. In the first place, the increasing demand for powering systems of portable electronic devices and zero-emission vehicles stimulates research towards high energy and high voltage systems. In the second place, low cost batteries are required in order to advance towards smart electric grids that integrate discontinuous energy flow from renewable sources, optimizing the performance of clean energy sources. Na-ion batteries can be the key for the second point, because of the huge availability of sodium, its low price and the similarity of both Li and Na insertion chemistries. In spite of the lower energy density and voltage of Na-ion based technologies, they can be focused on applications where the weight and footprint requirement is less drastic, such as electrical grid storage. Much work has to be done in the field of Na-ion in order to catch up with Li-ion technology. Cathodic and anodic materials must be optimized, and new electrolytes will be the key point for Na-ion success. This review will gather the up-to-date knowledge about Na-ion battery materials, with the aim of providing a wide view of the systems that have already been explored and a starting point for the new research on this battery technology.