Graphene-based electrodes for high-performance Na-ion batteries

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Nowadays, rechargeable Li-ion batteries (LIBs) represent the state-of-the-art for the power supply in technological devices [1]; however, the wide-scale implementation of this technology, for example in the automotive field, would raise issues, especially concerning the limited lithium mineral reserves. The investigation of alternatives to lithium is hence highly desirable, although it requires the identification of new materials suitable as components for new batteries, possibly displaying even better performance of the current commercial systems.

In this framework, graphene-based materials can be good candidates. It is known that chemically produced graphene is suitable for the development of high-capacity LIBs, in virtue of its high porosity, electronic and mechanical properties. Recently, we found that anodes based on graphene derivatives can also support the insertion of Na^+ ions with high capacity and stability upon cycling [2]. In particular, thermally exfoliated graphene oxide (TEGO) produces capacities of 248 mAh/g after 50 cycles, H-treated TEGO shows reversible capacity of 491 mAh/g after 20 cycles, while Ni-nanoparticles decorated TEGO displays up to 420 mAh/g reversible capacity after 25 cycles with 97% coulombic efficiency. Moreover, solid state ^{23}Na NMR performed on different chemically synthesised graphene materials allowed to shed light on the mechanism of sodium insertion/extraction on the defective graphene surfaces [3].

These findings indicate the feasibility of the development of novel Na-ion batteries (SIBs), whose research is still at an early stage, just because of the lacking of suitable Na anode materials [4].

References

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Figures

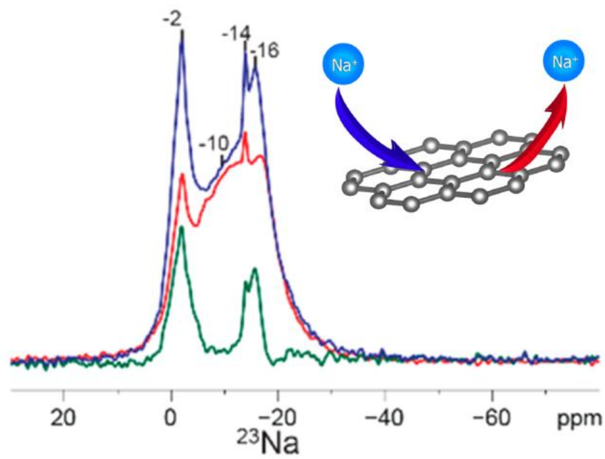

Figure 1: Mechanism of Na insertion/extraction probed by ^{23}Na NMR. Spectrum in blue belongs to the electrode with Na inserted, spectrum in red with Na extracted and green is the difference.