Graphene and nanoparticle hybrid materials for energy storage applications

Lucy McElhone
Andrew Thomas, Aravind Vijayaraghavan
The University of Manchester, National Graphene Institute, Booth Street East, Manchester, M13 9PL
lucy.mcelhone@manchester.ac.uk

Graphene has unique properties to benefit energy storage applications. These include a high specific surface area (2630 m^2g^{-1}), high intrinsic mobility (200 000 $cm^2\ v^{-1}\ s^{-1}$) and high electrical conductivity.[1,2,3] However, pure graphene electrodes suffer from various problems such as re-stacking of graphene layers and defects.[4] Recent advancements in nanotechnology include the design of hybrid electrodes, for instance, an electrode comprised of graphene and transition metal oxide nanoparticles. These hybrid electrodes can maximise the benefits of each component and achieve synergy between the two, presenting an opportunity to combat the challenges driven by the rising global energy demand. In particular, manganese oxides possess several advantages over other metal oxides, including favourable rich oxidation states for reversible redox reactions, high specific capacitance, low cost and high abundance.[5] In this work, a novel graphene and Mn_3O_4 hybrid electrode has been synthesised and characterised.

References

[1] Randviir, E. P., Brownson, D. A. C. & Banks, C. E. A decade of graphene research: production, applications and outlook. Materials Today 17, (2014), 426-432.
[2] Zhu, Y. et al. Graphene and graphene oxide: synthesis, properties, and applications. Advanced Materials, 22, (2010), 3906-3924.
[3] Geim, A. K. Graphene: Status and Prospects. Science 324, (2009), 1530-1534.
[4] Raccichini, R., Varzi, A., Passerini, S. & Scrosati, B. The role of graphene for electrochemical energy storage. Nature Materials 14, (2015), 271-279.
[5] Kuila, B. K. et al. Mesoporous Mn_3O_4 coated reduced graphene oxide for high-performance supercapacitor applications. Materials Research Express 6, (2018), 015037.

Figures

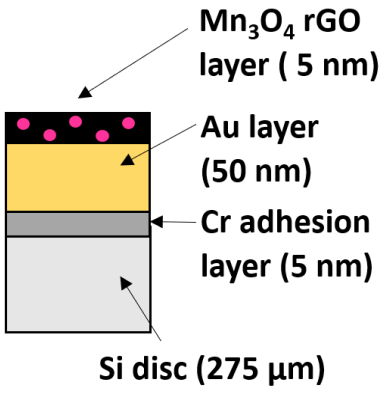

Figure 1: A schematic showing the structure of the manganese oxide hybrid electrode.