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Tuning Graphene Oxide electronic properties through low-temperature thermal annealing

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Abstract

Graphene Oxide (GO) is a single-atom layer of carbon with both the sides and area of the flake functionalized with groups containing oxygen such as, epoxide hydroxyls, ketones and carboxyl acids.[1–4] The presence of these functional groups makes the flakes well dispersible in water making them easy to be processed. However, GO is not suitable for application electronics due to insulator behaviour for the presence of oxygenated functional groups. To restore the conjugation into the carbon framework, removal of oxygen atoms from the flake surfaces is needed and several methods have been investigated in these years.[5,6] Among the vastness of protocols studied, GO thermal reduction is one of the most promising route due to the absence of chemical reagents involved in the process that does not require any further purification steps.[5,7,8] We investigated the thermal reduction of GO in a range of temperature < 300 °C in air and inert atmosphere, characterizing the chemical modification on the flakes surface via XPS and solid-state NMR spectroscopy. The change of oxidation degree in GO by varying the reduction temperature and the atmosphere leads to chemically different materials with different electronic behaviours. Those differences have been highlighted by measuring the electrical resistivity on thin films and using the different thermally reduced GOs as electrodes in supercapacitors.

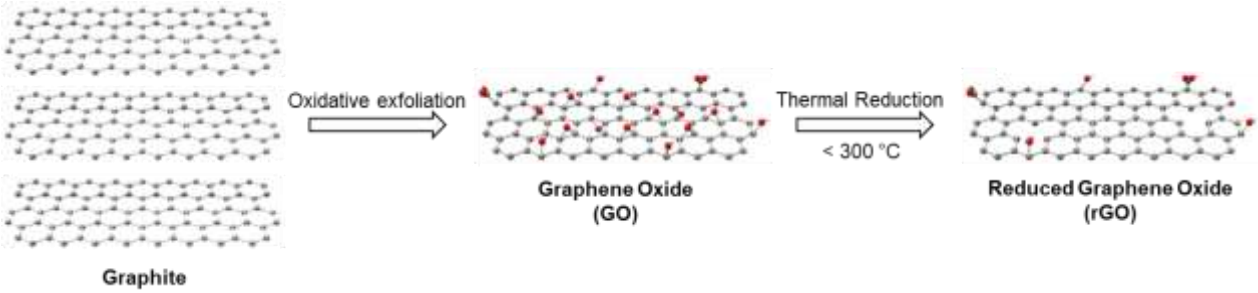

Figure 1: Low-temperature thermally reduced Graphene Oxide production process.

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