# The functionalization of graphene oxide as a route towards reduced graphene oxide with an increased water-dispersibility

**Francesco Amato**
Alessandro Motta, Leonardo Giaccari, Roberto Di Pasquale, Francesca Anna Scaramuzzo, Robertino Zanoni, Andrea Giacomo Marrani
*Dipartimento di Chimica Università di Roma La Sapienza, p.le A. Moro 5 I-00185, Rome, Italy*
francesco.amato@uniroma1.it

Abstract

The large-scale production of graphene is of great importance owing to its unique electronic, electrochemical, optical, thermal and mechanical properties that open the way to its application in a variety of research and industrial areas [1]. However, the employment of graphene on a large scale is still limited owing to its low yield of production and dispersibility both in water and in many organic solvents. Graphene oxide (GO) is the oxidized form of graphene that shows exceptional dispersibility in water due to the presence of oxygen-based functional groups in its structure, such as hydroxyls, epoxides and the less abundant carboxyl groups [2]. In the presence of reducing reagents, GO is converted to reduced graphene oxide (RGO), with the removal of a large portion of oxygen-based functional groups and the partial restoration of the extended conjugation. As in the case of graphene, the layers of RGO are prone to aggregate in water by restricting its employment in many fields, especially in the biological ones. Herein, the sustainable preparation of highly water-dispersible RGO is presented. In particular, GO has been obtained from high-purity synthetic graphite, enriched with carboxyl functional groups via the reaction with succinic anhydride, and eventually chemically reduced with L-ascorbic acid. The obtained dispersion displays unprecedented colloidal stability in water in a wide range of pH, afforded by the ionizable carboxylic groups (Figure 1). All the reaction steps and intermediates have been widely monitored through spectroscopic and morphological techniques in addition to theoretical calculations.

References

[1] S. Eigler, A. Hirsch, Angew. Chem. Int. Ed., 53 (2014) 7720
[2] S. Guo, S. Garaj, A. Bianco, C. Ménard-Moyon, Nat. Rev. Phys., 4 (2022) 247

Figures

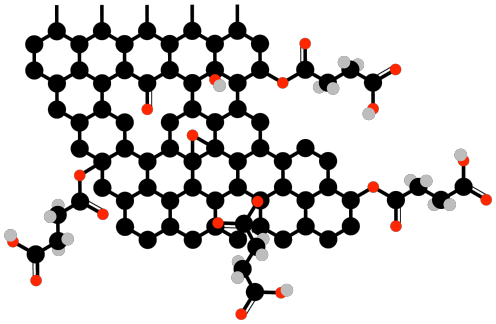

**Figure 1:** Proposed structure of a single layer of carboxyl-rich reduced graphene oxide