Insights on a novel and biocompatible reduction route of graphene oxide by N-acetyl cysteine

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We propose here a novel method for the production and use of partially reduced graphene oxide (rGO) by means of a green biocompatible molecule, N-acetyl cysteine (NAC), which stays active at the rGO surface [1]. Such use of NAC has never been reported before.
We demonstrate by suitable chemical and biophysical techniques a partial and progressive reduction of graphene oxide (GO) at room temperature using NAC for different exposure times. NAC remains attached to the surface of rGO (Figure 1) while retaining its activity, as shown with spectroscopic and microscopic techniques as well as with reliable tests of reactivity. This result is unprecedented in the field to the best of our present knowledge, and can be of advantage for drug delivery purposes, like brain delivery or pulmonary delivery, where anchored NAC can act as a radical scavenger.
Given the widespread application of rGO in vivo, we foresee that this method of reduction can offer new possibilities for the graphene biomedical research field.

Electrochemical reduction on the partially reduced GO has been carried out as a post-treatment [2,3], to better understand the GO reduction mechanism. Moreover, modelling of the graphene oxide reduction by NAC and the adhesion mechanism of NAC on rGO is proposed (Figure 1) and compared to the experimental findings. It was found that NAC can covalently graft on the edge of GO nanosheets as sulphide, partially retaining its reductant ability.

References

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[3] A. G. Marrani, R. Zanoni, R. Schrebler, E. A. Dalchiele, J. Phys. Chem. C., 121 (2017) 5675

Figures

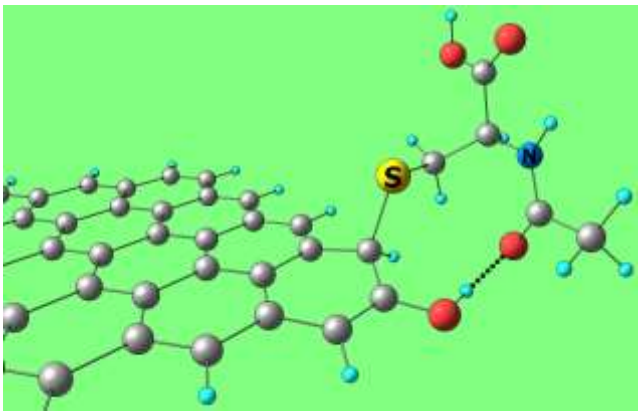

Figure 1: Sulphide species produced by the reduction of a carbonyl terminal group of the GO surface using NAC