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Graphene Oxide and Graphene Oxide Derivatives, Properties and Applications

Abstract

Graphene oxide (GO), as prepared by the so called Hummers method¹ is a solid acidic compound that can be modified in a number of ways. It can be reduced, thermally, chemically or by light to become graphene-like rGO, partly reduced or fully reduced, it can be functionalized to become for example organophilic and it can be doped with N and B. The acidity of both GO and rGO can be reduced by washing with water or even neutralized by treatment with ammonium hydroxide or other bases. The sheets can be small or large, all these variations giving rise to a large family of related compounds with different properties, suitable for different application. Our company aims at offering all these varieties of GO to end-users, in Kg-quantities. Keeping in mind that GO is a metastable material, it is essential to understand the stability or shelf-life of all these different forms, as well as the most suitable storage conditions. In Figure 1 and 2 below we compare dispersibility, color and X-ray diffractograms of standard graphene oxide stored for 3 months, 3 years and 6 years respectively, observing that standard GO is fairly stable for years, still being fully dispersible after 6 years, although its composition has slightly changed as manifested by the color becoming darker. Now, we have undertaken a much wider study where we store a range of derivatives under different conditions (frozen, cool and ambient). These samples will be analyzed regularly over the coming years in order to exactly define the changes that occur and how fast. Our aim is to establish well defined standardized products spanning the entire parameter space of graphene oxide derived materials.

Potential applications of graphene oxide and graphene oxide derivatives include such diverse technologies as load-speaker membranes, water treatment, polymer composites, protective coatings, sports equipment, energy storage and medical applications. We see several applications now being piloted around the globe.

References

- [1] Hummers, William S.; Offeman, Richard E. "Preparation of Graphitic Oxide". Journal of the American Chemical Society. **80** (1958): 1339

Figures



Figure 1: Suspensions of GO aged 6, 3 and 0.3 years.

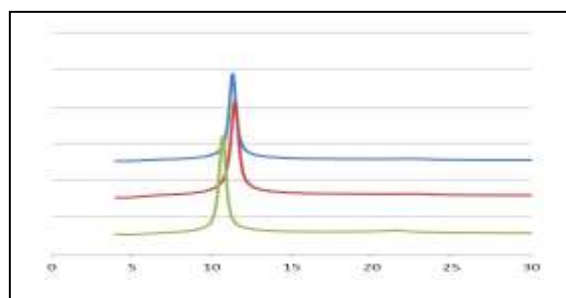


Figure 2: XRD patterns of GO aged 6, 3 and 0.3 years.