Gamma radiation assisted reduction of graphene oxide in unoxidized environment

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Graphene is a honeycomb like structure of carbon atoms of sp^2 hybridization, with remarkable physical and chemical properties. Perhaps, the most desirable properties of a such material is the quasi-ballistic electronic transport and its excellent thermal conductivity that make graphene an excellent alternative to build electronic devices related to silicon, for instance. However, the lack of organic functions and the strong bonds between carbons in graphene nano-sheets make them unable to undergo functionalization reactions, that is important for many applications such as gas and biochemical sensors or nanoparticles decoration. So, in order to allow the functionalization of graphene nano-sheets and make possible a variety of new applications it was developed a nanomaterial based on the oxidation and exfoliation of graphite: the graphene oxide. This new material has epoxide and hydroxyl groups in the basal planes, with carboxyl groups in the borders, improving the hydrophilic properties and potential for chemical functionalization. Graphene oxide also serves as a starting material to graphene production by reduction routes. Partial reduction of graphene oxide leads to reduced graphene, a nanomaterial that combines both proprieties of graphene and graphene oxide: an excellent electrical and thermal conductivity, high superficial area and remaining oxygen groups that allow its functionalization. In the literature is described different ways to produce reduced oxide graphene from graphene oxide, such as chemical reduction using hydrazine hydrate or $NaBH_4$, thermal reduction using high temperatures and plasma hydrogenation. Here in it is described a sustainable process to reduce graphene oxide in sodium bisulfite solution using gamma radiation. Exfoliated Graphene oxide (1-100mg/L) with $NaHSO_3$ under inert medium was submitted to gamma radiation. The radiation dose ranged from 50 to 500 kGy and the product was centrifuged and analyzed by X-ray diffraction (XRD), Raman and infra-red (FT-IR) spectroscopies.
It was observed that depending on the dose total or partial reduction was achieved. This methodology does not produce any toxic residue.