Functionalization of graphene oxide for higher chemical activity, compatibility and selectivity

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The development of new applications of graphene oxide in the biomedical field requires the covalent bonding of bioactive molecules to the sheet skeleton. To get high carboxyl group population over the surface is the target, since the population of carboxyl groups in conventional graphene oxide is low among a majority non-useful sp3-C based-functionalities. The present work proposes a new method that yields an impressive and selective carboxyl group population, which is just using single layer thermally reduced graphene oxide as a precursor in a conventional Hummers-Offeman reaction. When starting with a reduced graphene oxide with no interlayer registry, the sulfuric acid cannot form a graphite intercalated compound. Then, potassium permanganate just attacks in internal and external structural defects (numerous over a thermally reduced graphene oxide) yielding majorly carboxyl groups without sheet cutting and unzipping and very few hydroxyl and epoxy groups, as undoubtedly evidenced by XPS and 13C-NMR. A single layer precursor, with no ordered stacking, prevents the formation of an intercalated compound and is the responsible of this different mechanism of the potassium permanganate for a great carboxyl groups formation and hydrophilic character.