Covalent Multi-Functionalization of Graphene Oxide

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With the tremendous development of nanotechnology and nanomaterials in the recent years, well-designed multifunctional nanomaterials have shown immense potential of applications in different areas, such as imaging and therapeutics.[1] Graphene oxide (GO) is the oxidized form of graphene, usually prepared from graphite through modified Hummers' method. The abundant oxygen-containing groups (e.g. hydroxyl, epoxide, and carboxylate) on the basal plane and edges of GO provide good water dispersibility and chemically reactive groups for surface functionalization with different molecules or nanoparticles.[2] Many routes targeting different reactive groups have been employed for the covalent functionalization of GO including acylation reaction, epoxide ring-opening reaction, isocyanate/esterification reaction, diazotization, and cycloaddition reaction.[3] But, few researches focus on the covalent multi-functionalization of GO. Covalent multi-functional strategies allow to better control the specific attachment of different molecules or nanoparticles through stepwise functionalization. In addition, the binding between GO and the functional groups is more stable compared to non-covalent functionalization. Therefore, it is highly required to develop methods for covalent multi-functionalization of GO. In our work, two different protocols have been developed. The first protocol relies on the combination of epoxide ring opening reaction and carboxylation on GO. A polyethylene glycol chain with an amine moiety was successfully grafted onto GO in two steps. The second protocol of multi-functionalization was achieved through epoxide ring opening and Michael addition. Two different functional groups were covalently grafted on GO in a stepwise approach. The prepared multi-functionalized GO was characterized using XPS, TGA and FT-IR. Thanks to these multi-functionalization strategies, GO could be modified with different functional groups such as targeting molecules and therapeutic particles including photosensitizers for applications in the treatment of different diseases.

References

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[3] Xuezhong G. et al. Chem. Mater. 28(2016), 8082−8118

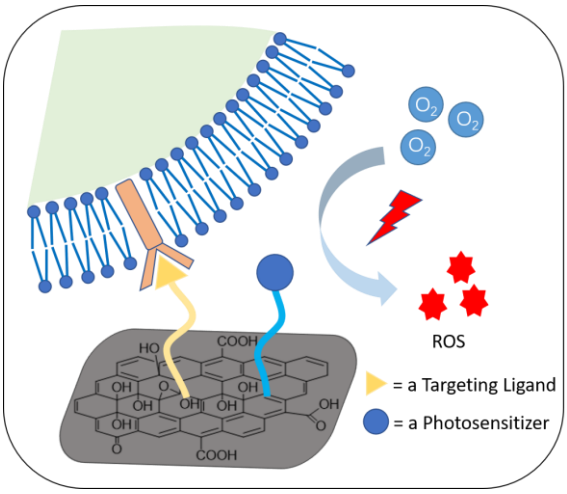

Figure 1: Covalent multi-functional graphene oxide for disease therapy.