Engineering non-covalent graphene oxide complexes with biomolecules for therapeutic use

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Graphene oxide (GO) - the oxidized form of graphene - has become one the most investigated materials in the biomedical field due to its hydrophilicity and improved compatibility with biological systems. We have made a systematic bottom-up effort during the last decade to generate 'medical grade' GO suspensions. These stable water-based suspensions can be reproducibly synthesized with minimum structural, chemical, and biological impurities, are produced from graphite following a modified Hummers' method [1]. Further improvements ensure endotoxin-free [2] suspensions of single-to-few layer GO sheets of the highest chemical purity. Such 'medical grade' 2D materials have been produced in a range of different lateral dimensions [3] to assess the impact of this structural parameter on biological responses and reactivity [4]. All the above-mentioned properties turn GO into a potential platform for drug delivery, enhancing the therapeutic activity of carried molecules by increasing their bioavailability. Most of the protocols described in the literature to either chemically conjugate or non-covalently complexed drug molecules onto the GO surface are lacking in detailed molecular and atomic characterisation, that makes reproducibility very challenging. This talk will describe how to engineer a robust GO platform for biomedical applications, non-covalently complexed to active biomolecules regardless of their molecular weight, ranging from protein, peptides, and small molecules. pH, water-solubility, and dose of biomolecule are the key parameters that will determine the quality of the colloidally and chemically stable complexes. We are currently working on non-covalent GO platforms for cancer immunotherapy [5], vaccine development, neuropharmacological applications, antiviral drug, and anti-cancer therapeutics [6].

References

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Figures

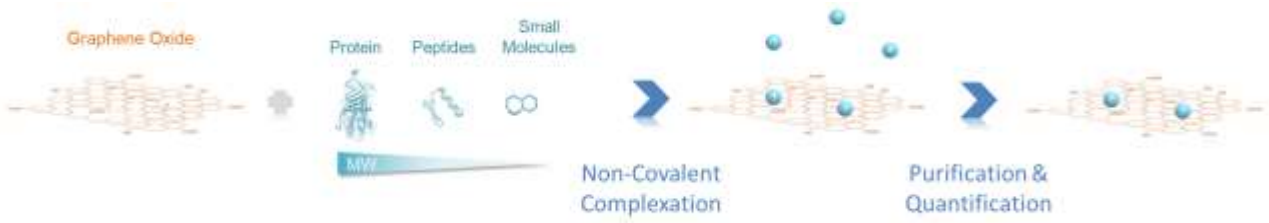

Figure 1: Schematic of engineered non-covalent 'medical grade' GO complexes for biomedical use.