The Effects of Surface Coatings on the Drug Delivery Capacity of Oxidized Graphene Nanoribbons

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INTRODUCTION

What are oxidized graphene nanoribbons (O-GNRs)?
- GNRs are thin, elongated strips of graphene with straight edges.
- Derived from multi-wall carbon nanotubes (MWCNTs), a more widely known carbon nanoparticle.

What are the benefits of studying O-GNR?
- Photoluminescence in the visible and infrared region, allowing for live cell imaging.
- Can be multifunctionalized, allowing for optimizing solubility and half-life, which is an important factor for efficient drug delivery.
- Biocompatibility of having aggregates of nanoparticles in aqueous solutions can be tailored through functionalization of GNR.

How can this be used in future for breast cancer diagnosis and treatment?
- Multi-functionalized - molecular imaging probe to consist of O-GNR functionalized with a targeting agent that recognizes a biomarker specific to tumor.
- Currently, most chemotherapy drugs target all cells, consequently destroying not only cancer cells, but also other rapidly dividing cells such as stomach lining, blood cells, and hair follicles. As a result, side effects like nausea, loss blood cell counts, and hair loss result.
- However, because targeted drug delivery would deliver drugs directly to the cancer cells, these harmful side effects caused by chemotherapy would be avoided. By coating nanoparticles with proteins that recognize receptors on cell membranes, a wide range of drugs and imaging agents can enter cells through endocytosis.
- The method of functionalizing a targeting agent to specific cells would use GNR in a way that also enhances the contrast between malignant and benign tissue in an MRI scan, making it easier to detect the tumor.
- Consequently, this method allows for the quick diagnosis and an improved accuracy, localization, and efficiency of drug delivery agents.

The purpose of this experiment was to determine the efficacy of various surface coatings for solubilization and for drug delivery into cells.

METHODS

Synthesizing and Coating O-GNR.

Loading O-GNR with Doxorubicin.

Cell Line Collection and Maintenance.

Colorimetric (Fluorimetric and Absorbance-based) Assay.

LOADING O-GNR WITH DOXORUBICIN

- The coated nanoparticles were loaded with the anti-cancer drug doxorubicin via simple mixing.
- Raman spectra and UV-Vis of the O-GNRs were taken and analyzed to ensure that the structure and bonds of the nanoparticles were not disrupted during the coating and loading process, and that Doxorubicin (DOX) was successfully loaded onto the O-GNR.

CONCLUSION & FUTURE WORK

- The coating that provided the most effective drug delivery in MCF-7 cells was doxorubicin with a molecular mass of ten thousand nucleotides (Desmin 10ks), in NH2 cells, PEG-DISP was the most effective.
- It was determined that in both cell lines, the nanoparticles delivered three times more doxorubicin than the cells would take up without the nanoparticles. This effect may have a large impact on the efficacy of drug therapy, and may significantly reduce the side effects of the cancer drug treatments.
- The future applications of O-GNRs seem promising, thus researching the environmental impact of O-GNR before it reaches the consumer is imperative.

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REFERENCES