Preparation and cytotoxicity of a novel carbon nano-onion platinum nanomaterial for potential cancer therapy

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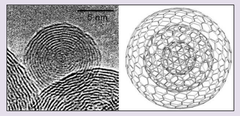
Abstract

Figure 1: Carbon nano-onions



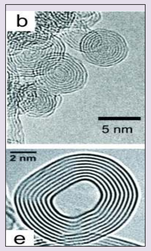
The applications of carbon nanomaterials (CNM), including graphene and its derivatives such as carbon nano tubes (CNTs) in nanomedicine is well established. These nanomaterials have been widely used as *theranostic* delivery systems with the potential to deliver bioactive agents and simultaneously detect selectively diseased tissues. A rather underexplored CNM for biomedical imaging and theranostics delivery are carbon nano-onions (CNO). CNO are carbon-based nanomaterials that can potentially be used in cancer therapy when they are functionalized. Recent studies on cellular fate of different CNMs, including CNOs, have demonstrated that the surface composition is critical for the *in vivo* application of these CNM. Current research discusses the preparation and characterization a novel CNO-Pt nanomaterial and the cell viability of U87 glioblastoma cells in the presence of this functionalized CNO. In order to form the desired CNO-Pt compound, the CNOs were first oxidized, followed by attachment of the *cis*-diammine platinum(II) dichloride. The novel CNO-Pt nanomaterial was characterized by IR and UV-vis spectroscopies. Cytotoxicity of the material was tested on U87 glioblastoma cells.

Introduction

U87 Cell Line

- Glioblastoma cancer cells
- ~20,000 Americans are diagnosed with a glioma each year
- Glioma tumors sprout and spread quickly in the brain
- More than 50% die within 18 months
- Very low survival rate

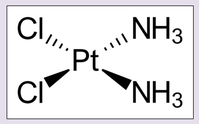
Carbon Nano-onions



- Consist of spherical closed carbon shells and an outer structure resembling an onion
- Poor solubility in organic and aqueous solvents
- Carbon nano-onions (CNOs) are primarily used as drug carriers and delivery vehicles
- Attaching a functional group increases solubility

Cisplatin

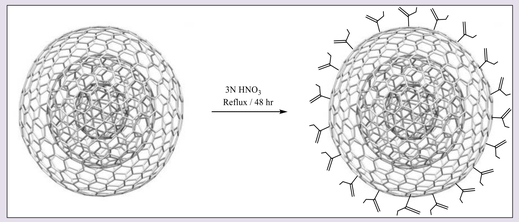
- Chemotherapy drug that destroys rapidly dividing cells by blocking DNA replication
- Used in a large variety of cancer treatments



Preparation

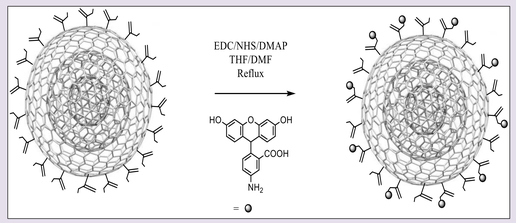
Reaction 1

- CNOs refluxed in 3M nitric acid to form oxidized-CNOs



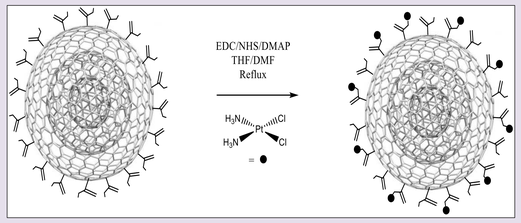
Reaction 2

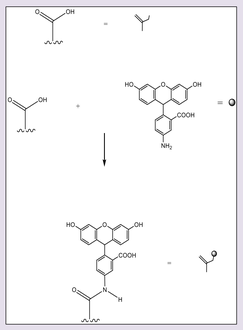
- Oxidized-CNOs and fluoresceinamine refluxed in DMF/THF to form fluorescent-CNOs

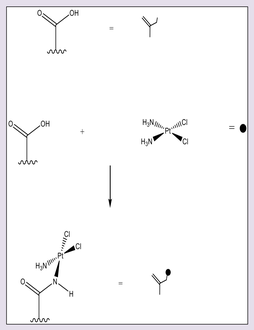


Reaction 3

- Oxidized-CNOs and cisplatin refluxed in DMF/THF

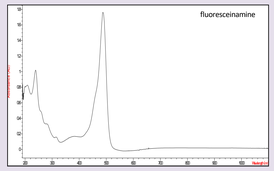


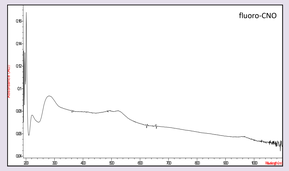


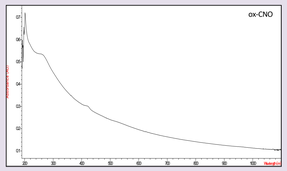


Characterization

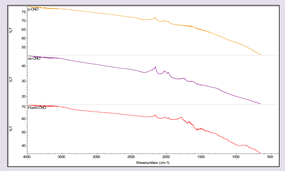
UV-vis Spectroscopy

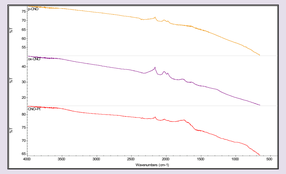




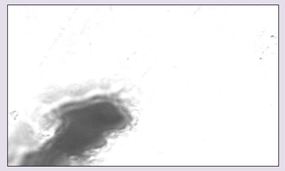


Infrared Spectroscopy



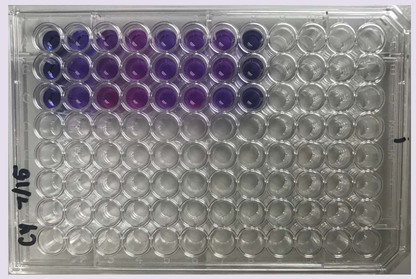


Fluorescence Microscopy



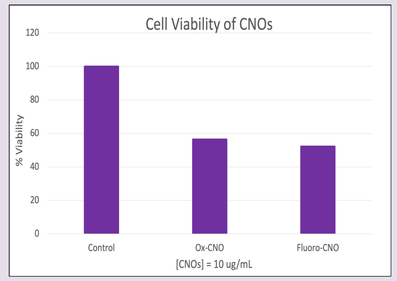
- Fluorescent-CNOs under regular light (left) vs. UV light (right)

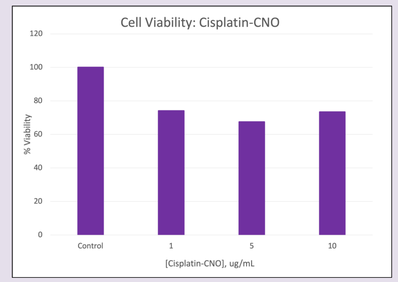
In-vitro Cytotoxicity Assay



- Cells were exposed to oxidized-CNOs and fluorescent-CNOs at concentrations of 10 ug/mL
- Cells were exposed to cisplatin-CNO concentrations of 10 ug/mL, 5 ug/mL, and 1 ug/mL
- Cells were treated with Alamar Blue

Results





- The i*n-vitro* Cytotoxicity Assay indicates that percent cell viability decreased at all concentrations of the cisplatin-CNO
- Cell viability also decreased when exposed to oxidized-CNOs and fluorescent-CNOs

Conclusions

- A novel carbon nano-onion platinum material was prepared successfully.
- The compound was characterized by UV-Vis and IR spectroscopies.
- The spectrums confirm that the correct product was actually formed.
- Alamar Blue Assay revealed that cell viability decreased at all concentrations

Future Direction

- Pt determination using AA/ICP
- Perform MTT Assay on cells with a greater range of concentrations
- Examine cytotoxicity of cisplatin-CNOs on normal cells and other cancer cell lines

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