

## **Graphene Oxide Mediated Carboplatin Delivery and its Anticancer Activity**

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Graphene and its derivative, graphene oxide (GO), have been considered as promising materials for drug loading and delivery. Nanoscaled materials, such as liposomes, microspheres, polymeric shells, and nanoparticles, are mostly used as drug loading agents acting through different mechanisms (e.g. embedding, surface absorption, hydrogen bonding, van der Waals interactions, etc.). However these materials have a low loading capacity for drug molecules [1-3]. Therefore, for efficient drug activity, drug loading efficiency needs to be improved in drug carrier research. For the first time, nanographene oxide (NGO) used as nanocarrier for drug loading and delivery [4,5], the loading capacity increased dramatically and graphene did not provoke cytotoxicity in human fibroblast cells. Prior drug loading, graphene has to be functionalized via covalent or noncovalent interaction with other organic materials, the functionalization provides high dispersability and biocompatibility in physiological media. Several studies emphasized that numerous factors such as chemical composition, size, shape, contaminants, concentration, and cell types will influence the cellular uptake and the cytotoxicity of graphene. A variety of characterization techniques have been used to utilize the structure and properties of GO. These techniques are classified into spectroscopic and microscopic approaches. The spectroscopic approaches are used to identify the chemical structure of GO, and include Raman, FTIR, and XPS. Microscopic tools are used to map out the structure of GO at various heights and lateral dimensions, for instance, AFM, SEM, TEM, and STM.

For graphene 2014 conference in Toulouse, the subject talk will be concentrated on NGO functionalized Polyamido amide (PAMAM) for carboplatin (CP) delivery (figure 1). The results revealed that NGO-PAMAM as a platform was found to be able to deliver carboplatin to the cancer cells, by enhancing the drug anticancer efficiency. Moreover, the carboplatin loaded NGO carrier shows no significant effect on the viability of mesenchymal stem cells (hMSCs) even at high concentration ( $100 \text{ mg ml}^{-1}$ ) Figure 2.

## Figures:

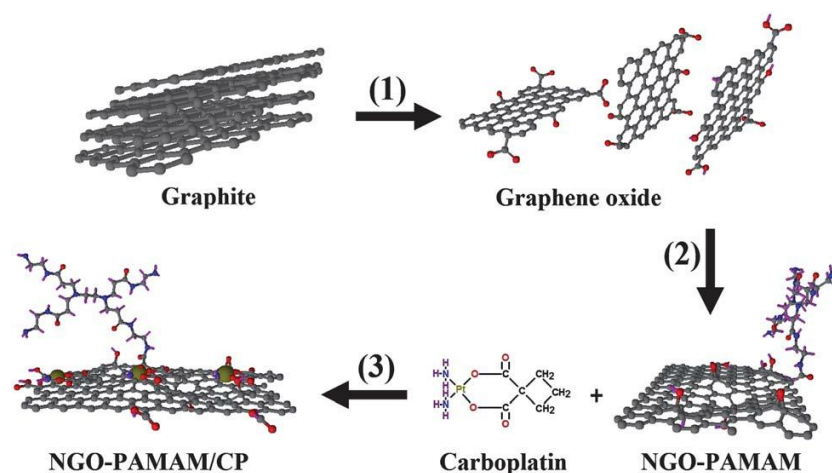


Figure 1: Schematic illustration of NGO-PAMAM/CP: (1) chemical oxidation exfoliation reaction, (2) size reduction and functionalization by PAMAM, and (3) carboplatin loading.

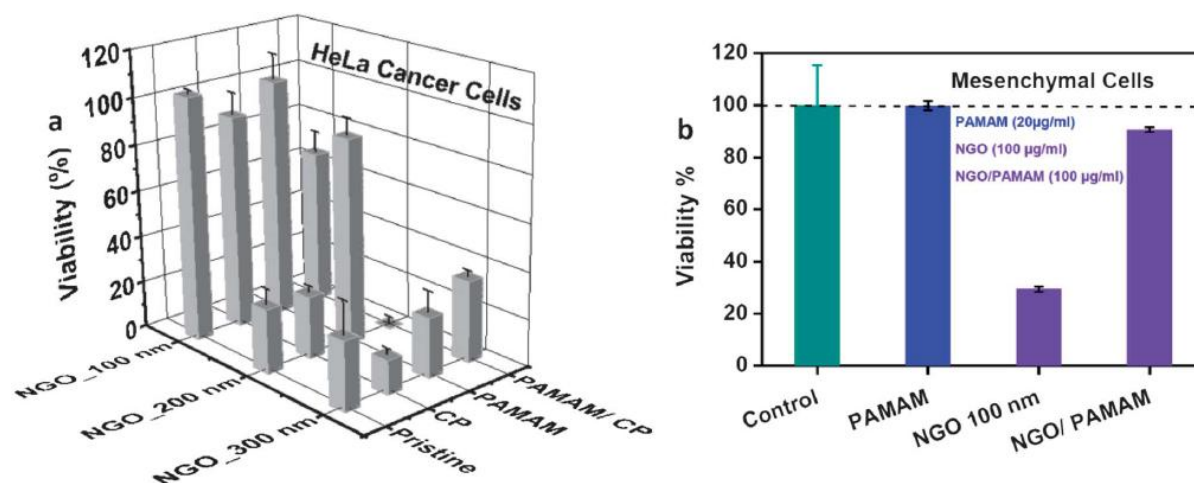


Figure 2: Cell viability (WST-8) of HeLa and hMSCs after 24 h of incubation: (a) pristine NGO, CP-NGO, and CP/PAMAM-NGO. The concentrations tested were: CP (10 mgml<sup>-1</sup>), PAMAM (20 mgml<sup>-1</sup>), and NGO (100 mgml<sup>-1</sup>); (b) PAMAM, NGO and PAMAM-NGO.

## References

- [1] C. Soldano, A. Mahmood and E. Dujardin, Carbon, **48**, (2010) 2127–2150.
- [2] F. Wang, Y. Zhang, C. Tian, C. Girit, A. Zettl, M. Crommie and Y. R. Shen, Science, **320** (2008) 206–209.
- [3] D. Garcia-Sanchez, M. van der Zande, S. Paulo, B. Lassagne, P. L. McEuen and A. Bachtold, Nano Lett., **8** (2008) 1399–1403.
- [4] X. Sun, Z. Liu, K. Welsher, J. T. Robinson, A. Goodwin, S. Zaric and H. Dai, Nano Res., **1** (2008) 203–212.
- [5] Z. Liu, J. T. Robinson, X. Sun and H. Dai, J. Am. Chem. Soc., **130** (2008) 10876–10877.