Highly biocompatible reduced graphene oxide and its applications in drug delivery and early cancer detection

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Abstract

A simple, one-pot strategy was used to synthesize reduced graphene oxide (RGO) nanosheets by utilizing a medicinal and edible mushroom, *Ganoderma lucidum* [1]. The obtained RGO was highly biocompatible to colon (HT-29) and brain (U87MG) cancer cells as well as normal cells (MRC-5). Following this, the RGO was used as a drug delivery cargo by functionalizing with an amphiphilic polymer, PF-127 forming a GP cargo [2]. Combination of natural and commercial anti-cancer drugs, Curcumin (Cur) and Paclitaxel (Ptx) were then loaded via pi-pi interactions, resulting in a nanosized GP-Cur-Ptx of 140 nm. High Cur loading of 678 wt.% was achieved with pH sensitive drug release. Based on cell proliferation assay, GP-Cur-Ptx is a synergistic treatment (CI < 1) and is highly potent towards lung, A549 (IC50 = 13.24 µg/ml) and breast, MDA-MB-231 (IC50 = 1.450 µg/ml) cancer cells. For biosensing application, RGO functionalized folic acid (FA) was used for the detection of the over expressed cancer protein, folate receptors (FR). FA is a vitamin with high bioaffinity to FR. The RGO-FA modified GC electrode was analyzed by differential pulse voltammetry (DPV) for its specific detection towards FR. RGO-FA exhibited a limit of detection (LOD) of 1.69 pM and showed excellent specificity and reliability when tested against similar interfering biomolecules. This RGO-FA sensor offers a highly sensitive detection in a fast, reliable and economical way.

References

[1] K. Muthoosamy, R. G. Bai, I. B. Abubakar, S. M. Sudheer, H. N. Lee, H. S. Lim, et al. Int. J. Nanomed. 10 (2015) 1505-19.
[2] K. Muthoosamy, I. B. Abubakar, R. G. Bai, H. S. Lim, et al. Sci. Rep. (2016) 6: 32808.

Figures

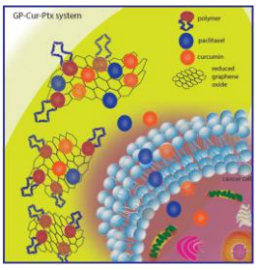

Figure 1: Drug release model of GP-Cur-Ptx.

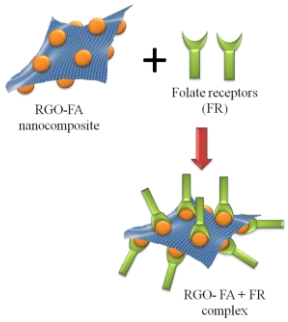

Figure 1: Formation of RGO-FA-FR complex.