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## POxylated Graphene Oxide Nanomaterials for Combination Chemo-Phototherapy of Breast Cancer Cells

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### Abstract

PEGylated graphene oxide (GO) nanomaterials have been showing promising results in cancer therapy, due to their drug loading and photothermal capacities. However, the recent reports regarding the immunogenicity of poly(ethylene glycol) based coatings highlight the importance of investigating alternative materials to functionalize GO. Herein, GO derivatives were functionalized for the first time with an amphiphilic polymer based on poly(2-ethyl-2-oxazoline) and were co-loaded with doxorubicin (DOX) and D- $\alpha$ -Tocopherol succinate (TOS) to be applied in chemo-phototherapy of breast cancer cells. The results revealed that POxylated GO displays the required properties for application in cancer therapy. Moreover, the screening of different DOX:TOS combination ratios showed that the 1:3 DOX:TOS molar ratio produces an optimal synergistic therapeutic effect towards breast cancer cells. Furthermore, this drug ratio had a lower impact on normal cells. POxylated GO was then loaded with this drug combination in order to assess its chemo-phototherapeutic potential. The delivery of DOX:TOS by POxylated GO to cancer cells induced a stronger therapeutic effect than that attained with the free drug combination. Furthermore, an even greater cytotoxicity towards cancer cells was achieved by exposing DOX:TOS loaded POxylated GO to near infrared radiation. Overall, POxylated GO is a promising drug delivery and phototherapeutic agent.

**Keywords:** cancer treatment; co-delivery; graphene oxide; photothermal therapy; POxylation.

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