Environmentally-friendly reduced graphene oxide functionalized with hyaluronic acid for targeted cancer photothermal therapy

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Abstract:
Reduced graphene oxide (rGO) is one of the most promising nanomaterials for application in cancer photothermal therapy (PTT).[1] This nanomaterial has a high near infrared (NIR) absorption, producing, upon interaction with NIR light, hyperthermia that can cause the death of cancer cells.[1] However, rGO is commonly produced using hazardous agents (e.g. hydrazine hydrate), hindering its biocompatibility.[2] Furthermore, the broader use of rGO in cancer PTT is also limited by its poor colloidal stability and inability to target cancer cells.[3] To address these limitations, herein rGO was produced using an environmentally-friendly reduction method and was functionalized with a hyaluronic acid based amphiphilic polymer (HA-rGO) for application in targeted breast cancer PTT (Figure 1).[2]
For the production of rGO, the concentration of L-ascorbic acid (1.5 and 3 mM) and the time of reduction (30 to 120 min) were optimized. The results revealed that by treating GO with 3 mM of L-ascorbic acid for 60 minutes, at 80 ºC, yields rGO with suitable NIR absorption (mass extinction coefficient of 12.67 L/(g.cm)), at 808 nm) and adequate size distribution for photothermal applications. Subsequently, the attained rGO was functionalized with an HA-based amphiphilic polymer, leading to an improvement in nanomaterials' colloidal stability and cytocompatibility. The HA-rGO also demonstrated a higher internalization in CD44 overexpressing cells, revealing its targeting capacity. Finally, the combination of HA-rGO and NIR light (808 nm, 1.7 W/cm^2, 5 min) decreased cancer cells' viability to about 6%, further confirming the potential of this nanomaterial for cancer photothermal therapy.

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Keywords: Breast cancer, Hyaluronic acid, L-Ascorbic acid, Near infrared light, Photothermal therapy, Reduced graphene oxide.

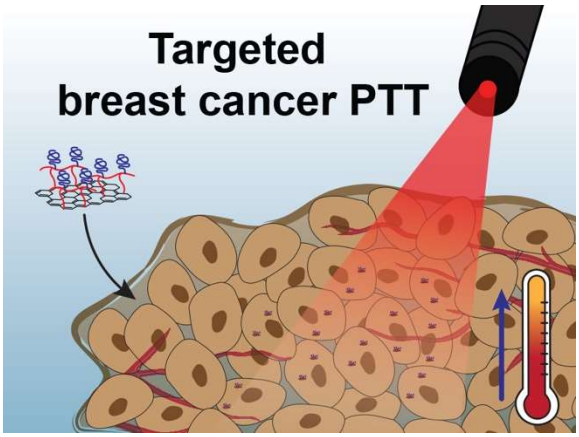

Figure 1: Schematic illustration of the targeted breast cancer PTT mediated by HA-rGO.

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