New two-dimensional nanomaterials and devices for phototherapy

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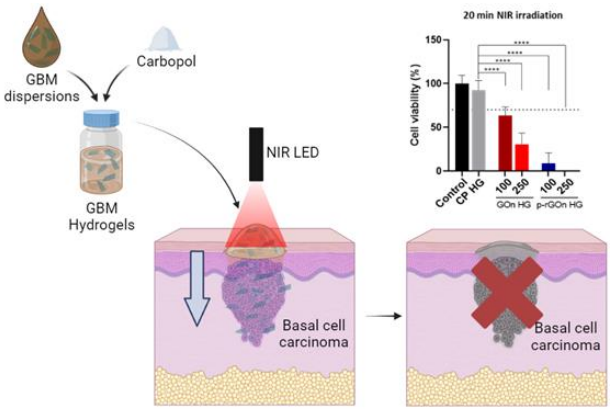

Nanosized graphene oxide (GOn) is stable in aqueous dispersion, due to the oxygen functionalities on its surface, but possess low photothermal efficiency in near infrared (NIR) region. GOn total reduction originates reduced nanographene oxide (rGOn) that presents high NIR absorption, but poor water stability. In this work, we produced a never before reported partially-reduced nanographene oxide (p-rGOn) by GOn photoreduction using light irradiation, yielding nanometric particles that preserve the original water stability, but acquire high light-to-heat conversion efficiency. GOn and p-rGOn presented mean particle sizes of 170 ± 81 nm and 188 ± 99 nm, respectively. 8 h of light irradiation allowed to obtain a p-rGOn stable for up 8 months in water, with a zeta potential of −32.3 ± 1.3 mV. p-rGOn water dispersions have shown to absorb NIR radiation, reaching 57.2 °C (250 μg mL-1) after 30 min of irradiation. Chemical characterization of p-rGOn showed a decrease in the number of characteristic oxygen functional groups, confirming GOn suitable chemical modification. Additionally, p-rGOn (150–250 μg mL-1) has been proven not to have impact on human skin fibroblasts (HFF-1) cell viability, after 24 h of incubation. Furthermore, an innovative custom-built NIR LED-system has developed and validated for 2D-nanomaterials photothermal effect evaluation. Nanomaterials were included in pharmaceutical formulations, and proven effective for skin cancer cells complete eradication, revealing to permeate across human skin. This is the 1st pharmaceutical formulation ever reported to deliver graphene through skin for cancer therapy. A general perspective on the work of our team will be presented, focusing on applications of graphene-based nanomaterials and also of other never before explored 2D-nanomaterials in phototherapy, immunotherapy and 3D-printing for tissue regeneration [1-3].

References

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