New nanomaterials for biomedical applications with focus on 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 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 reduced nanographene oxide (N-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 New-rGOn presented mean particle sizes of 170 ± 81 nm and 188 ± 99 nm, respectively. 8 h of light irradiation allowed to obtain a N-rGOn stable for up 6 months in water, with a zeta potential of −32.3 ± 1.3 mV. N-rGOn water dispersions have shown to absorb NIR radiation, reaching 57.2 °C (250 μg mL^{-1}) after 30 min of NIR irradiation. Chemical characterization of N-rGOn showed a decrease in the number of characteristic oxygen functional groups, confirming GOn suitable chemical modification. Furthermore, N-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. Finally, an innovative custom-built NIR LED-system has developed and validated for N-rGOn photothermal effect evaluation.

A general perspective on the work of our team will be presented, focusing on applications of graphene-based nanomaterials in phototherapy, immunotherapy and 3D-printing for tissue regeneration [1-3].

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