# Nano Graphene Oxide: An emerging nanoplatform for cancer therapy

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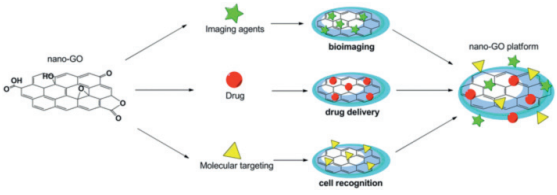
Nano-GO is a graphene derivative with a 2D atomic layer of $sp^2$ bonded carbon atoms in hexagonal conformation together with sp3 domains with carbon atoms linked to oxygen functional groups. The supremacy of nano-GO resides essentially in its own intrinsic chemical and physical structure, which confers high aspect ratio, unusual physical properties and an extraordinary chemical versatility arising from the oxygen functional groups on the carbon structure that make possible its relatively easy functionalization.

Hence, the synergistic effects resulting from the assembly of well-defined structures at the nano-GO surface, in addition to its intrinsic optical, mechanical and electronic properties, allow the development of new multifunctional hybrid materials with a high potential in the biomedical area (*Adv Healthcare Mater, 2 (2013) 1072*). (Figure 1).

Nano-GO is being investigated on different areas of nanomedicine, especially on the development of cancer treatments by hyperthermia. Due to its strong Near Infrared optical absorption ability and its unique and smaller two-dimensional shape and aspect ratio, it is incomparable to any other particle, especially concerning its low-cost production in contrast with gold or magnetic nanosystems.

Moreover, the functionalization of nano-GO with polyethylene-glycol (PEG) allows the development of new hybrid materials with potential therapeutic effects on applications which imply long lasting circulation on the blood stream and particle cell internalizations. Our recent results showed nano-GO-PEG uptake kinetics differences in the agent's uptake amount and speed as a function of the type of cell involved on the process. Moreover, the PEG nature (poly or single branched) also influences cell viability and particle uptake speed (*Nanotechnology 23 (2012) 465103*). Further studies showed that the subcellular distribution of nano-GO-PEG inside the cell (particles are labelled with green fluorescence on Figure 2) is also dependent on the cell type. L929 fibroblasts and RAW macrophages showed particles mainly localized on the cell membrane and in the cytoplasm. However, in SAOS osteoblasts and MC3T3 preosteoblasts, the signal seems located on the microtubules, F-actin filaments, and high doses could induce cell-cycle alterations, apoptosis and oxidative stress. The published results, about PEG nano-GO functionalization, size and dose, were the first discoveries for performing a safe therapy with no secondary effects on surrounding healthy cells (*Biomaterials 34 (2013) 1562*).



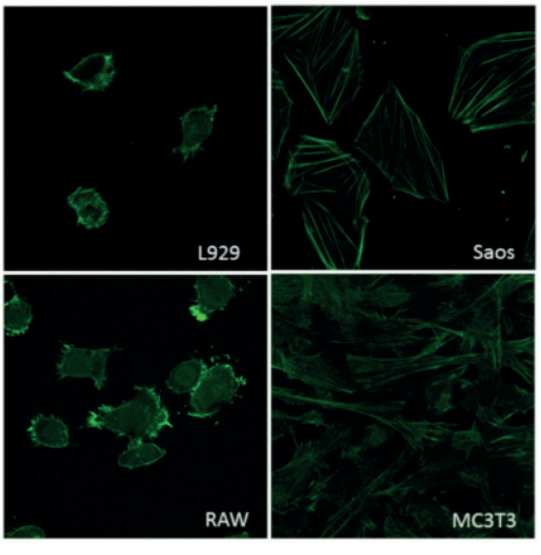




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**FIGURE 1**
Schematic representations of different approaches for the functionalization of nano-GO in order to obtain multifunctional platforms for cancer therapy.

**FIGURE 2**
Incorporation of GOs by cultured human SAOS-2 osteoblasts, murine MC3T3-E1 preosteoblasts, murine L929 fibroblasts and murine RAW-264.7 macrophages after 1 day treatment observed by confocal microscopy.