Hybrid graphene quantum dot-manganese oxide nanoparticles for photodynamic therapy

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Photodynamic therapy (PDT) is a novel approach in cancer treatment owing to its reduced side effects and improved selectivity [1]. Nontoxic photosensitizers absorb near infrared light at specific wavelength and damage cancer cells by generating reactive oxygen species (2). The photosensitizers are excited by light exposure resulting in fluorescence emission, which acts as both therapeutic and imaging agents [3,4]. We synthesized core manganese oxide (Mn3O4) nanoparticles and functionalized with highly reduced graphene oxide (HRG). The synthesized nanocomposites were found to be stable and therefore suitable for storage and biomedical applications. The cellular uptake of nanoparticles was evaluated in lung cancer cell line (A549) following exposure of nanoparticles solutions (25, 50, and 100 µg/ mL) and incubation for 4 h. The cells were then washed before quantification of intracellular Mn. Cellular uptake of nanoparticles was directly proportional to their concentration. More than 95% of cells survived even after the exposure of a high concentration of nanomaterials (100 µg/mL), indicating that these nanoparticles are nontoxic and biocompatible. We performed fluorescence microscopy for live/dead cellular analysis. A549 cells were incubated with nanoparticles for 24 h and stained with fluorescein diacetate (green emission for live cells) and propidium iodide (red emission for dead cells) to visualize live and dead cells, respectively. Almost 100% cells were viable when treated with phosphate buffered saline or Mn3O4 while only few dead cells were detected after exposure of HRG-Mn3O4 nanoparticles. However, laser irradiation resulted in massive cellular damage by HRG-Mn3O4 nanoparticles. These findings suggest the imaging and therapeutic potential of these nanoparticles for photodynamic therapy. (Supported by National Plan for Science, Technology and Innovation, KACST, Saudi Arabia, No. 14-NAN-862-02)

References

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Figures

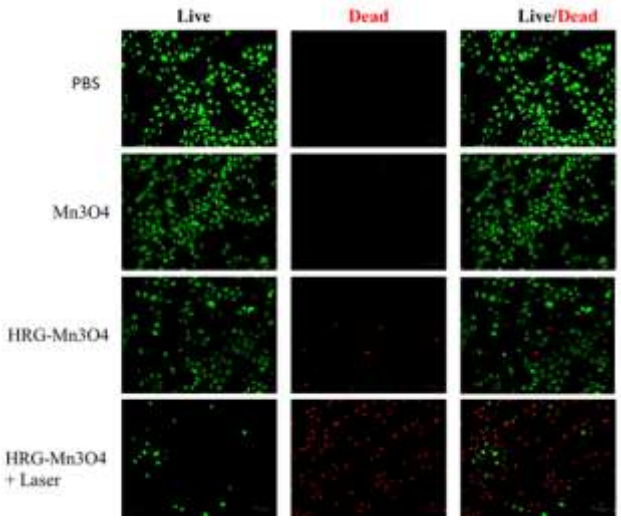

Figure 1: Fluorescence microscopy images of A549 cells co-stained with fluorescein diacetate and propidium iodide after exposure of nanoparticles with/without laser irradiation (670 nm, 0.1W/cm2) for 5 min.