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Mass production of functionalized graphene quantum dots and their application in cancer diagnosis and therapy

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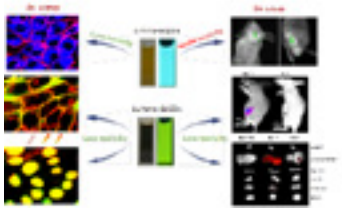
Graphene quantum dots (GQDs) have garnered increasing attention because of their various alluring physicochemical properties and a wide range of potential application. However, their large-scale applications are limited by current synthetic methods that commonly produce GQDs in small amounts. Moreover, GQDs usually exhibit polycrystalline or highly defective structures and thus poor optical properties. We established a new mass-productive synthesis method of single-crystalline GQDs via a green and low-cost alkali-mediated hydrothermal molecular fusion using an active PAH molecule as a precursor. Functionalized GQDs featured excellent optical properties, strong excitonic absorption bands extending to the visible region, large molar extinction coefficients, and long-term photo-stability. Positively charged amino-GQDs could easily pass through cell membranes and localize in cell cytoplasm but show acute toxicity *in vivo* causing death of mice even after tail vein injection at low concentrations. Negatively charged sulfonic-GQDs could not pass through the cell membrane even after co-incubation for 48 hours under normal culture conditions. However, specific targeting of cell nuclei was found when cells were cultured in an ultrathin film with the sulfonic-GQDs. Both subcutaneous and orthotopic mice tumor models revealed that the sulfonic-GQDs showed specific targeting performance for the tumor tissues *in vivo*. Confocal images of frozen tumor and normal tissue sections further demonstrated the exceptional *in vivo* cancer-cell-nuclear-targeting capability of the sulfonic-GQDs, which showed no cancer type specificity. Both materials showed good performance for both *in vitro* and *in vivo* imaging, however, the toxicity issues of the amino-GQDs may limit their *in vivo* applications. Negatively charged sulfonic-GQDs showed low toxicity both *in vitro* and *in vivo*, which indicates their good potential for clinical applications.



Biography

Yanli Wang is currently working at Institute of Nanochemistry and Nanobiology of Shanghai University as Associate Professor since 2012. She obtained her PhD degree in Environmental Engineering from Shanghai University in 2010. Her research interests mainly focus on bio-effects and safety evaluation of nanomaterials and their application in bio-imaging and cancer therapy..

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