Exploring photothermal hot spots of graphene in first and second biological window to inactivate cancer cells and pathogens

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Abstract: We have developed a new composite material composed of reduced graphene oxide (RGO) and poly acrylic acid (PAA) to achieve reduced graphene oxide functionalized poly acrylic acid (RGOPAA). The photothermal capability of RGOPAA was demonstrated at 808 nm and 1064 nm near infra-red (NIR) wavelengths to kill HeLa cancer cells and *S. aureus*. The key feature of RGOPAA is that it exhibits wide range of NIR adsorption both in first (650~950 nm) and second biological windows (1000~1300 nm). The photothermal heating curves of RGOPAA show similar temperature profiles at 808 nm and 1064 nm wavelengths. The confocal laser scanning microscopy (CLSM) images reveals the successful internalization of RGOPAA when into HeLa cancer cells. The MTT assay and heat shock protein expression studies reveal that the cytotoxicity of HeLa cancer cells was mainly attributed from the heat generation of graphene upon photoirradiation. In addition, the photothermal studies were also demonstrated in the pathogenic bacteria, *S. aureus* which reveals excellent killing efficiencies. Overall, our results clearly shows that graphene exhibits excitation wavelength independent photothermal therapy in the NIR region covering both the biological windows and can be a robust and economic photothermal reagent to combat against cancer and pathogens.

References

[1] Yang K, Hu L, Ma X, Ye S, Cheng L, Shi X, et al. Advanced Materials. 24 (2012) 1868-72.

Figures