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Preparation and functionalization of graphene nanocomposites for biomedical applications

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Abstract

Functionalized nano-graphene– and graphene-based nanocomposites have gained tremendous attention in the area of biomedicine in recent years owing to their biocompatibility, the ease with which they can be functionalized and their properties such as thermal and electrical conductivity. Potential applications for functionalized nanoparticles range from drug delivery and multimodal imaging to exploitation of the electrical properties of graphene toward the preparation of biosensing devices. This protocol covers the preparation, functionalization and bioconjugation of various graphene derivatives and nanocomposites. Starting from graphite, the preparations of graphene oxide (GO), reduced GO (RGO) and magnetic GO–based nanocomposite, as well as how to functionalize them with biocompatible polymers such as polyethylene glycol (PEG), are described in detail. We also provide procedures for ^{125}I radiolabeling of PEGylated GO and the preparation of GO-based gene carriers; other bioconjugation approaches including drug loading, antibody conjugation and fluorescent labeling are similar to those described previously and used for bioconjugation of PEGylated carbon nanotubes. We hope this article will help researchers in this field to fabricate graphene-based bioconjugates with high reproducibility for various applications in biomedicine. The sample preparation procedures take various times ranging from 1 to 2 d.

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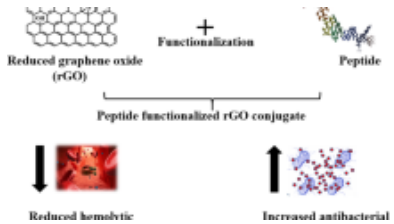

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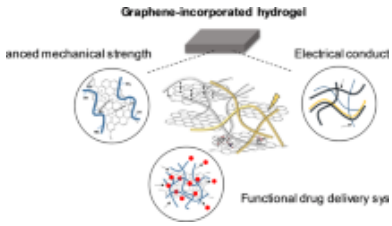

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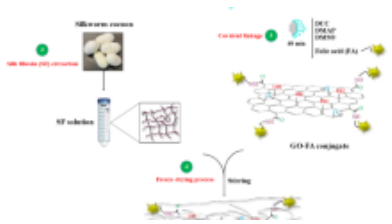

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Contributions

Z.L. and W.C. designed the experiments and wrote the manuscript; K.Y., L.F. and H.H. performed the experiments, analyzed the results and wrote the manuscript.

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Ethics declarations

Competing interests

The authors declare no competing financial interests.

Integrated supplementary information

Supplementary Figure 1 Biodistribution of free ^{125}I and ^{125}I-nGO-PEG at 6 h post i.v. injection.

Minimal uptake of free ^{125}I was observed in the liver, spleen, as well as most other organs except thyroid and stomach due to the fast renal excretion of small iodine ions[33].

Supplementary information

Supplementary Figure 1

(PDF 147 kb)

Supplementary Table 1

Summary of *in vivo* toxicity of different polymer-functionalized GO. (PDF 169 kb)

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