Article

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PII: S2095-9273(17)30634-5
DOI: https://doi.org/10.1016/j.scib.2017.12.015
Reference: SCIB 296

To appear in: *Science Bulletin*

Please cite this article as: S. Zhang, J. Li, J. Wei, M. Yin, Perylenediimide chromophore as an efficient photothermal agent for cancer therapy, *Science Bulletin* (2017), doi: https://doi.org/10.1016/j.scib.2017.12.015

Perylenediimide chromophore as an efficient photothermal agent for cancer therapy

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Abstract

Photothermal agents with improved bioavailabilities can generate heat from near-infrared light, which has been efficiently used for in vivo photothermal therapy (PTT) for cancer, with minimum tissue invasion. Strategies for developing organic near-infrared-absorbing molecules for photothermal cancer therapy have drawn intensive attention among academic investigators. However, conventional organic near-infrared-absorbing molecules may not only have complex synthesis procedures, but also easily suffer from photobleaching under light irradiation. These drawbacks might lead to an increase in the synthesis cost, and elicit a risk of side effects in PTT. Thus, it is essential to devise an organic photothermal agent with stable photothermal capacity, which involves a facile synthesis process. In this study, incorporating a secondary amine group (donor) in the bay regions of perylenediimides (PDIs) could lead to a 150-nm bathochromic shift of the absorption maximum. Next, a modification of poly(ethylene glycol) (PEG) at the periphery of the chromophore renders the targeted macromolecule PDI-PEG highly water-soluble, and capable of intense absorption in the near-infrared region. The self-assembled PDI-based nanoparticles (PDI-NPs) have a size of 55 nm in aqueous solutions. PDI-NPs with excellent photostability possess a high photothermal conversion efficiency of up to 43% ± 2%. Finally, PDI-NPs allow for efficient in vitro and in vivo photothermal cancer therapy. Meanwhile, PDI-NPs exhibit quite low cytotoxicity and no biotoxicity on major organs in vivo. Thus, these easily-manufactured PDI-NPs can serve as extremely stable photothermal agents for efficient photothermal cancer therapy.

Keywords: Perylenediimides· Photothermal Therapy· Photostability· Biotoxicity