Accepted Manuscript

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PII: S0142-9612(18)30527-1

DOI: 10.1016/j.biomaterials.2018.07.042

Reference: JBMT 18785

To appear in: *Biomaterials*

Received Date: 11 April 2018

Revised Date: 12 July 2018

Accepted Date: 25 July 2018

Please cite this article as: Zhang J, Chen J, Ren J, Guo W, Li X, Chen R, Chelora J, Cui X, Wan Y, Liang X-J, Hao Y, Lee C-S, Biocompatible semiconducting polymer nanoparticles as a robust photoacoustic and photothermal agent revealing the effects of chemical structure on high photothermal conversion efficiency, *Biomaterials* (2018), doi: 10.1016/j.biomaterials.2018.07.042.

Biocompatible Semiconducting Polymer Nanoparticles as a Robust Photoacoustic and Photothermal Agent Revealing the Effects of Chemical Structure on High Photothermal Conversion Efficiency

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Abstract: Understanding the relationship between polymer chemical structure and its performance of photoacoustic imaging (PAI) and photothermal therapy (PTT) is important for developing ideal PAI/PTT agents. In this report, four semiconducting polymer nanoparticles (SPNs) with different donor-acceptor architectures are self-assembled for highly effective PAI-guided PTT. In particular, SPN1 with the longest π-conjugation length and the highest mass extinction coefficient which are beneficial for intramolecular charge transfer as well as light harvesting, exhibits the highest photothermal conversion efficiency up to 52.6%. Moreover, the as-prepared SPN1 possess good water-dispersibility, robust size-stability and excellent photothermal properties. Furthermore, the SPN1 not only exhibits a remarkable cancer cell-killing ability but also shows a prominent tumor inhibition capacity. Finally, the as-prepared water-dispersible SPN1 displays good biocompatibility and biosafety, making it a promising candidate for future biomedical applications. Considering the plenty of near infrared absorbing semiconducting polymer available, our work provides fundamental