

Author's Accepted Manuscript

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Yamina Ait Mehdi, Asma Itatahine, Meriem Fizir, Deli Xiao, Pierre Dramou, Hua He



PII: S0022-4596(18)30163-4
DOI: <https://doi.org/10.1016/j.jssc.2018.04.024>
Reference: YJSSC20192

To appear in: *Journal of Solid State Chemistry*

Received date: 16 January 2018
Revised date: 28 March 2018
Accepted date: 18 April 2018

Cite this article as: Yamina Ait Mehdi, Asma Itatahine, Meriem Fizir, Deli Xiao, Pierre Dramou and Hua He, Multifunctional core-shell silica microspheres and their performance in self-carrier decomposition, sustained drug release and fluorescent bioimaging, *Journal of Solid State Chemistry*, <https://doi.org/10.1016/j.jssc.2018.04.024>

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Multifunctional core-shell silica microspheres and their performance in self-carrier decomposition, sustained drug release and fluorescent bioimaging

Yamina Ait Mehdi, Asma Itatahine, Meriem Fizir, Deli Xiao, Pierre Dramou^{*}, Hua He^{*}

Department of Analytical Chemistry, School of Sciences, China Pharmaceutical University, Nanjing, Jiangsu, China.

jcb315@163.com,

pierred@cpu.edu.cn,

dochehua@163.com.

ABSTRACT

An ideal nanocarrier system for drug delivery is that one made from biocompatible and biodegradable materials for safe excretion from the biological system, and often with additional imaging abilities. In the present work, new core-shell silica microspheres have been prepared, with carrier decomposition after drug release. Paclitaxel, which is one of the most efficient drugs against a wide range of malignancies was integrated into the silica core. The carrier decomposition resulted from the escape of drug molecules with loading capacity about 16.95%. To achieve the fluorescent properties of the synthesized material a biocompatible photoluminescent prepared carbon dots were inserted in a silica shell around the Ptx-SiO₂ core. The resultant silica core-shell (Ptx-SiO₂@CDs-SiO₂) NPs with average particle size around ~100 nm showed high fluorescent properties from the confocal laser scanning microscope observation. Further observation under UV-light at 365 nm also confirmed the photoluminescence. The Ptx-SiO₂@CDs-SiO₂ NPs were highly water soluble, and provide a sustained drug release as well as pH sensitivity. The incubation of A549 cells line with Ptx-SiO₂@CDs-SiO₂ NPs exhibits high cellular uptake as shown by CDs imaging. These properties in addition to the biocompatibility of Ptx-SiO₂@CDs-SiO₂ NPs and biodegradability of the silica core contributed simultaneously with the drug release process for easy body excretion after its functionality via renal system.

Graphical abstract

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