PO-12

Enhanced biostability and biocompatibility of zinc oxide nanocrystals shielded by a phospholipid bilayer

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In recent years many efforts have been devoted to study zinc oxide nanocrystals (ZnO NCs) as diagnostic and therapeutic tools, in particular for cancer treatment. Those nanostructures show interesting cytotoxic properties and can be easily synthesized and functionalized, with the purpose of improve their biocompatibility and selectivity [1]. However, in order to enable the use of ZnO NCs for clinical applications, a better control of their stability in the biological environment is required. In particular, the issues to be addressed are the aggregation and dissolution of nanocrystals and their interaction with the components of the biological media, all parameters that can affect the NCs bio-distribution, and cytotoxicity [2].

In this scenario, we decide to evaluate the colloidal stability and the long-term biodegradation behavior of synthesized ZnO NCs as a function of their surface functionalization. In particular, we propose to modify the surface of pristine ZnO NCs with a biomimetic phospholipid shell, constituted by self-assembled liposomes [3] or cell-derived extracellular vesicles, in order to promote the stability and biocompatibility of the nanocrystals in the physiological environment. The stability tests, performed in multiple biological media, demonstrate that pristine ZnO NCs rapidly aggregate in complex biological media while long-term assessments show that this aggregation is accompanied by a small dissolution into potentially cytotoxic Zn^{2+} cations and a slight alteration of NCs surface and crystalline structure.

In contrast, the encapsulation of ZnO NCs in a lipid layer, leads to NCs with better colloidal stability and chemical resistance in the biological environment. In addition, the biological nature of the cell-derived vesicles allows to improve the biocompatibility, making our hybrid nanoconstruct a promising candidate for theranostic applications.

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