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Lipid-coated zinc oxide nanocrystals as innovative ROS-generators for photodynamic therapy

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Photodynamic Therapy (PDT) is a medical treatment that combines the administration of a nontoxic drug, called photosensitizer (PS), with light irradiation of the targeted region. It has been proposed as a new cancer therapy, promising better selectivity and fewer side-effects compared to traditional chemo- and radio-therapies. PSs indeed can accumulate specifically within the region of interest so that when the light is directly focused only in that region the therapeutic effect is highly localized.

Traditional PSs, like chlorins and porphyrins, suffer from several drawbacks such as aggregation in biological media and poor biocompatibility. Thus, the development of innovative photosensitizers able to overcome these issues is crucial to the therapeutic action of PDT. Among the others, nanostructured Zinc Oxide (ZnO) has been recently proposed as new therapeutic agent and PS thanks to its semiconducting properties, biocompatible features, and ease of functionalization [1]. Nevertheless, further efforts are needed in order to improve its colloidal stability in biological media and to unravel the effective therapeutic mechanism.

Here, we propose the synthesis and characterization of lipid-coated ZnO nanoparticles as new photosensitizer for cancer PDT [2]. First, by Dynamic Light Scattering (DLS) experiments, we show that the lipid-coating increases the colloidal stability of the ZnO NPs in Phosphate buffered saline (PBS). Then, using Electron Paramagnetic Resonance (EPR) coupled with the spin-trapping technique, we demonstrate and characterize the ability of bare and lipid-coated ZnO NPs to generate Reactive Oxygen Species (ROS) in water only when remotely actuated via light irradiation. Interestingly, our results aware that the surface chemistry of the NPs greatly influence the type of photo-generated ROS. Finally, we show that our NPs are effectively internalized inside human epithelial carcinoma cells (HeLa) via a lysosomal pathway and that they are able to generate ROS inside cancer cells.

[1] B. Dumontel, M. Canta, H. Engelke, A. Chiodoni, L. Racca, A. Ancona, T. Limongi, G. Canavese and V. Cauda, *J. Mater. Chem. B.* under revision.
[2] A. Ancona, H. Engelke, N. Garino, B. Dumontel, W.Fazzini and V. Cauda, to be submitted.
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