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Intrinsically fluorescent silica nanocontainers: a promising theranostic platform

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A large decrease in the side effects of a drug can be obtained if it is efficiently delivered in a timely manner and in the needed location only [1]. By combining therapeutic and diagnostic (theranostic) functionalities with targeting capabilities and large surface areas, nanoparticles provide an ideal vehicle for personalized medicine.

The main objective of our work is to develop hybrid Mesoporous Silica Nanoparticles (MSNs) for theranostics, carrying fluorescent beacons for traceability and imaging, featuring a smart release control mechanism, able to accommodate large drug loads and to deliver their cargo on demand to a desired location. This communication focus on the preparation of the fluorescent MSNs, and characterization by transmission electron microscopy (TEM), scanning electron microscopy (SEM) and laser scanning fluorescence confocal microscopy (LSFCM).

Mesoporous Silica Nanoparticles (MSNs) with well-defined and controllable particle morphology are exceptional supports/nanocontainers for molecules and polymers [2].This class of materials are characterized by an ordered pore system of 2-8nm diameter, pore volumes above 1mL/g and particle size from 40nm to several hundred nanometers. The preparation of fluorescent hybrid MSNs involves the presence of a fluorescent molecule during particle synthesis, which becomes aligned with the pores, thus impervious to aggregation and self-quenching effects. The MSNs external surface can be selectively functionalized to immobilize polymers or (bio)molecules for possible targeting or sensing, and the pore is available for solvent diffusion, allowing the incorporation of different molecules [3].

We prepared monodispersed hybrid MSNs incorporating a fluorescent perylenediimide (PDI) derivative in the wall structure. The MSN-PDI were characterized by TEM (Figure 1), SEM and fluorescence emission spectroscopy. LSFCM images of the MSN-PDI after incubation in HEK293 cells show the internalization of the nanoparticles (Figure 2). These new hybrid nanoparticles, after surface-functionalization with stimuli-responsive gate systems, open possibilities for the development of traceable drug delivery systems.

References

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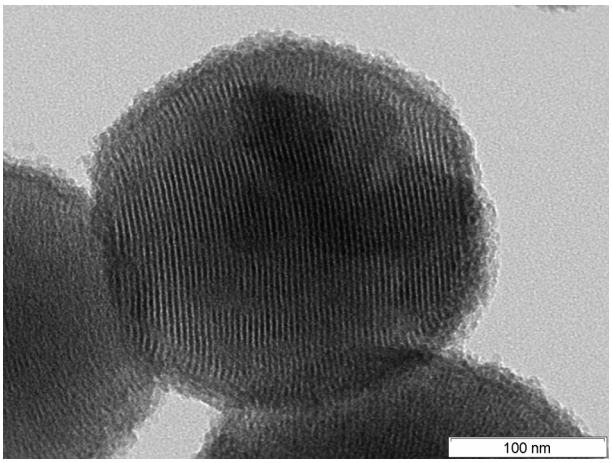

Figure 1. TEM image of MSN-PDI, showing particle morphologies and the mesopore structure.

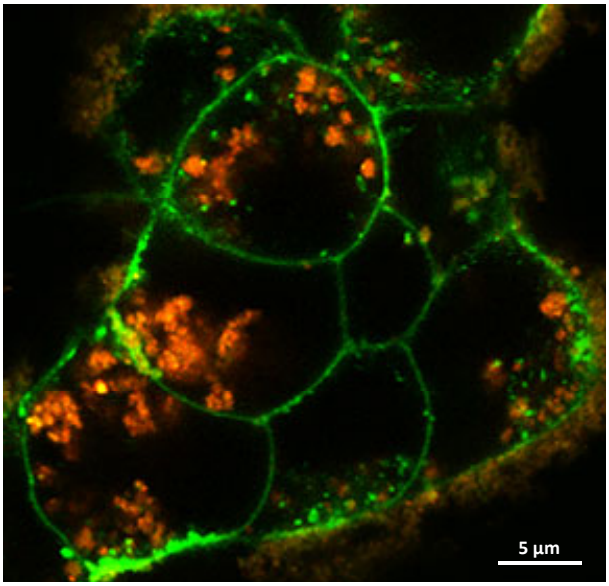

Figure 2. Confocal fluorescence image of HEK293 cells stained with AF594-WGA plasma membrane marker (*green*). The MSN-PDI, shown in orange, appears in the cytosol.

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