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Multifunctional nanocarriers and BIO-Encapsulation for drug- and cell-Therapy.

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We present the construction and the application of biocompatible micro- and nano-structures that can be administered systemically and transport in a targeted and effective way drugs, small molecules, stem cells or immune system cells. These polymeric nano-systems represent a primary goal for the treatment of a wide family of neurological/systemic disorders, as well as tumors and/or acute injuries As natural, biocompatible, biodegradable and non-immunogenic building blocks, alginate and chitosan are been currently exploited. Here we present a microfluidic-assisted assembly method of nano- and micro-vesicles -under sterile, closed environment and gas exchange adjustable conditions- a critical issue, when the cargo to be upload is very sensitive. Polymer/polymer and polymer/drug mass ratio relationship are crucial in order to attain the optimum in terms of shuttle size and cargo concentration. By modulating polymer reticulation conditions, it become possible to control drug loading efficiency as well as drug delivery dynamics. Recent results on the application of the vesicles for the encapsulation and delivery of Inhibin-A and Decorin secreted by Human Adult Renal Stem/Progenitor Cells for Renal tubular cell regeneration will be presented. Moreover combination with Superparamagnetic iron oxide nanoparticles (SPIONs) are promising for implementing magnetic drug or small mollecules polymeric carriers as they are biocompatible, biodegradable, readily tunable and controllable by an external magnetic field. Interesting results were also obtained integrating a layer of GO derivative into the shell of biodegradable capsules by exploiting an easy layer-by-layer (LbL) protocol. Here we discourse on the morphological properties of these hybrid capsules, the GO derivative layer influence on the porosity and the robustness of the multilayer composite shells as well as the composite capsules intracellular localization and biocompatibility. Finally, the impact of these polysaccharide sub-micron vesicles on Human Immune cells and the metabolic activity of cells embedded in the micro vesicles will be presented and discussed.

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