Título: HIERARCHICAL NANOSTRUCTURES FOR ENZYMATIC CATALYSIS AND DRUG DELIVERY

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Resumen: The main objective of this thesis has been the design, synthesis and characterization of different hierarchical structures composed by different nano-structural elements, which have been inspired in the hierarchical organization that can commonly be found in nature, in order to obtain structures with specific and improved properties, required for particular applications.

In this work, enzyme immobilization strategies had been carried out in different supports, in order to provide enzymes with an exceptional performance even in denaturing environments. Membranes based on carbon nanotubes have been developed as bio-permeable barriers with a significant potential for application in processes that require multi-batch or continuous mode. Hierarchically nanostructured systems comprising integration of enzymes in a magnetic nanocomposite with carbon nanotubes, have also been developed, obtaining an improved operational state which allows their recovery and the reuse of the biocatalyst without loss of activity.

Another particular applications for which hierarchical nanostructures have been developed is drug delivery. Biomimetic structures have been manufactured based in carbon nanotubes coating of particles, improving intracellular targeting and therapeutics release. Simulating virus morphology, initial interaction with the surface and cellular uptake, as well as exceptional escape mechanism from endo-lysosome to cytosol, versatile structures have been obtained for cellular delivery of a wide variety of chemical or biological compounds.

Finally, films based on the incorporation of plasmonic silica nanocapsules into a hydrogel network for long term

drug delivery have been developed. The control of the drug delivery in a carrier confined within the hydrogel have been achieved by applying an external stimulus, minimizing unwanted or accidental releases.