551a Enzymes-Containing Microcapsules Self-Assembled from Silica Nanoparticles and Polyamines

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Enzyme entrapment in confined micro-environments is an immobilization technique that allows recovery and re-use of the homogeneous catalyst without the need for chemically binding the enzyme molecule to a solid support. In this work, we demonstrate a novel one-step encapsulation of acid phosphatase enzyme within polyamine/silica composite microcapsules (~1-10 μm). In brief, addition of multivalent anions (e.g., Citrate3-) induces cationic polyamines to form short-lived spherical aggregates by way of salt-bridging. Addition of negatively charged nanoparticles (e.g., silica nanoparticles) to these aggregates leads to the formation of robust microcapsules with multi-nanoparticle layer thick shell wall (Rana et al., Adv. Mater. 2005, 17(9), 1145-1150). The enzyme can be easily introduced inside the microcapsules by combining with the polyamine/salt aggregate suspension before shell formation. Catalytic activity of acid phosphatase was observed through in situ time-lapse confocal microscopy. Fluorescein diphosphate (FDP) substrate (non-fluorescent) diffuses inside the microcapsule, and turns highly fluorescent upon catalytic cleavage of the phosphate groups. We discuss the quantitative aspects of enzyme encapsulation such as encapsulation efficiency and enzymatic activity.