

Nanobiocatalysis and Its Potential Applications

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The specificity of enzymes promises great improvements in a variety of their potential applications. However, the short lifetimes of enzymes frequently limit their usefulness. This presentation will discuss recent developments in nanobiocatalysis to improve the enzyme stability using various nanostructures such as single enzyme nanoparticles (SENs), mesoporous materials, nanofibers, nanoparticles, and carbon nanotubes. In the form of SENs, each enzyme molecule is surrounded with a nanometer scale network, resulting in stabilization of enzyme activity without any serious limitation for the substrate transfer from solution to the active site. SENs can be further immobilized into mesoporous silica with a large surface area, providing a hierarchical approach for stable, immobilized enzyme systems. Nanoscale enzyme reactors in mesoporous media will be discussed in detail together with enzyme coatings on electrospun nanofibers, magnetic nanoparticles, and carbon nanotubes. Stabilized enzyme systems in various nanostructures will make an ideal system for many applications including bioremediation, antifouling, biosensors, bioreactors, microfluidic devices, trypsin digestion, and biofuel cells. Several successful examples of nanobiocatalytic applications will be given in this presentation.