

Nanobiocatalysis for Enzyme-Based Biofuel Cells

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Enzyme-based biofuel cells are a promising technology using biofuels (such as glucose, ethanol, or oil) as a source of sustainable and renewable energy. Biofuel cells have been proposed as a power source for communication device, sensors, and medical implants. However, their practical applications have been hampered by the short lifetime of enzymes. This presentation will discuss recent developments in nanobiocatalysis to improve the enzyme stability by using several approaches: single enzyme nanoparticles, and crosslinked enzyme aggregates in mesoporous media and on nanofibers. Single-enzyme nanoparticles (SENs) stabilized the enzyme activity by surrounding each enzyme molecule with a porous composite organic/inorganic network of less than a few nanometers thick. The approach of nanometer-scale enzyme reactors (NERs) stabilized enzymes in mesoporous media via a ship-in-a-bottle approach, which employs adsorption of enzymes followed by cross-linking using glutaraldehyde (GA). A similar approach resulted in the enzyme coating on the surface of electrospun nanofibers, which also stabilized the enzyme activity in a vivid way. We anticipate that the stabilized enzyme systems in various nanostructures can be used for biofuel cells by extending the lifetime and increasing the power output due to the improved enzyme loading.