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Enzyme Immobilization on Functionalized Polystyrene Nanofibersfor Bioprocessing Applications

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Abstract : Advances in biotechnology have witnessed a growing interest in enzyme applications for the development of green and sustainable bio processes. While known as powerful bio catalysts, enzymes are no longer of economic value when extended to large commercialization. Alternatively, immobilization technology allows enzyme recovery and continuous reuse which subsequently compensates high operating costs. Employment of enzymes on nano structured materials has been recognized as a promising approach to enhance enzyme catalytic performances. High porosity, inter connectivity and self-assembling behaviors endow nano fibers as exciting candidate for enzyme carrier in bio reactor systems. In this study, nano fibers were successfully fabricated via electro spinning system by optimizing the polymer concentration (10-30 %, w/v), applied voltage (10-30 kV) and discharge distance (11-26 cm). Microscopic images have confirmed the quality as homogeneous and good fiber alignment. The nano fibers surface was modified using strong oxidizing agent to facilitate bio molecule binding. Bovine serum albumin and β-galactosidase enzyme were employed as model bio catalysts and immobilized onto the oxidized surfaces through covalent binding. Maximum enzyme adsorption capacity of the modified nano fibers was 3000 mg/g, 3-fold higher than the unmodified counterpart (1000 mg/g). The highest immobilization yield was 80% and reached the saturation point at 2 mg/ml of enzyme concentration. The results indicate a significant increase of activity retention by the enzyme-bound modified nano fibers (80%) as compared to the nascent one (60%), signifying excellent enzyme-nano carrier bio compatibility. The immobilized enzyme was further used for the bio conversion of dairy wastes into value-added products. This study demonstrates great potential of acid-modified electrospun polystyrene nano fibers as enzyme carriers.

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