Bio-hybrid materials by electrospinning

Eyal Zussman

Faculty of Mechanical Engineering

Technion -Israel Institute of Technology,

Haifa 32000, Israel

meeyal@tx.technion.ac.il

Abstract

Cell encapsulation aims to entrap cells within the confines of semi-permeable membranes. While the membranes are needed to be permeable to allow the passage of molecules, they need to be able to prevent the transport of molecules larger than a desired critical size. Encapsulated cells are useful for a variety of biotechnological applications such as microbial fuel cell (MFC) systems, bioremediation, particle biofilm reactors, phage therapy, and regenerative medicine transplant cells among others. However, the longevity of functional bacteria is limited once they have been isolated from their native environment. The goal is to find both appropriate immobilization methods and biocompatible environments. Electrospun polymeric nanofibers have been widely used in biological applications as host capsules for viruses and bacteria. The versatile use of such fibers is attributed to the size of the fibers which range from about 100 nm to several micrometers in diameter, the accompanying large surface area of such nanofibers, and the large variety of polymers from which they can be spun from aqueous based solution at room temperature. In this lecture, biohybrid materials comprised of encapsulated cells in electrospun polymer fibers are presented. Such bio-encapsulation allows for the protection of cells from harsh environments as well as the control of the physico-chemical properties in the cell's immediate surroundings, and control of the mass-transfer mechanisms and kinetics of molecules of interest in/out of the electrospun fibers. This lecture presents the preparation methods of these “living materials” and their potential applications using examples of the encapsulation of bacterial cells in various electrospun fibers configuration which can be monolithic, core-shell or hollow. Their utilization in functional-nanofiber based nonwovens could generate materials with novel structure-property profiles acting as thin-film catalyst, or engineered bio-film.