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Frontiers in bio-nanocomposites

Dear Readers

In today's world, bio- nanocomposites are becoming increasingly prevalent owing to the extraordinary properties that they possess. Scientists learn to select suitable matrix (e.g. aliphatic polyesters, polypeptides and proteins, polysaccharides, and polynucleic acids) and fillers (e.g. nanotubes, nanofibers, clay nanoparticles, hydroxyapetite and metal nanoparticles) and alter their chemistry and structure to suit the target field. A critical challenge in the design and development of bio- nanocomposites is the adhesion of filler and matrix at their nanointerface. Also, bio- nanocomposites in addition to providing enhanced properties such as mechanical and thermal are biocompatible and/or biodegradable. This makes them one of the most versatile materials available today and thus can be prominently applied to biomedical technologies such as bone restructuring/repair, tissue engineering, dental applications, and controlled drug delivery.

During last decade, bionanomaterials have emerged as a new frontier of multidisciplinary science viz. roots in biology, chemistry, and engineering, and are presenting an array of both opportunities and challenges across all areas of biomedical sciences. In particular, rapid progress with the use of engineered nanomaterials with diameters from 10 to 100 nm has led to significant new advances in detection of biological molecules, organism and in bioprocess. Because of the nature of their targets, biosensors need to be faster, smaller, more sensitive, and more specific than nearly all of their physicochemical counterparts or the traditional methods that they are designed to replace. Rapid and accurate detection of biomolecules are essential parameters in medical diagnosis as it permits for fast treatment and does not allow patients to be lost to follow-up. Small size and greater sensitivity mean less-invasive sampling and detection of molecules such as neurotransmitters or hormones at biologically-relevant levels. Greater specificity allows assays to be performed in complex fluids such as blood or urine without false negative or false positive results. Nanotechnology promises to improve biosensing on all of these fronts. Nanofabricated bio- materials can bind directly to biomolecules and/or act as transducers to extremely small and sensitive detectors. The unique electrical, chemical, thermal and catalytic properties of namomaterials offer excellent prospects in the development of electrochemical biosensors. The high sensitivity of such devices, coupled to their compatibility with modern microfabrication technologies, portability, low cost (disposability), minimal power requirements, and independence of sample turbidity or optical pathway, make them excellent candidates for clinical diagnostics.

Similarly, organic-inorganic bionanocomposites based on biopolymer and silica are an important class of advanced nanomaterials. The combined organic-inorganic characteristics of the composites represent an improvement in their physical properties. The silicate-filled polymer composites often exhibit remarkable improvement in mechanical, thermal, and physicochemical properties when compared with their pure one. Sol-gel synthesis of nanocomposite biomaterials allows the production of materials by which it is possible to control particle size, shape and sometimes even final packing of the colloidal particles.

With kindest regards,

Ashutosh Tiwari, PhD
Editor-in-Chief
Biosensors & Bioelectronics Centre
IFM-Linköping University, Sweden

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