Nanomedicine & Biotherapeutic Discovery

Extended Abstract

Versatility of nanomaterials in commercial applications

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Abstract

The two applications that used clays with particular sizes from 3 to 5 were implemented in the dehydration of food and in ballast water treatment. The former allowed the concentration of vitamins, augmentation of inulin content, improvement of probiotics bacteria count and preservation of more than 1000 products for periods longer than one year without employing chemicals. The latter contributed to destroy bacteria in ballast water and also to remove seawater in oil byproducts and recover their characteristics to be reused for the same application or as a lower grade product; important outcome especially during oil spills. The process consists of using clays as filters in a vacuum chamber and tuning the changes of temperature and pressure by trial and error until the maximization of desired characteristics is obtained. Results showed that vitamin content could increase at least five times more than the natural product for the same analyzed quantity, for inulin content three times more and probiotics bacteria count up to five times more. For ballast water, with initial count at 1:1 dilution, 8 cells/g were found; after the clay nano-filter process at 1:100 dilutions, less than 100 cells/g were counted. For seawater and sediments at 1:100 dilutions before the treatment 1200 cells/g were found, while after the process at the same dilution, only 100 cells/g were counted. For the oil based components, different viscosities and seawater mixes of 50%-50% and 25% oil and 75% seawater were tested in a 12- hour and 24-hour cycle. Water removal results between 65%-80%. The viscosities and seawater removal of the three studied oil based components determined the final applications. Nanotechnology has wide applications in medicine in the form of diagnostic imaging, treatment and prevention. Developments of nanorobots which are capable of tissue repair at cellular level are materialising. All these are achieved by the enhancement of gaseous and nutrient transport, promotion of tissue regeneration in which minimum cellular inflammation and less toxicity. Nanotechnology can uplift the medical imaging and biomarker detection by methods like extracellular deposition and cell adhesion. Biosensors, tissue engineering, targeted drug delivery and nanorobotics make the nanomedicine cutting edge.

Nanoparticles enable the transport of drugs particularly to the infected sites very accurately and precisely.

Biomarkers or tumor markers detection has become faster and more sensitive using nanotechnology enabling the doctors for an early diagnosis compare to tissue biopsies. This paper explores the potential and versatile applications of nanoparticles in the field of medicine.

A novel system for generation of engineered nanomaterials suitable for in situ toxicological characterization within biological matrices was developed. This Versatile Engineered Nanomaterial Generation System (VENGES) is based on industry-relevant, flame spray pyrolysis (FSP) aerosol reactors that can scaleably produce engineered nanomaterials (ENMs) with controlled primary and aggregate particle size, crystallinity and morphology. ENMs are produced continuously in the gas phase, allowing their continuous transfer to inhalation chambers, without altering their state of agglomeration. Freshly generated ENMs are also collected on Teflon filters for subsequent physico-chemical and morphological characterization and for in vitro toxicological studies.

The ability of the VENGES system to generate families of ENMs of pure and selected mixtures of iron oxide, silica and nanosilver with controlled physico-chemical properties was demonstrated using a range of state-of-the-art-techniques. Specific surface area was measured by nitrogen adsorption using the Brunauer-Emmett-Teller (BET) method, and crystallinity was characterized by X-ray diffraction (XRD). Particle morphology and size were evaluated by scanning and transmission electron microscopy (STEM/TEM). The suitability of the VENGES system for toxicological studies was also shown in both in vivo and in vitro studies involving Sprague-Dawley rats and human alveolar-like monocyte derived macrophages, respectively. We demonstrated linkage between physico-chemical ENM properties and potential toxicity.

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