

New opportunities in sustainable materials

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Green chemistry started for the search of benign methods for the development of nanoparticles from nature and their use in the field of antibacterial, antioxidant, and antitumor applications. Bio wastes are eco-friendly starting materials to produce typical nanoparticles with well-defined chemical composition, size, and morphology. Cellulose, starch, chitin and chitosan are the most abundant biopolymers around the world. All are under the polysaccharides family in which cellulose is one of the important structural components of the primary cell wall of green plants. Cellulose nanoparticles (fibers, crystals and whiskers) can be extracted from agrowaste resources such as jute, coir, bamboo, pineapple leaves, coir etc. Chitin is the second most abundant biopolymer after cellulose, it is a characteristic component of the cell walls of fungi, the exoskeletons of arthropods and nanoparticles of chitin (fibers, whiskers) can be extracted from shrimp and crab shells. Chitosan is the derivative of chitin, prepared by the removal of acetyl group from chitin (Deacetylation). Starch nanoparticles can be extracted from tapioca and potato wastes. These nanoparticles can be converted into smart and functional biomaterials by functionalisation through chemical modifications (esterification, etherification, TEMPO oxidation, carboxylation and hydroxylation etc) due to presence of large amount of hydroxyl group on the surface. The preparation of these nanoparticles include both series of chemical as well as mechanical treatments; crushing, grinding, alkali, bleaching and acid treatments. Transmission electron microscopy (TEM), scanning electron microscopy (SEM) and atomic force microscopy (AFM) are used to investigate the morphology of nanoscale biopolymers. Fourier transform infra-red spectroscopy (FTIR) and x ray diffraction (XRD) are being used to study the functional group changes, crystallographic texture of nanoscale biopolymers respectively. Since large quantities of bio wastes are produced annually, further utilization of cellulose, starch and chitins as functionalized materials is very much desired. The cellulose, starch and chitin nano particles are currently obtained as aqueous suspensions which are used as reinforcing additives for high performance environment-friendly biodegradable polymer materials.

Biography

Sabu Thomas is serving as the vice-chancellor of Mahatma Gandhi University, Kerala. He is also a full professor (25 March 1998 onwards) of Polymer Science and Engineering at the School of Chemical Sciences. He was the Pro-Vice Chancellor of Mahatma Gandhi University, Kerala during the period of 31 August 2017 to 31 August 2018, Director of School of Chemical Science during the period of 1 November 2010 to 31 December 2013. Hon. Director of International & Inter-University Centre for Nanoscience and Nanotechnology during the period of 28 March 2009 to 11 September 2015, 2 February 2016 to 11 October 2017.