Dendrimer Nanocomposites: Synthesis, Properties and Applications

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Abstract

Controlled synthesis of nanoparticles and fabrication of controlled nanostructures have gained considerable interest recently. One possible way to control size and distribution of nanomaterials is applying polymer templates.

Dendrimer composite nanoparticles are nanosized organic-inorganic hybrid particles made from dendrimer templates that contain small clusters of inorganic nanomaterials of interest entrapped in the network of the macromolecular templates. The method of reactive encapsulation involves preorganization of an appropriate reactant by the active interior sites of a dendrimer molecule, followed by immobilization of the product with respect to the host. Immobilization is performed by further chemical or physical treatment of the preorganized ions, molecules or atoms using the dendrimer molecule as a nanosized reactor. Size (2-50 nm), shape and surface functionality of these guest domains (1-250 atoms) are determined and controlled by the dendrimer template. Dendrimer composite nanoparticles are spherical "soft" nanoparticles and display the chemical and physical properties both of the inorganic molecules/atoms/clusters and the template. They display fascinating and useful physical and chemical properties as the consequence of the intimate dispersion/mixing of the components. The method will be demonstrated on nanocomposites of zerovalent metals and poly(amidoamine) dendrimers. Structure and properties of nanocomposites has been studied and confirmed by electronmicroscopy, chromatography, spectroscopy, by scattering and many other techniques.

Combination of inorganic guests and dendritic building blocks into multiple structures such as chains, films and covalent clusters in solvents and solid matrices afford a wide repertoire of nanosized building blocks and architectures for more complex nanocomposite structures. This general platform provides a simple and economic way to prepare unique nanocomposite materials with many potential applications in medicine and materials science. Medical applications will be illustrated on examples from imaging and therapy of cancer.

Biography

Dr. Lajos P. Balogh joined the Roswell Park Cancer Institute in January 2005 as Director of Nanotechnology Research. He is being appointed as a Professor of Biomedical Nanotechnology, Department of Radiation Medicine, SUNY, Buffalo. He came to RPCI after serving as a Research Associate Professor of both of Internal Medicine and of Biomedical Engineering, and Research Associate Professor of Biologic Nanotechnology and of Macromolecular Science and Engineering, University of Michigan, Ann Arbor, MI. He earned his PhD in Chemical Technology (1983) and his MS in Chemistry (1975) at the Kossuth L. University of Sciences and Arts, Debrecen, Hungary.

Dr. Balogh's research involves conceptualization, synthesis, characterization and utilization of polymers, dendrimers, organic/inorganic hybrid nanomaterials and engineered nanostructures for medical and materials applications.

Dr. Balogh has authored or coauthored more than 100 journal publications, book chapters and abstracts and has been issued nine patents. Four additional patents are pending.