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Atomic clusters: A unique building motif for future smart nanomaterials

Debesh R Roy
S. V. National Institute of Technology, India

The fundamental issue in understanding the origin of materials and the mechanism of their growth from a fundamental unit is a big challenging problem to the scientists. The behavior of matter, as we go from a single atom towards the macroscopic materials that met our daily life, deserves a careful investigation to understand the cardinal aspects of their usefulness. This realm of science where individual atoms get together to form a motif, containing two to several thousands of atoms, establishes the field of atomic clusters, the ultimate nanostructured material. The most exciting thing is that the atomic clusters of sub-nano or nano-scale are often show drastic change in the physical and chemical properties compared to that of their bulk material, due to the effect of quantum confinement. This different behavior of nano-scale materials is found to be very useful in various kinds of applications to the mankind for the last two decades. Some of the special clusters of stable motif classified with aromatic, jellium and Zintl models, possesses potency to be used as building blocks in the cluster assembled materials. The cluster assembled materials are solids where atomic clusters serve as the fundamental units. The exciting thing for these solids is that they takes the advantage of the exotic properties of clusters due to the effect of quantum confinement and make them accessible in a bulk material with a tunable chemical, electronic, optical and magnetic properties. The cluster assembled materials are formed with a network by linking the cluster motifs as building blocks with an atomic/molecular linker.

drr@ashd.svnit.ac.in

Development, characterization and site specific peptide conjugated PLGA-PEG polymeric nanoparticles with cancer specific active dual targeting delivery system

Madhu Gupta and **S P Vyas**
Dr. H.S. Gour University Sagarm, India

Certain tumor cells over express a membrane-spanning molecule, aminopeptidase N (CD13) isoform, which is the receptor for peptides containing the NGR motif. NGR-modified docetaxel (DTX)-loaded PEG-b-PLGA polymeric nanoparticles (NGR–NP-DTX) were developed and evaluated for their in vitro potential in HT-1080 cell line. The NGR–NP-DTX containing particles were about 148 nm in diameter with spherical shape and high encapsulation efficiency. Cellular uptake was confirmed both qualitatively and quantitatively by confocal laser scanning microscopy (CLSM) and flow cytometry. Both quantitatively and qualitatively results confirmed the NGR conjugated nanoparticles revealed the higher uptake of nanoparticles by CD13-overexpressed tumor cells. Free NGR inhibited the cellular uptake of NGR–NP-DTX, revealing the mechanism of receptor mediated endocytosis. In vitro cytotoxicity studies demonstrated that NGR–NP-DTX formulation was more cytotoxic than unconjugated one, which were consistent well with the observation of cellular uptake. Hence, the selective delivery of NGR-NP-DTX formulation in CD13-overexpressing tumors represents a potential approach for the design of nanocarrier-based dual targeted delivery systems for targeting the tumor cells and vasculature.

madhugupta98@gmail.com

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