From Atoms to Nanomatter

Institute Lecture on 05th October 2016 at 5:30 pm in L-4

by

Professor K L Chopra

Founder Thin Film Laboratory, Indian Inst of Technology, Delhi
&
Former Director, Indian Inst of Technology, Kharagpur

Abstract

Atomic species (atoms/molecules/ions) are the building blocks of matter in the universe. Such atomic species can be created in a laboratory by various physical, chemical, electrochemical, plasma and biochemical techniques. By depositing these atomic species *one-by-one* onto a suitable substrate and by controlling a large variety of deposition control parameters, matter can be created *ab-initio* through a nucleation and growth process initiated by the getting together of a small but critical number of atoms such that the attractive volume energy exceeds surface repulsive energy. Depending on numerous deposition parameters, matter can thus be created on a nanometric scale in a variety of dimensions, shapes, sizes, topographies, micro- and nano-structure, compositions, metastable structures, multilayers, periodic and aperiodic lattices, etc. Such nanomatter of different sizes and shapes includes quantum dots, nanoparticles, nano-wires, nano tubes, nanogells, nanosponges, nanosheets, thin-films, multilayers, nanocomposites, etc. The physical, mechanical, optical , magnetic, electrical and electronic properties depend strongly on the size, shape, topography and dimensionality (quantum dot/nanofiber/thin-film) of nanomaterials and thus can be tailored during processing, giving birth to a new era of Materials Science and Technology for appropriate applications. The science and technology of Thin Film and Nanomatter have created new frontiers in a variety of interdisciplinary fields in such application oriented areas as: nano-optics, photonics, LEDs, micro and nano-electronics, sensors, nanofilters, photovoltaic and photothermal energy harvesting, thin-film batteries, spintronic-based memories, decorative and protective coatings, thermal barriers, catalysis, hydrophobic, hydrophyllic, tribological and wear and tear surfaces, biomedical coatings, sensors and drug delivery devices, etc.