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Intelligent nanomaterials for prospective nanotechnology

Dear Readers

Nanomaterials play very prominent role in physical, chemical and biomedical engineering applications due their high surface energies. Also the electronic configuration of atoms within the materials is very important since this principally detrmines the type of bonding and thus electrical, optical, luminescent, mechanical and magnetic properties. At nanoscale dimensions, materials exhibit entirely different properties as compared to thieir bulk counterpart. Noble metallic nanoparticles/nanostructures exhibit interesting feature of localised surface plasmon resonant; absorption can be tuned from ultraviolet region to infrared region of electromagnetic spectrum and this field has been developed to deliver potential applications in photonics, optoelectronics, optical-data storage, solar cells, filters, sensors not to mention the considerable scope in medical engineering, such as DNA labeling, tumor and cancer therapy etc.

Study of the propagation of electromagnetic waves through metallic nanostructures with different shapes has become a major field due to fascinating applications in antennas and also left handed materials. Semiconductor nanostructures on the other hand are very promising candidates for applications in luminescent devices such as light emitting diodes, flat screen displays, lasers etc. and especially in electronic devices, due to their extraordinary feature of band gaps ranging from UV-visible to infrared regions.

Silicon has reigned supreme amongst materials responsible for miniaturisation of the world of electronics in the last century. However, recent progresses in the design of materials synthesised from other semiconducting families, such as III-V or II-VI, are showing even more promise for versatile applications and may provide a new generation of materials. For example, nano-micro structures of zinc oxide/sulphide, tin oxide, cadmium sulphide and titanium oxide exhibit interesting electrical, optical and mechanical properties. They can be used in a wide variety of applications ranging through from sensors, LEDs, flat panel displays, energy storage/ harvesting and batteries. Similarly, advances in synthesising nano-micro structures from insulators like silica and polymers, have found interesting applications in biomedical engineering such as drug delivery and implants. Organic electronics have recently opened an entirely new field of organic field-effect transistors, organic light-emitting diodes, light weight electronics etc. The current challenges in material engineering demand the fabrication of multicomponent composite materials having multifunctional properties. Inter-mixing of two or several nanostructural components into a composite form will give rise complementary properties which will enable these materials to exhibit the capability of self-repair under any external damage or perturbation. These kind of materials at nano-scale which exhibit the ability of self-repairing under external cause clearly fall into the category of 'intelligent nanomaterials'.

With kindest regards,

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