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Advanced Polymer Composites

Ashish Chauhan[1]* and Priyanka Chauhan[2]

[1]National Institute Pharmaceutical Education and Research, Mohali, India
[2]Shikhar Sr. Secondary School, Dhampur, India

The term 'composite' in material science refers to a material made up of a matrix containing reinforcing agents. The beginning of composite materials may have been the bricks, fashioned by the ancient Egyptians from mud and straw. Considering the high performance standard of composite materials in terms of durability, maintenance and cost effectiveness, applications of natural fiber reinforced composites as construction material, have done wonders and are environment friendly material for the future use.

Functional composite materials represent a very attractive class of materials that differ in structure. Their physical and chemical properties are sensitive to changes in surroundings, so they have an ability of adjustment to the outside parameters such as temperature, pressure, magnetic field, optical wave length etc. They can intelligently adapt their functionality to find their application in fields that range from aeronautics to commercial products. The properties that they possess leads to the focus of numerous interdisciplinary researches and constant development of the new and broader functional area of use of composite materials. Functional composites with polymeric matrix are very interesting materials to which the certain properties can be created by adjusting the ingredients, morphology as well as modifying the matrix and using different techniques for their processing. Composite materials that have been strengthen lead to the creation of new mechanical, electrical, optical or magnetic properties that demarcates them in a special class of materials.

In the last couple of years, there has been advancement of science in the exploitation of material optical properties, so their use varies from home appliances, which are in everyday use to the devices of high precision and accuracy designed for use in areas like medical diagnostics and therapy, astronomy, particle and atomic physics etc. Modern optical-electric devices such as optical cables and sensors are some of the examples of successful use of nanotechnology and nano-processing in terms of plastic optical cables. The highest use is from composites with polymeric matrix and nano phosphors strengthening. Polymers are very important group of optical materials because of their high resistance to damage, low density, simple manufacturing and economic value. Nanophosphors show greater luminescent efficiency in comparison with those with greater dimensional variability. Materials supplemented by rare earth elements, such as Tb, Eu, Yb and Er, draw great attention because of the energy transfer, up conversion and ability to apply on large areas. Among non-organic oxides the best suited for supplementation with rare earth elements are Gd_2O_3 and Y_2O_3 because of their high physical and chemical properties, efficient sensitivity and low phonon energy. Polymers with variable index of refraction are used as wave conductors with adjustable difference in index of refraction between the core and the shell. It is possible to change the index of polymer refraction by adding particles of materials with high index of refraction. This type of modification is being used with the potential materials for detection of ionized radiation and particles and where the polymer matrix is being inserted with heavy scilated powders, such as BaF_2, CeF_3, CsI, $Bi1_2GeO_{20}$ (BGO) or $Bi1_2SiO_{20}$ (BSO) powders in terms of strengthening. One of the listed science areas that have turned to this group of materials is atomic physics, for the requirement of developing economically acceptable heterogenic electromagnetic (EM) calorimeters with optical readout system. Bismuth silicium oxide, $Bi1_2SiO_{20}$ (BSO), belongs to the family of silicates that are suitable for supplementing different metals of atoms due to the ability of tetrahedral that is made from atoms of oxygen around the central atom of metal, and the ability to contract or expand without damaging the centrally positioned volumetric cubic grille. BSO is familiar by its high frequency sensitivity and photo conduciveness, high speed response and unlimited recyclability so it finds application in optical devices.

The use of polymer and polymer matrix based composite in the field of photo conductivity and optical devices has immensely increased. We hope that new scientists could further elaborate the field and explore better results by the development of science and technology, for the service of humanity.

***Corresponding author:** Ashish Chauhan, Jr. Scientist, National Institute of Pharmaceutical Education and Research (NIPER), Punjab, India, Tel: +91-9464616773; E-mail: aashishchauhan26@gmail.com

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