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Chitosan a potent nanoparticle for nutritient delivery into plant systems

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Fertilizers are organic compounds applied to plants to enhance growth and are applied either to the soil directly or by foliar spreading. Thus applied fertilizers contribute to provide macro nutrients (NPK) to the plant. NPK helps in leaf growth, enhances root elongation, fruiting & flowering, etc. According to Saigusa.et al., 40-70% of Nitrogen, 80-90% of Phosphorous, 50-70% of Potassium are lost to the environment but not absorbed by the plant, increasing the intrinsic economic loss and heavy environmental pollution. Hence usage of bio fertilizers may be very much helpful in reducing the problem to major extent. Plants easily absorb bio fertilizers and as they are from an organic source they may not harm the environment. But the absorption rate of bio fertilizers by the plants is very low so, to enhance it certain facilitators are used which in conjugation with nutrients may help in easy absorption of the nutrients. Recent studies have revealed that nanoparticles are one of the best mediators for delivering nutrients to the plants. There are several inorganic mediators like silver nanoparticles, nanotubes, nano beads etc., and among them chitosan is found to be a potent mediator for nutrient delivery. Studies have discovered that chitosan nanoparticles have controlled release of NPK fertilizer to the plants. Chitosan is a polysaccharide derived from chitin a skeletal material of crustaceans. Due to its poly cationic nature, chitosan reacts with negatively charged molecules showing a favourable reaction. Thus the ability of its controlling nanoparticle size it is highly favourable for most of nanotechnology applications.

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Synthesis and characterization of ZnO–TiO2 nanocomposites co-doped with Dy3+ and Eu3+ ions

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Down-conversion in nanomaterial phosphors doped with Rare Earth (RE) ions is currently being explored for solar cell applications. This is inspired by the ability of RE elements to luminescence over a wide range, from the near-infrared, through visible to the ultra-violet wavelength energy regions, whilst exhibiting only weak interactions with the host lattice. Titanium dioxide (TiO_2), zinc oxide (ZnO), europium (Eu^{3+}) and dysprosium (Dy^{3+}) individually show excellent luminescence properties. In this report, ZnO and TiO_2 nano-based composite phosphor was activated with different concentrations of Eu^{3+} and Dy^{3+} fabricated using the sol-gel method of synthesis such that, ZnO-TiO_2: xDy^{3+} and yEu^{3+} (x=0.4 and y=0.05 to 0.75 mol). The prepared phosphors were characterized by X-ray Diffraction (XRD) technique for confirmation of the formation of the desired product, crystallinity and product phase purity. The XRD patterns confirmed crystallization of wurtzite hexagonal ZnO and tetragonal TiO_2 (anatase and rutile) phases. In addition, the XRD data confirmed that secondary phases of $ZnTiO_3$ and $Zn2TiO_4$ were also formed. Morphological analysis was carried out using scanning electron microscopy (SEM), and formation of nanoflake-like structures, nanorods and uniformly distributed structures was confirmed. Photoluminescence characterization of the as-prepared phosphors was carried out under UV excitation at 248 nm and the prominent emission bands were observed in the visible region at 496, 584, 593 and 614 nm, corresponding to transitions of Dy^{3+} and Eu^{3+} ions. The energy transfer mechanism between the ZnO-TiO_2 host and dopants (Dy^{3+} and Eu^{3+}) is discussed.

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