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SYNTHESIS, CHARACTERIZATION AND PROPERTIES OF METAL OXIDE NANOCOMPOSITES

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SUMMARY

Nanostructured NiO particles have been successfully synthesized through the chemical precipitation technique using nickel nitrate hexahydrate and ammonium carbonate. TGA results show a sharp weight loss at 350_ C, caused by the conversion of nickel carbonate into nickel oxide. The results obtained from XRD and TEM confirms the nanocrystalline nature of the synthesized particles and the crystallite size was found to increase with increase in calcination temperatures. W-H analysis found that the micro-diffraction for NiO calcined at 400^{O}C has large value, which decreases with increase in calcination temperature. UV-visible absorption studies revealed that an increase in the calcination temperature produces a blue shift in the absorption spectrum, and a decrease of band gap being a consequence of the increase in particle size. Also, photoluminescence studies showed that an increase in calcination temperature causes a decrease in PL intensity due to crystal growth. Furthermore, calcination temperature plays a vital role in controlling the particle size, which in turn helps to modify structural and optical properties of the formed NiO nanoparticles. Based on these systematic observations, it is concluded that NiO nanoparticles can be a promising material for optoelectronic applications because of its desired structural and optical properties.

The effect of 8 MeV EB on their structural and optical properties was studied in order to improve the optical absorption performance and photocatalysis. The size variation, non-stoichiometry and defects of the samples caused by the EB irradiation produced an increase in optical band gap and PL intensity. Moreover, the systematic investigation found that high-energy EB irradiation of suitable dose rate is an efficient technique to promote the optical response and photoactivity of NiO nanocubes for optoelectronics and photocatalytic applications. The emission hue of the NiO phosphor can be tuned from one colour to other by changing the EB irradiation dose rate. Thus, NiO can be developed as a suitable phosphor material for the application in NUV excited colour LEDs.

NiO/CoPc nanocomposites were synthesized successfully by adopting a standard procedure. The composites were prepared using a standard method by

coating NiO nanoparticleswith cobalt phthalocyanine, dissolved in a solvent mixture containing 50% dimethyl sulphoxide,30% dimethyl formamide and 20% ethanol, at 60^0C. The required amount of NiO nanoparticles was gradually added to this solution under constant stirring and heating, resulting in a suspension with homogeneous appearance. After complete solvent evaporation, the obtained material is washed several times with distilled water under vigorous stirring to remove residues and remaining organic solvent. Then, the composite is dried at 100^0 C in a hot air oven for 15-20 h. This is the room temperature prepared nanocomposite sample. A part of this sample is calcined at 350^0 C in a muffle furnace. As prepared NiO/CoPc nanocomposite sample and the sample calcined at 350^0 C are denoted as S1and S2 respectively.

Absorption spectra display the existence of absorption bands in 500-800 region caused by the π-π* transitions of the conjugated macro-cycle of 18 π- electrons. There is a red shift for the Sorret bands and slight blue shift for the Q bands due to the phase change activity.