International Journal of Psychosocial Rehabilitation, Vol. 25, Issue 01, 2021
ISSN: 1475-7192

A Review on Synthesis of Nanocomposite Material

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ABSTRACT

This paper mainly focusing on the synthesis of poly-matirx metal oxide prepared bySol-gel method,Co-precipitation method and Hydrothermal method. This review is designed to research characterization,synthesis and applications of polymatrix nanocomposite material. Metal oxide nanocomposites have the materials with the range of applications in the industrial sector. For the formation of complex matrix co-precipitation is the simplest method. Characterization of this materials are with the help of XRD, atomic force microscopyand TGA method. Which explain the particle size , thermal stability and morphology etc.

KEYWORDS: XRD, SEM, TGA, Microscopy and Morphology

INTRODUCTION

Metal matrix nanocomposites based materials known for their high strength, wear resistance, temperature resistance and ballistic properties. The incorporation of high strength nanofibres into ceramic matrix will lead to the preparation of advanced ceramic nanocomposites with improved thermal and crack resistance properties. Different materials such as Al_2O_3, $MgAl_2O_4$, ZrO_2, SiC and Si_3N_4*etc*. have been used as the ceramic matrix with various reinforcement materials like whiskers, particles or platelets, fibres*etc*to obtain the desired application based ceramic matrix nanocomposites [1-2].

Different fillers like TiO_2, $Mg(OH)_2$, graphite oxide, Fe_2O_3, clinoptiloliteetc., have been incorporated in PSAN based polymer matrix for various applications[3-6]. Every filler have its own specific properties on the basis of which it will further give its fingerprint in the polymer matrix. In the present case, ZnO semiconductor has been chosen as filler in insitu polymerization of polymer, due to its wide band gap, large exciton binding energy, luminescence etc. properties [7-8].

Heriberto*et. al*.2012 have synthesized poly/ZnO nanocomposite by mass-suspension polymerization. The ABS nanocomposite gives enhanced impact strength of 11% at 0.05% of ZnO, which get decreased with further increase of ZnO content. The nanocomposite processing by extrusion technique improves the glass transition temperature (Tg), effective dispersion, UV shielding of ZnO NPs [9]. Sirirat*et. al*.2013 has fabricated PSAN/PMMA/ZnO composite by melting compounding techniques. Tensile strength, Youngs modulus, impact strength and thermal stability properties have been studied in detail with content of ZnO in polymer [10]. J Sudeepan*et. al*.2014 have studied the ABS/ZnO nanocomposite friction and wear properties. The addition of ZnOnanono filler with proper load and speed to ABS leads to improve the tribological properties [11]. Zongyu*et. al*. 2016 have studied the PSAN/ZnO nanocomposite by ligand exchange method. The exchange in ligand takes place between oleic acid-ZnO NPs and PSAN-NH_2 ligands.

The characterizations of prepared materials is important in sense of impurities, structural phase, composition and crystallization quality *etc*. factors. In order to check whether the synthesized material with one method is successful with respect to desired properties or not, a proper characterization technique must be required. Structural, morphological, optical properties of Ag-ZnO NPs and PSAN/ZnO PNs are studied. The colloidal and thermal stability of PSAN PNs were studied by zeta sizer and thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC) techniques respectively between ZnO and PSAN via $-NH_2$. The final product obtained through above synthesis can be utilized in optical sensing, electronic and plastic designs applications [12-13].

MATERIALS AND METHODS

Synthesis of Metal Oxide Nano-composites: The synthesis of uniform sized nano-composite is very important due to their extra properties like electrical, optical and biological properties [14]. Synthetic approaches are classified into two stagesfirst stage is top-down stage ie. Known as physical methods and b) bottom up stage known as wet methods [15-16].Here on the variable change conditions Chemical reactions are proceeds due to which found in different shapes of nano-rods, nanowires, nanotubes etc. can be synthesized [17].

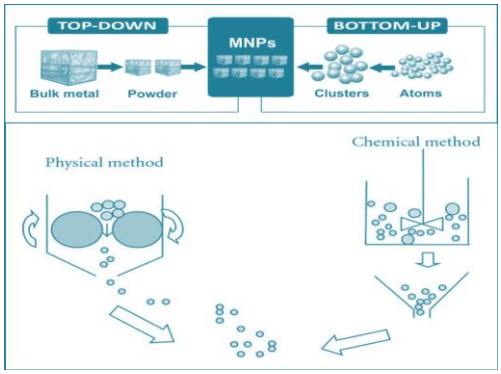

Fig.1 Synthesis of Metal oxide [18]

Analysis of Nanocomposite

nanocomposites can be analysed with the help of the followings techniques like morphology, phases, composition, thermal stability, size of particle optical, electrical and thermal properties.

Diffraction of X-Ray: Innano-composite investigation wedetermine the unit cell properties phase determination with the help of powder X-ray diffraction[19]. The technique is also frequently employed to determine particle size using Scherrer's formula[20].

$$C = \frac{K\lambda}{\beta \cos\theta} \qquad \text{(i)}$$

Here mean size of the crystalline = C nm , dimensionless shape factor =K , α = wavelength and β = broadening and θ = Bragg angle. when nanocomposites have definite crystalline structure then this formula is applicable when having definite crystalline structure but this formula is not applicable when particle size is amorphous in nature.

Microscopic procedures – In this procedure we can use microscopic scanning electron microscopy ,atomic force microscopy and transmission electron microscopy .Throughthe SEM we study the surface morphology of the metal oxide nanocomposite but that requires the surface of electrically conductive but in the case of non-conducting samples it is coated with carbon or gold thin layer. After that we found the resolution of SEM is 1-2 nm [21-22]. We shown in the figure 2,the shape[23] agglomeration[24] and matrix[25] of different metal oxide nanoparticles after doping.

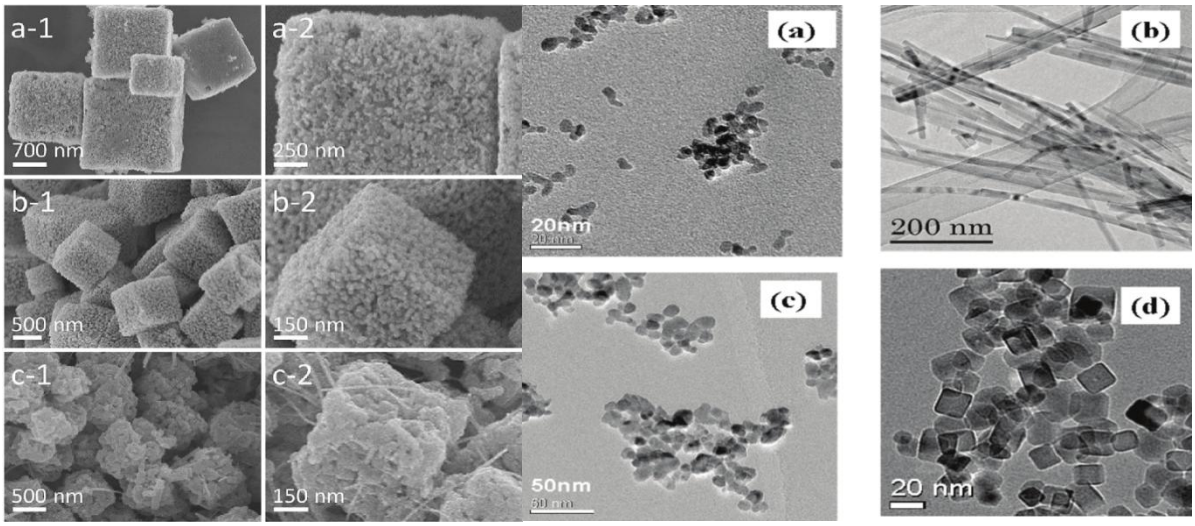

Figure2SEM and TEM images of some metal oxide nanocomposites

Advantages of MO Nanocomposites

The main advantages of metal oxide nanocomposites are in the field of agriculture, health issues, food sectors and medicine sectors. Different metal oxide nanocomposites have different properties , so it have a very wide applications.

Environmental applications : To tackle the environmental pollution problems noano composite materials are used as sensors, photocatalyst . The nanoscale materials are high surface area and high reactivity and effective for water purification and in earlier it is sensing the different [26]. For the removal of dyes, heavy metals polymers of metal oxides nanoparticles are used in combination with graphene, silica, other oxides, CNT[27].

Usefulness inhealth and medicine sector : The metal oxide nanoparticleshave several applications such as in health sectors like medicine, imaging, diagnosis and screening of diseases for delivery of drugs and sequencing, in gene therapy, DNA sequencing,tissue culture and treatment of cancer[28].

Usefulness in agriculture and food sectors: metal oxide nanoparticles polymers were used in thepackaging of foodstuff, it is working as a filler material like TiO_2it is also used as a antimicrobial agent like silver oxide nanocomposites and oxygen scavengers. In the crops and

vegetable sector, metal oxide nanoparticles are used as a nanosensor for pesticide detection and pathogen detection in plants[29]. It is also prevent of soil degradation and development of agriculture[30].

CONCLUSION

Present study synthesis of metal doped in metal oxide nanoparticles through different method is reported. The structural purity of synthesized metal oxide nanoparticles has been confirmed by XRD technique. Polymatrix nanocopmposite materials are analysed by using various procedures .Now these metal oxide nanoparticlesuseful for drug delivery, medical devices, surgical tools, adsorbents, photocatalyst, sensors, fuel cells, solar cells etc.

ACKNOWLEDGEMENTS

Author is thankful to Management and administrator ofKalinga University for providing library facility.

CONFLICT OF INTEREST

Conflict of interest declared none

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