Fabrication Techniques and Structural Analysis of Aluminum Oxide Dispersed within Polystyrene Matrix

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ABSTRACT

Nanomaterials can be incorporated into polymeric coatings to enable significant improvement in targeted properties, i.e., scratch resistance, UV resistance, etc. Commercialprocessing methods have been developed to surface treat nanoparticles to render compatibility between the nanoparticle and polymer matrix. In addition, commercial processes to disperse the surface treated nanoparticles have been developed. These integrated technologies allow transparent coatings containing nanoparticles to be formed in a wide range of resin formulations. This paper will address the preparation and analytical characterization ofnanoparticle dispersions in polymer, as well as their performance attributes. Aluminum oxide (Al_2O_3) nanoparticles was successfully synthesized by Urea decomposition method. synthesized samples weremixed in polystyrene to form composite. The formed composites characterized by X-ray diffraction (XRD), Fourier transform infrared (FTIR), The x-ray diffraction pattern indicated that as-synthesized sample had a crystal size was obtained at 600°C calcination temperature. Fourier transform infrared spectra confirmed the presence of composite formation. Experimental result of the composites exhibitedmany activities of under different investigation under process as of next research going to publish in the next session.

KEYWORDS: Polystyrene, composites, film. .

I. INTRODUCTION

The more usage of metal oxide nanoparticles and Nano structured materials attracts many people to research for their controlled synthesis via new method [1,2]. Special properties of metallic or metal oxide nanoparticles exhibited several potential application in electronics, optoelectronics, catalysis and thin film coatings [3,4]. In particular, alumina nanoparticles are expected to play important roles in a variety of relevant applications, and hence, the field has generated important contributions regarding the synthesis and processing of such particles [5]. Polymernano composite material represents a new alternative to Conventionally used nanoscopic inorganic material filled polymer [6]. Because of their nanosized filler dispersion nanocomposite Exhibitmarkedly improved properties when compared to the pure polymer or their traditional composite [7]. These include increased modulus and strength, outstanding barrier. Properties that improved heat resistance anddecreased flammability [8]. Researchers have attempted to enhance the desired properties of polymer nanocomposites and to extend their utility by reinforcing them with nanoparticles and homogeneous precipitation [9]However, a disadvantage to fabrication of nano devices is the agglomeration of nanoparticles [10]. In view of the said applications and vast utility of the above, aim of this work is to prepare nanoparticles dispersed(Al_2O_3) nano particlespolystyrene composite through polymerization method. The composite film has been thoroughly studied using different characterizations like spectral, XRD aspects

II. MATERIALS AND METHODS

Synthesis of Al_2O_3 nanoparticles disperse polystyrene composites

Commercially polystyrene was procured and Al_2O_3, was synthesized by Ureadecomposition method reported earlier Spin coating method is adapted for the preparation of nanocomposite film which is given as follows: A known weight (1.0 gram) of polystyrene is dissolved in benzene and stirred well to make polymer gel. A known quantity of Al_2O_3(1%) is sonicated (Sonic Vibra cell)for 0.5 hour in separate container. Both the solutions were mixed in a rotary evaporator constantly maintained at 40^0C till the solvent was evaporated. Few drops of the solution was put on glass slide and kept on the spin coating unit (SCU 2007 A) at 800 RPM for about 15 min. A transparent film formation takes place. This film is detached from glass slide by using polar solvent such as distilled water.

Characterization

FTIR is carried out from our institute using Park in Elmer FTIR instrument ranges from 400 cm^{-1} 4000 cm^{-1}. X-ray powder diffraction (XRD) analysis was carried out with Goniometer Ultima IV using a Cu Kα radiation (λ=1.54060Å) operating at 40 kV and 40 mA. Absorbance carried out by spectrophotometer.

III. RESULTS AND DISCUSSION

FTIR Studies:

FTIR spectroscopy of Al_2O_3dispersed polystyrene composite is shown in figure 1. The spectrum of the nanocomposite film indicates that majorpeaks are associated with styrene (υ-OH), strong stretching band is observed at 3025cm^{-1} to 3082cm^{-1}.The υ-CHalkyl stretching at 2923cm^{-1},(υC=Ostretch at 1745cm-^{1}1802cm^{-1},1810 cm^{-1},1942,υ-CHbending at1372cm^{-1}, υ-C-Ostretch at 1154cm^{-1} , υ-C-Ostretch at1181cm^{-1},υ-CHstretchingat 965cm^{-1},756cm^{-1}, thepeaks below 697cm-1peaks are associated to H-typeinteraction between Al_2O_3 and polymer , the peaks from451cm^{-1}to539$cm^{-1}$are the two shift peaks for oxide sample, along with a small red shift was observed. The instrumental limitation did not allow the two peaks to be clearly resolved. The peakposition of Polymer and oxide clearly indicate a composite formation and that the composites chemicallyhomogeneous, transparent and well dispersed.

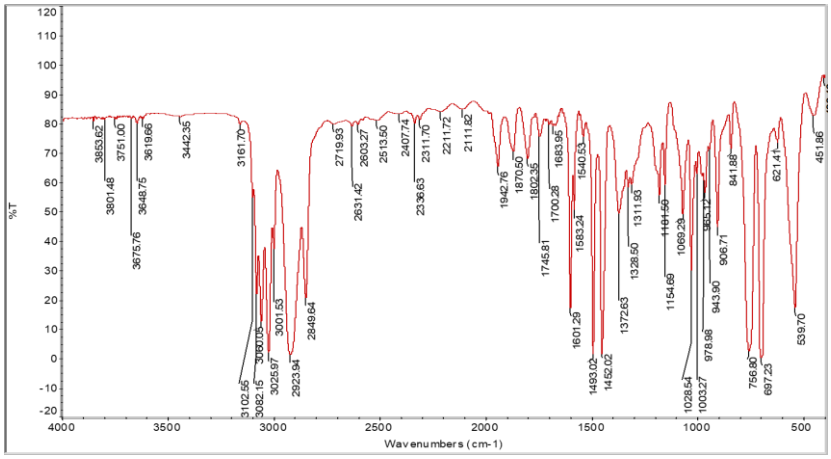

Figure 1. FTIR of Al_2O_3dispersed composite

XRD Studies:

The phase formation and orientation of Al_2O_3nanoparticleswere investigated using X–ray diffraction in the ranges (20-80deg). X-ray diffraction patterns of nanoparticles with shown in figure 2. It was found that the presence of polystyrene composites at $20^0$and the remaining peak are diminished due to the polymer. The XRD results also reveal the composites formations.

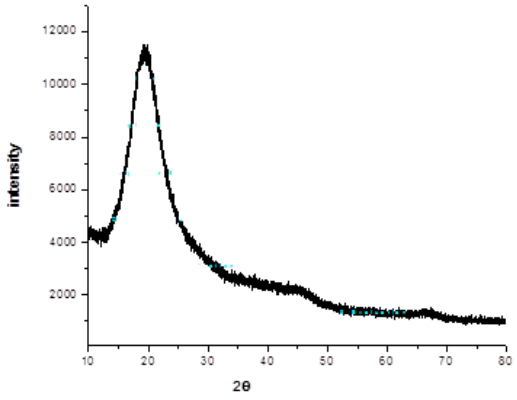

Figure 2. XRD of Al_2O_3 nanoparticles dispersed Polystyrene composite

IV. CONCULUSION

Al_2O_3 nanoparticles dispersed composite can successfully be synthesized by urea decomposition and UV-assisted method using aluminum nitrate, at room temperature then the burnt product was calcined at 600^oC for 2h. The prepared sample was characterized by using different tools; FTIR, XRD.The FTIR spectroscopy for the film showed several vibrational bands at various wave numbers. Several new bands disappeared in the IR spectraof the composite film due to formation of complexes by the addition ofAl_2O_3 nanoparticles to the polystyrene matrix. The continues part of studies related to applications part are still on trial.

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VI. REFERENCES

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