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Research paper

Preparation of poly methyl methacrylate thin film by solution casting method to study its ultrasonic velocity

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Abstract

Polymers are long chain giant organic molecules are assembled from many smaller molecules called monomers. The work reflects the preparation of poly methyl methacrylate thin film by solution casting method. The XRD of PMMA/ZrO2 polymer is taken to confirm the structure and nature of material. Furthermore, it is characterized by finding the ultrasonic velocity at different concentration of ZrO2 and at different temperature keeping the frequency same.

Keywords: *Polymer; Ultrasonic; Solution Casting Method.*

1. Introduction

Polymers are complex and long chain giant organic molecules are assembled from many smaller molecules called monomers. They consisted of many repeating monomer's units in a long chain. Many objects in daily use from packing, wrapping materials include half of all polymers synthesized. Other uses include textiles, TVs, CD's, Automobiles and many others all are made from polymers. Many of the researchers have been prepared PMMA/ZrO_2 composites using various methods and characterized it to study their different properties. The ultrasonic and dielectric properties of PMMA/ZrO_2 composites, prepared by sol-gel method were studied and found that the electrical conductivity of composite's increases by increasing the ZrO_2 concentration [1]. PMMA/ ZrO_2 composites were prepared using ex-situ method to study the ultrasonic and dielectric properties. Prepared nanocomposites were investigated by XRD and FTIR confirmed the dispersion of nanoparticles in PMMA [2]. Different methods like situ emulsifier-free emulsion polymerization, where the thermal stability of PMMA/ZrO_2 nanocomposites was improved with increasing concentration of ZrO_2 [3]. The polymer films of PMMA with different thickness and its composites with ZrO2 at various weight percentages but of same thickness have been studied [4]. Ultrasonic study used to investigate and correlate the behavior of material under different conditions. PMMA is ever demanding due to its biocompatibility and mechanical strength it altered with various metal oxides. ZrO2 is one of the promising metal oxides, which improves physical properties of PMMA. The composite materials of polymers are important to the electronic industry for its optical properties and as well as for dielectric properties through the use of capacitors. It can be used as a shock absorber, e.g. the coatings of this composite material provide extra support to glasses or any material and avoid the dispersion normal or accidental applied.

2. Experimental

When the polymer is shaped into a hard and tough utility article by the application of heat pressure, it is used as plastic. In this work, two materials have been chosen to prepare the thin film of PMMA/ZrO_2 for preparation of bone coating and sealing agent having specific ultrasonic absorption using Solution Casting Method.

Characteristics of PMMA and Zirconium Oxide

1) Poly methyl methacrylate (PMMA): It is a transparent thermoplastic, often used as a lightweight or shatter-resistant alternative to glass. Sometimes called as acrylic glass. Chemically, it is the synthetic polymer of methyl methacrylate. PMMA is an economical alternative to polycarbonate (PC) when extreme strength is not necessary. PMMA does not contain the potentially harmful bisphenol- subunits found in polycarbonate. It is easy to handle and processing, low cost, etc.
2) Zirconium dioxide (ZrO2): Zirconia is a white crystalline oxide of zirconium. Zirconium is an extremely refractory material and offers chemical and corrosion inertness to temperature well above the melting point of alumina. The material has low thermal conductivity. It is electrically conductive above 600oC and is used in oxygen sensor cells and as the heater in high-temperature induction furnaces.

The poly methyl methacrylate (PMMA) is taken as a host polymer matrix in which zirconium dioxide is taken as additive filler in W/Wt. % ratio as (1-X)PMMA, XZrO2, where X=(0.2, 0.4, 0.6, 0.8, 1.0).

If we put X=0.01 then we get 0.49Wt. % of PMMA, upto X=1.0 we make the concentration of PMMA.

3. Procedure

The amount of PMMA and ZrO_2 is weighted by using digital weighing balance for different concentration of ZrO_2. PMMA is then dissolved in chloroform, and ZrO_2 is mixed into a polymer matrix in the appropriate ratio. The solution is kept for warming in a furnace for 3 minutes and then kept out that solution. The thin films of polymer metal dioxide were synthesized. The synthesis used to prepare the material is solution casting method.

Solution casting method is the simplest method to create thin films. By the drops small amount of polymer solution onto glass slide or on the surface then spread the solution for few seconds then keep the slide for evaporation of the solution. After evaporation of the solution, the thin film of the solution is made.

3.1. Formulation

Ultrasonic velocity provide an excellent means of studying various types of change of phase in vicinity of melting point of super cooled liquids and round the critical temperature of individual liquids and mixture, transition in liquid crystal from their anisotropic region to isotropic region. The formula by which ultrasonic velocity were calculated

u= 2d/t

Where d= separation between transducer & reflector

T= travelling time period of ultrasonic wave

3.2. Observation

Table 1: Ultrasonic Velocity of PMMA/Zro_2 at 2 MHz and at 298K

Wt% of ZrO2	0	0.2	0.4	0.6	0.8	1
Ultrasonic velocity(m/s)	2743	2791	2837	2874	2948	2981

Table 2: Ultrasonic Velocity of PMMA/Zro_2 at 2 MHz and At 303K

Wt% of ZrO2	0	0.2	0.4	0.6	0.8	1
Ultrasonic velocity(m/s)	2701	2752	2791	2828	2902	2949

Table 3: Ultrasonic Velocity of PMMA/Zro_2 at 2 MHz and at 308K

Wt% of ZrO2	0	0.2	0.4	0.6	0.8	1
Ultrasonic velocity(m/s)	2345	2706	2745	2782	2856	2928

Table 4: Ultrasonic Velocity of PMMA/Zro2 at 2 MHz and at 313K

Wt% of ZrO2	0	0.2	0.4	0.6	0.8	1
Ultrasonic velocity(m/s)	2187	2660	2699	2736	2810	2856

4. Result and conclusion

The variation of wt% of ZrO_2 verses ultrasonic velocity indicates that the ultrasonic velocity of polymer metal oxide composite thin film increases from 2743 to 2981 upto 1% wt of ZrO_2. The ultrasonic velocity of PMMA is 2750.

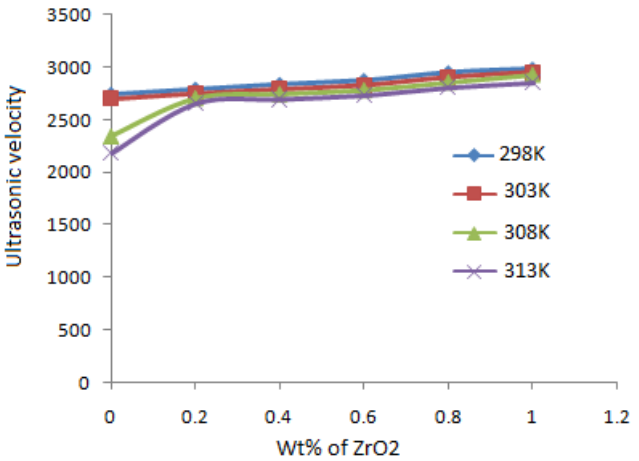

Fig. 1: Concentration Dependent of Ultrasonic Velocity at Different Temperature.

The composite of the synthesized PMMA-ZrO_2 composite is analyzed through XRD and found to be matched with JCPDS data no. 872105. The interplanar spacing has been calculated and is observed from the value, the structure of composite film is found to be in tetragonal phase of ZrO_2. The appearance of sharp peaks indicates that samples have partial crystalline in nature.

References

[1] S. Devikala et. al "Conductivity and Dielectric studies of PMMA composites" Chemical Science Transaction 2(S1), 2013, S129-S134.

[2] R. Kumar and G. kaur Sidhu " Synthesis and characterization of PMMA/ZrO2 nanocomposites" AIP conference proceeding, 1536, 187(2013) https://doi.org/10.1063/1.4810163.

[3] S. K. Awain et. Al studied the ultrasonic and dielectric properties of PMMA-ZrO2 composites.

[4] Basavaraja Sannakki and Anita/ Physics Procedia 49 (2013) 15-26.