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Research paper

Design of Compresion Sensor by Zno Substrate using Precipitation Method

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Abstract

The Zinc Oxide nanoparticles are synthesized by the precipitation method using zinc acetate dehydrate and sodium hydroxide. The significance of characterization techniques like AFM, SEM, FTIR Spectrum and XRD for the prepared nanomaterial is studied. The prepared nanoparticles are used to improve the electrical conductivity of dielectric polymer like PMMA. Polymer metal Nano composites are prepared by in-situ oxidative polymerization of Methyl methacrylate monomer in the presence of different concentration of prepared metal nanoparticles. The electrical conductance is investigated using multimeter. The conductivity of the dielectric polymer is found to be increased with the increasing semiconductor concentration. Based on the result the prepared Nano composites can be used to convert the insulating foam into conductive one which can used to fabricate compression sensor.

Keywords: *wearable sensors, compression sensors, Zno- Zinc oxide.*

1. Introduction

Wearable sensors play a major role in the diagnostic as well as the monitoring applications. Their current capabilities include the physiological and the biological sensing as well as the motion sensing. The wearable sensor also a plays a vital role in the monitoring of the human activity and in the rehabilitation process. Wearable sensor detects abnormal situations by monitoring along with the other symptoms. The main advantage of the wearable sensor is that it monitors the patient continuously which is much better than the measurements given by the occasional clinic visits. The other major advantage is that it can be worn on the body.
This could be like a chest strap wireless linked to a watch which is used to monitor the heart rate. However, in order to do this the wearable sensor must be integrated in the clothes we wear and this makes it a textile based sensors. The wearable systems are also used in the wearable computing applications which is applied to a variety of medical applications like observing the patients, collecting the specific medical data and also supporting the disabled people with various tasks. Thus the system helps to facilitate the medical professionals by providing an overview of the patient"s health state over a long period of time as they cannot observe their patients all day long. This also provides an advantage to the patients as they do not need to stay in the hospital all the time for the monitoring of their health. The below picture shows a pure metal that is been foamed.

Fig. 1: A piece of compressible foam

Though it is stiff and rigid, when heavy pressure is applied, it gets compressed. This foam can be made from stainless steel, copper, nickel and various other materials. This foam can withstand high temperature and also has good flexibility and good strength. Thus, this type of rigid and compressible foam can be used in various applications such as filtering hot fluids, to dissipate heat in electrical
applications. This foam is also used in the fabrication of the wearable sensors

2. Literature survey

Copper nanoparticles were prepared by Polyol Method and the prepared metal nanoparticles were characterized by various techniques like AFM, SEM, FTIR Spectrum and XRD. The prepared metal nanoparticles are used to improve the electrical conductivity of dielectric polymers like PMMA. Polymer Metal

Nano composite was prepared by in-situ oxidative polymerization of Methyl methacrylate monomer in the presence of different concentration of prepared metal nanoparticles.

The formation of the polymer metal Nano composites was characterized by UV-Vis Spectroscopy, SEM and AFM. The electrical conductivity was investigated using Four-Point Probe Techniques and the conductivity value of the PMMA/Cu Nano Composite was in the range of MS/cm. The conductivity of the dielectric polymer was found to be increased with the increasing metal concentration. The prepared Nano composite can be used to convert the insulating foam into conductive one which can be used to fabricate wearable sensors for physiological (Breath Rate, Limb Movement, etc.,) monitoring.

3. Proposed Design

The zinc oxide nanoparticles were synthesized by the precipitation method. This method uses the zinc acetate dehydrate (Zn(Ace)2.2H2O) and sodium hydroxide (NaOH) as the source materials. The capping agent such as PVP can also be used during the synthesis but not mandatory. The Zinc acetate solution of 0.5M was prepared by mixing 10.8g of zinc acetate and 100 ml of water in a beaker using a magnetic stirrer. The solution is mixed until a clear homogeneous solution is obtained. The sodium hydroxide solution of 1M was prepared by mixing 4g of sodium hydroxide and 100 ml of water in a beaker using a magnetic stirrer. This solution is also mixed until a clear homogenous solution is obtained. Then the Sodium hydroxide solution is added drop wise to the zinc acetate solution along with a vigorous stirring using the magnetic stirrer.

This process is continued for about 30 minutes. During this process, a white precipitate is formed. After the completion of this process, the solution is filtered by using a filter paper .The obtained precipitate is then heated at 2200C for about 2 hours in a hot air oven. After the heating, the particles is allowed to cool at room temperature and then crushed into fine powder. This method can also be done with the use of the capping agent such as PVP. In this method, the Zinc acetate solution of 0.5M was prepared by mixing 10.8g of zinc acetate and 100 ml of water in a beaker using a magnetic stirrer. To this solution, 2% weight of PVP that is 0.08g and it is mixed vigorously to get a homogeneous solution. The sodium hydroxide solution of 1M was prepared by mixing 4g of sodium hydroxide and 100 ml of water in a beaker using a magnetic stirrer. This solution is also mixed until a clear homogenous solution is obtained.

Then the Sodium hydroxide solution is added drop wise to the zinc acetate solution and the PVP mixture along with a vigorous stirring using the magnetic stirrer. This process is continued for about 30 minutes. During this process, a white precipitate is formed. After the completion of this process, the solution is filtered by using a filter paper .The obtained precipitate is then heated at 2200C for about 2 hours in a hot air oven. After the heating, the particles is allowed to cool at room temperature and then crushed into fine powder to get the Zinc Oxide nanoparticle.

$$Zn(CH3COO)2 + NaOH \; Zn(CH3COO)(OH) + NaCH3COO \quad (3.1)$$

$$Zn(CH3COO)(OH) + NaOH \; ZnO + NaCH3COO + H2O \quad (3.2)$$

This equation represents the reaction to synthesize the zinc oxide nanoparticle. This method can also be done with the use of the capping agent such as PVP. In this method, the Zinc acetate solution of 0.5M was prepared by mixing 10.8g of zinc acetate and 100 ml of water in a beaker using a magnetic stirrer. To this solution, 2% weight of PVP that is 0.08g and it is mixed vigorously to get a homogeneous solution. The sodium hydroxide solution of 1M was prepared by mixing 4g of sodium hydroxide and 100 ml of water in a beaker using a magnetic stirrer. This solution is also mixed until a clear homogenous solution is obtained.

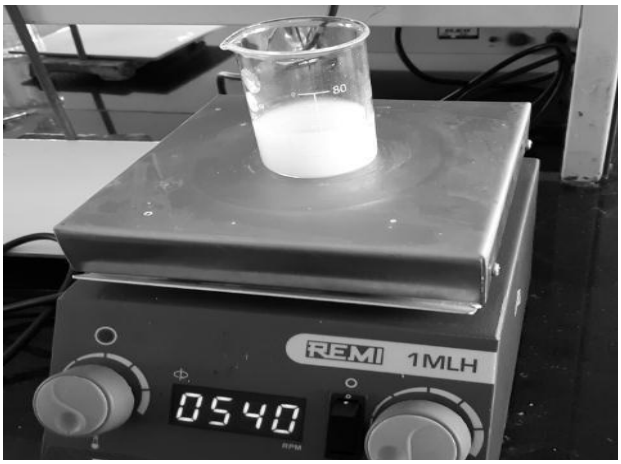

Fig. 2: Snapshot of a magnetic stirrer

Then the Sodium hydroxide solution is added drop wise to the zinc acetate solution and the PVP mixture along with a vigorous stirring using the magnetic stirrer. This process is continued for about 30 minutes. During this process, a white precipitate is formed. After the completion of this process, the solution is filtered by using a filter paper .The obtained precipitate is then heated at 2200C for about 2 hours in a hot air oven. After the heating, the particles are allowed to cool at room temperature and then crushed into fine powder to get the Zinc Oxide nanoparticle.

$$Zn(CH3COO)2 + NaOH \; Zn(CH3COO)(OH) + NaCH3COO \quad (3.3)$$

$$Zn(CH3COO)(OH) + NaOH \; ZnO + NaCH3COO + H2O \quad (3.4)$$

4. Result & Discussion

The non-conducting polymer was converted to a conducting polymer. When the conductivity increases, the resistance value decreases. This change in the resistance is measured using a digital multimeter. The conductivity of the foam increases when it is compressed.

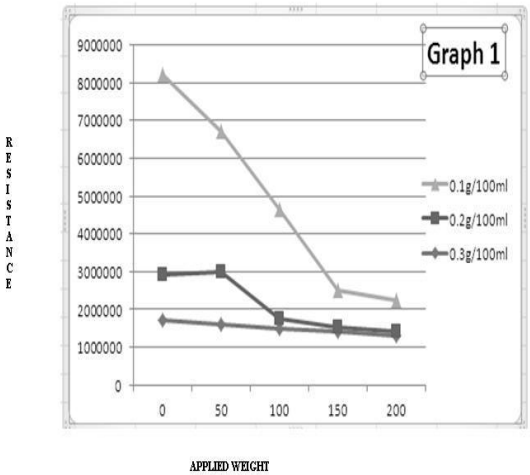

Fig. 3: Graph of resistance values of ZnO nanoparticles with PVP

In order to achieve the compression, pressure is applied. The pressure is applied by placing a certain amount of weight on the foam.The above graph shows the graph of the resistance values with PVP. The resistance values of various amount of ZnO like 01.g, 0.2g, 0.3g were registered. The resistance values decreases with the increase in the pressure applied.

The 0.1g of ZnO is taken and various weights are applied. When weight is applied, the resistance value is high and then decreases with the increase in the weight. The 0.2g of ZnO is taken and

various weights are applied. When no weight is applied the resistance values decreases when compared to the 0.1g and then further decreases with the increase in the weight.
The 0.2g of ZnO is taken and various weights are applied. When no weight is applied the resistance values decreases when compared to the 0.1g and then further decreases with the increase in the weight.
The 0.1g of ZnO is taken and various weights are applied. When no weight is applied the resistance values decreases when compared to the 0.2g and then further decreases with the increase in the weight.

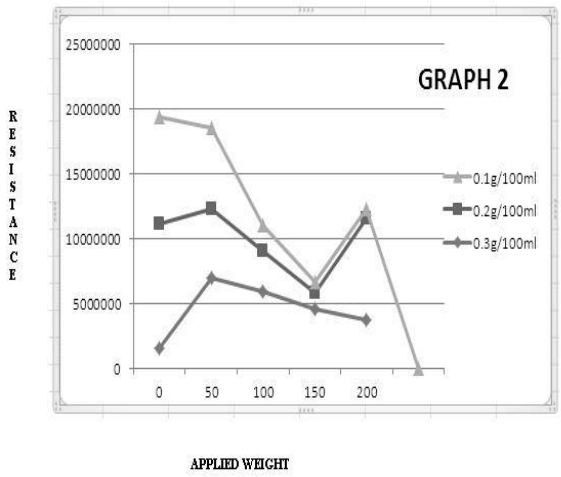

Fig. 4: Graph of resistance values of ZnO nanoparticles without PVP

The above graph shows the graph of the resistance values without PVP. The resistance values of various amount of ZnO like 01.g, 0.2g, 0.3g were registered. The resistance values decreases with the increase in the pressure applied. The 0.1g of ZnO is taken and various weights are applied. When no weight is applied, the resistance value is high and then decreases with the increase in the weight.
The 0.2g of ZnO is taken and various weights are applied. When no weight is applied the resistance values decreases when compared to the 0.1g and then further decreases with the increase in the weight.
The 0.1g of ZnO is taken and various weights are applied. When no weight is applied the resistance values decreases when compared to the 0.2g and then further decreases with the increase in the weight.

5. Conclusion

By using these nanoparticles the polymer metal nanocomposites were prepared. Electrical conductivity of the insulating polymer is dependent on the concentration of the semiconductor nanoparticles. Impregnating the nanoparticles are important for the electrical conductivity. This conducting foam is used to sense the physiological signal.The polymer foam prepared by using this method is used to increase the sensitivity of the sensor. The conducting foam will show the linea relationship between the conductance and the stress applied. This conducting polymer foam is used for fabricating the compression sensor.

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