Electromagnetic Properties of Polymer Magnet/Tio_2 Composite Shrinkage Material

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Keywords: Polymer Magnet, Titanium Dioxide, Composite Shrinkage Material, Electromagnetic Properties

Abstract: with the Advancement of Modern Science and Technology, Electronic Communication Equipment Has Been Gradually Miniaturized and Flattened, and the Transmission Speed Has Been Increasing. Titanium Dioxide Has Been Widely Used in Various Electronic Devices Due to Its High Dielectric Constant and Low Dielectric Loss. However, Due to the Complicated Process of Making Titanium Dioxide and the Brittleness of Hardness, It Faces Many Difficulties in Practical Application. in This Paper, the Electromagnetic Parameters of Acrylic Coated Polymer Magnet/ Tio2 Dioxide Composite Shrinkage Material Were Analyzed in the Experiment, and the Influence of Acrylic Acid on Electromagnetic Parameters Was Discussed in Order to Provide Theoretical and Practical Value for the Development of Information Transmission Technology.

1. Introduction

1.1 Literature Review

Sun Naikun, Du Shengjie and Du Baosheng et al. Used Mechanical Chemistry to Prepare Ni/Tio_2, and Studied the Effect of Annealing on the Absorbing Properties of Ni/ Tio_2. the Annealing Caused the Lattice Defects and Internal Stress to Decrease. under the Influence of Annealing, the Particle Size and Magnetization of Ni Crystals Increase Significantly, and the Tio_2 Band Structure is Distorted after Annealing. the Luminescence Peaks and Intrinsic Luminescence Peaks Caused by Free Excitons and Bound Excitons Are Red-Shifted (Sun et al. , 2014). Wang Wen, Wang Chengguo and Guo Yu et al. Added Iron to the Polyacrylonitrile Polymerization Solution and Heated the Sample through Three Temperatures to Obtain Three Electromagnetic Composite Absorbing Materials. They Used X-Ray Diffractometer to Analyze the Physical Properties of Composite Materials Treated with Different Temperatures. on the Basis of This, It is Proposed That as the Heat Treatment Temperature Increases, the Electromagnetic Wave Loss Capacity of the Composite Increases and the Dielectric Constant Also Changes (Wang et al., 2012). Li Binpeng, Wang Chengguo and Wang Wen et al. Used X-Ray Diffraction and Scanning Electron Microscopy to Characterize the Physical Properties of the Composition, Properties and Structural Characteristics of the Polyacrylonitrile Solution, and Used a Vector Network Analyzer to Electromagnetically the Material. the Parameters Were Tested and It Was Suggested That the Carbonization Temperature Would Have an Effect on the Electromagnetic Properties (Li et al., 2012). Xue Zhi, Liu Tao, and Liang Difei et al. Conducted a Chemical Coprecipitation Method to Form a Nickel-Zinc Hydroxide on the Surface of a Flattened Ferrosilicon-Aluminum Alloy Powder by Chemical Action, and Coated the Nickel-Zinc Ferrite Powder with Iron-Silicon. the Electromagnetic Influence of Aluminum Alloy Composites Was Studied. They Proposed That the Dielectric Constant of the Derivatized Hydroxide is Declining Relative to the Raw Material, the Complex Permeability Curve Tends to Be Stable, and the Nickel-Zinc Ferrite Can Significantly Improve the Absorbing Properties of the Ferrosilicon-Aluminum Powder (Xue et al. , 2012). Wang Xuejiao, Yang Xiangyu and Wen Chengying et al. Studied the Polyvinyl Butyral/Nickel-Plated Graphite Composites and Discussed the Magnetic Shielding Mechanism by Observing the Changes of Complex Permittivity and Complex Permeability. Based on This, They Propose That the Electromagnetic Shielding

Effectiveness of Composites Increases with the Increase of Nickel-Plated Graphite Content, and the Electromagnetic Shielding of Composites Mainly Depends on Electrical Loss (Wang et al., 2019).

1.2 Purposes of Research

With the rapid development of modern science and technology, in the field of electronic technology, magnetic materials are widely used in various equipment and instruments. Since the magnetic material belonging to the inorganic substance has a relatively high density and a brittle hardness, it is difficult to perform secondary processing, so that it is difficult to form a minute and meticulous part, which cannot satisfy many special uses. Based on this, this paper studies the electromagnetic properties of polymer magnets and titanium dioxide (TiO_2) composite shrinkage materials, and briefly describes the current research status of composite shrinkage magnets, and studies the shrinkage materials at 0.01GHz-0.18GHz. The variation of electromagnetic parameters is used to efficiently utilize the shrinkage properties of polymer magnet/ TiO_2 composites.

2. Overview of Relevant Theory

Polymer magnets can generally be divided into two types, one being a composite type and the other being a structural type. A composite polymer magnet is a magnetic body obtained by mixing and filling a polymer material with another inorganic magnetic substance (Lv et al., 2018). The structural polymer magnet mainly means that the inorganic structure is not added, and its own structure has strong magnetic properties. Structural magnets are different from composite magnets in that they have relatively high electrical resistance and small specific gravity, which have important research significance and application prospects, but they are currently rare (Yang and Zhang, 2018). Compared with structural polymer magnets, composite magnetic materials have been widely used, and important conversions of research results to commercial production have been realized. The composite materials that can be directly used at present are magnetic plastics, magnetic ion exchange resins, and magnetic rubbers. The free radicals in the magnet are quite active. When the radicals are close to each other, they interact, so that the electrons cannot be paired to form a magnetic polymer. Therefore, in the design of the magnetic polymer, it is necessary to keep the molecular chain length and maintain the molecular. Ordered alignment is quite difficult.

At present, many researchers are looking for a dielectric material that is light in weight and easy to be reprocessed, and utilizes the processability, moldability of the polymer material and the high dielectric property of the ceramic material to form a composite material. Commonly used PTFE/ceramic dielectric substrates have lower electrical losses, but the dielectric constant of this composite is generally less than 10. It is difficult to continue to reduce the size on the existing basis to meet the needs of electronic component parts at this stage (Xv et al ., 2013). In recent years, some scholars have found that ferrocene-type polymer magnets have a low dielectric constant. Under microwave, it can break through the minimum size of known polymer magnets to form small-sized substrates, which are used to reduce antennas and micro-electronic transmission tools. . Since the dielectric constant of the polytetrafluoroethylene/ceramic substrate is large, and the magnetic permeability and magnetic loss of the polymer magnet are low, and the two are combined, it is possible to obtain a new composite material higher than the current research level.

3. Experimental Content

3.1 Material Preparation

1) The preparation method of ferrocene polymer magnet (OPM) is as follows

All operations in this experiment were under the protection of highly pure nitrogen and were carried out using double row tube operation techniques. The solvent required for the experiment needs to be pretreated by sodium. After pretreatment, it is refluxed for about 6h-8h in a pure nitrogen environment, and can be immediately put into the experiment after the reflux is completed. In this test, ferrocene was used as a raw material, and the experiment was carried out according to the experimental procedure in the polymer synthesis standard. First, a non-magnetic experimental intermediate was synthesized, that is, a reaction between ferrocene and an anthraquinone aromatic compound was carried out. Secondly, on the basis of the intermediate, it is further reacted with a self-made metal magnetization crosslinking agent containing a metal such as Cu, Co and Ni. Finally, the ferrocene polymer magnet (OPM) required for the experiment was generated.

2) Preparation of Acrylic Modified OPM/ TiO_2 Composite Shrinkage Material

Mix the magnetic material of 1:1 configuration with TiO_2 in a certain ratio, stir well in a high-speed stirrer, and mix the two thoroughly. On this basis, pour the appropriate amount of glycerin, silicone oil and organic acid and mix well, the ratio of the three is 1:2:10. After fully mixing for 1h-1.5h, the solvent in the sample is removed, and the solute is dried to obtain the acrylic modified OPM/ TiO_2 composite shrinkage material required for the experiment.

3.2 Experimental Results and Discussion

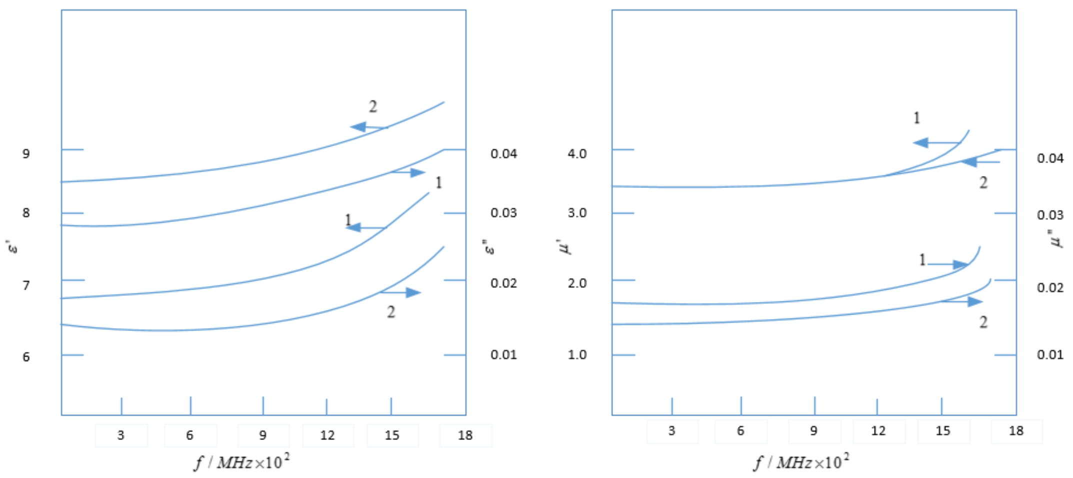

Fig.1

Figure 1. Comparison of Dielectric Parameters and Magnetic Parameters of Polymer OPM /TiO_2 Before and After Acrylic Acid Modification (Where the Left Picture is The Electric Parameter Curve, the Right Picture is the Magnetic Parameter Curve; Before Modification is 1, After Modification is 2)

Below 1 GHz, as the OPM content increases, the magnetic permeability of the OPM/ TiO_2 composite shrinkage material also increases. However, the dielectric constant generally varies with the change of titanium dioxide content, and is positively correlated with the titanium dioxide content, and does not change substantially with frequency. In the frequency range of 1 GHz to 1.8 GHz, the electromagnetic parameters generally have a small variation range. As shown in Fig. 1, the dielectric constant of the acrylic coated OPM/ TiO_2 material increased significantly, but the electromagnetic loss fluctuation curve showed a downward trend. During the experiment, the magnetic permeability of the material changed little and remained basically unchanged. This is because acrylic acid has a weak polarity and it has a very strong wetting effect on both the magnet and the titanium dioxide. The carboxyl group in the acrylic acid reacts with the iron in the ferrocene group and the titanium in the titanium dioxide to form a six-membered ring, and the surface activation energy of the composite is lowered by this chemical reaction. Under the action of the external field, the composite shrinkage material is prone to interfacial polarization, which increases the dielectric constant of the material and reduces the degree of electromagnetic loss. Acrylic modification is a chemical treatment on the surface of the experimental material, which does not affect the structure of the magnet itself, nor can it disturb the ordering of the internal structure of the magnet. Therefore, acrylic acid modification cannot seriously affect the magnetic permeability of the OPM/ TiO_2 composite.

4. Influence of Electromagnetic Parameters of Polymer Magnet/Tio_2 Composite Shrinkage Material

OPM/ TiO_2 composite materials are not only magnetic materials but also dielectric materials. Therefore, the material will simultaneously magnetize and polarize under the action of alternating electromagnetic fields. Under the dual action, polarization causes a change in the dielectric parameters of the material, and magnetization causes a change in the magnetic parameters. At low irradiation doses, the polymer magnets still maintain high resistivity and only partially crosslink during chemical reactions. The eddy current losses are also different due to the different magnet sizes. For a polymer magnet having a small size and a low resistivity, its eddy current loss is extremely small. In addition, the hysteresis loop obtained by the experiment shows that the hysteresis loss of the polymer magnet/ TiO_2 composite shrinkage material is also low. The residual loss in the experiment is mainly the energy loss generated after magnetization, which is affected by the diffusion of electrons and ions in the material, but these factors have little effect on the experimental results in this experiment. Therefore, the magnetic loss of the polymer magnet/ TiO_2 composite shrinkage material is not greatly affected by the frequency or the irradiation dose.

There are two main factors affecting the dielectric properties, namely the polarization of the medium and the movement of free charges in the material. In the process of dielectric polarization, it is usually accompanied by energy loss caused by ion vibration and collision deformation. The magnets are basically insulators, so the dielectric loss of the composite after processing is mainly based on the polarization loss of titanium dioxide. In the experiment, the acrylic modification can effectively eliminate the O_2 and H_2O attached to the surface of the material, and at the same time reduce the amount of surface active radicals, so that the dielectric loss of the material can be greatly reduced. In addition, through experimental data analysis, as the frequency and irradiation increase, the dielectric loss curve of the polymer magnet/ TiO_2 composite shrinkage material tends to be stable and has little change.

Acknowledgement

This research has been financed by The Science and Technology Guiding Plan Project in 2018 of Jinzhou Bureau of Science, Technology and Intellectual Property(18B1E42) and The Project in 2018 of Liaoning Petrol-Chemical Vocational and Technical College(LSHYJ1804)

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