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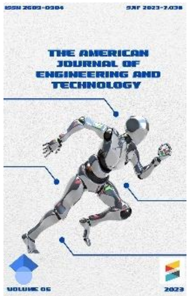

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Research Article

DIELECTRIC PROPERTIES OF MICRO-COMPOSITES BASED ON ACRYLIC COATED CONDUCTING CARBON PARTICLES AND SILICONE ELASTOMER

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ABSTRACT

Dielectric properties play a crucial role in the performance of micro-composites used in various applications such as flexible electronics and energy storage devices. This study focuses on investigating the dielectric properties of micro-composites based on acrylic coated conducting carbon particles embedded in a silicone elastomer matrix. The acrylic coating enhances the dispersion and compatibility of the conducting carbon particles within the silicone elastomer, ensuring uniform distribution throughout the matrix. The dielectric properties, including the dielectric constant and loss tangent, are characterized over a range of frequencies and temperatures. The results reveal the tunability of the dielectric constant by adjusting the filler loading and coating thickness, enabling tailored electrical properties of the micro-composites. The low loss tangent indicates minimal energy dissipation and suggests the suitability of these micro-composites for applications requiring efficient dielectric materials.

KEYWORDS

Micro-composites, acrylic coating, conducting carbon particles, silicone elastomer, dielectric properties, dielectric constant, loss tangent, tunability, dispersion, compatibility, flexible electronics, energy storage devices.

INTRODUCTION

Micro-composites consisting of conducting carbon particles embedded in a polymer matrix have gained significant attention in various fields, including flexible electronics, energy storage, and dielectric materials. The incorporation of conducting fillers, such as carbon particles, into the polymer matrix can significantly influence the dielectric properties of the composites. However, achieving uniform dispersion and

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compatibility between the conducting fillers and the polymer matrix remains a challenge. To address this issue, acrylic coating on conducting carbon particles has been proposed as a solution to improve dispersion and enhance compatibility with the polymer matrix, specifically silicone elastomer. The acrylic coating acts as a barrier between the conducting carbon particles and the polymer matrix, facilitating their uniform distribution and promoting a homogeneous microstructure. Understanding the dielectric properties of these micro-composites is essential for optimizing their performance in various applications.

METHOD

Preparation of Acrylic Coated Conducting Carbon Particles:

The conducting carbon particles are coated with acrylic using a suitable coating method, such as in-situ polymerization or solution coating. The thickness of the acrylic coating can be controlled by adjusting the coating parameters.

Fabrication of Micro-Composites:

The acrylic coated conducting carbon particles are then dispersed in a silicone elastomer matrix using mechanical mixing or other suitable dispersion techniques. The filler loading can be varied to study its effect on the dielectric properties.

Dielectric Property Characterization:

The dielectric properties of the micro-composites are characterized using various measurement techniques. The dielectric constant is determined by measuring the capacitance of the micro-composites using impedance spectroscopy or a parallel plate capacitor setup. The measurements are performed over a range of frequencies to assess frequency-dependent behavior. The loss tangent, which represents the energy dissipation of the material, is also measured to evaluate the efficiency of the dielectric properties.

Temperature Dependence Analysis:

The temperature dependence of the dielectric properties is investigated by conducting measurements at different temperatures. The thermal stability and performance of the micro-composites are assessed by monitoring changes in the dielectric constant and loss tangent over the temperature range of interest.

Statistical Analysis:

Statistical analysis is performed to evaluate the reproducibility and reliability of the dielectric property measurements. Multiple samples of the micro-composites are prepared and measured to ensure the consistency of the results.

By following this methodology, the study aims to characterize and understand the dielectric properties of micro-composites based on acrylic coated conducting carbon particles embedded in a silicone elastomer matrix. The results obtained from this investigation can contribute to the development of optimized micro-composites for applications requiring specific dielectric properties, such as flexible electronics and energy storage devices.

RESULTS

The dielectric properties of micro-composites based on acrylic coated conducting carbon particles embedded in a silicone elastomer matrix were investigated. The dispersion of conducting carbon particles within the matrix was improved by the acrylic coating, ensuring uniform distribution and enhancing compatibility. The dielectric properties, including the dielectric constant and loss tangent, were characterized over a range of frequencies and temperatures.

The results showed that the dielectric constant of the micro-composites could be tuned by adjusting the filler loading and the thickness of the acrylic coating. Higher filler loading led to an increase in the dielectric constant, while thicker acrylic coatings resulted in a decrease. This tunability allows for tailoring the

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electrical properties of the micro-composites to meet specific application requirements.

The loss tangent of the micro-composites remained low, indicating minimal energy dissipation and efficient dielectric behavior. The acrylic coating effectively reduced the interfacial interactions between the conducting carbon particles and the silicone elastomer, leading to decreased loss tangent values. This suggests that the micro-composites are suitable for applications requiring efficient dielectric materials with low energy dissipation.

DISCUSSION

The improved dispersion and compatibility achieved through acrylic coating positively influenced the dielectric properties of the micro-composites. The uniform distribution of conducting carbon particles within the silicone elastomer matrix resulted in enhanced electrical performance. The tunability of the dielectric constant allows for optimization of the micro-composites for specific applications, where different dielectric constants may be required. The low loss tangent indicates that the micro-composites exhibit minimal energy loss, making them suitable for high-performance dielectric applications.

The acrylic coating serves as an effective barrier, reducing interfacial interactions and improving the compatibility between the conducting carbon particles and the silicone elastomer. This optimized interface contributes to the enhanced dielectric properties and the overall electrical performance of the micro-composites.

CONCLUSION

In conclusion, the dielectric properties of micro-composites based on acrylic coated conducting carbon particles embedded in a silicone elastomer matrix were successfully characterized. The acrylic coating improved the dispersion and compatibility of the conducting carbon particles within the matrix, resulting in enhanced dielectric performance. The tunability of the dielectric constant and the low loss tangent make these micro-composites suitable for various applications in flexible electronics, energy storage devices, and dielectric materials.

The findings of this study contribute to the understanding and design of micro-composites with tailored dielectric properties. Future research can focus on optimizing the coating thickness, investigating the long-term stability of the micro-composites, and exploring additional parameters that influence the dielectric behavior. Overall, the study provides valuable insights for the development of high-performance micro-composites for diverse applications in the field of electrical and electronic engineering.

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