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DEVELOPMENT OF SILICONE POLYMER COMPOSITES WITH HYBRID BN AND SIC FILLERS FOR IMPROVED THERMAL CONDUCTIVITY

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1. ABSTRACT

The rapid evolution of electronic devices has resulted in increased heat generation, highlighting the demand for polymer composites with high thermal conductivity. However, traditional polymer composites typically exhibit low thermal conductivity at room temperature. This study enhances thermal conductivity of silicone polymer composites by adding Boron Nitride (BN) and Silicon Carbide (SiC) fillers. BN and SiC were aligned first and infiltrated with silicone together with nano-BN to further improve thermal conductivity.

2. INTRODUCTION

In recent years, electronic device development has progressed rapidly. Simultaneously, the demand for electric vehicles has surged, in response to the zero-carbon trend [1]. Consequently, electronics are evolving toward higher power density, increased integration, and miniaturisation, resulting in significant heat generation. Polymer composites with high thermal conductivity are thus gaining attention as packaging materials. However, traditional polymer composites typically exhibit low thermal conductivity at room temperature. Therefore, enhancing the thermal conductivity of polymer materials is crucial for effective heat dissipation. Both Boron nitride (BN) and silicon carbide (SiC) have excellent thermal conductivity, making them promising fillers for enhancing the properties of pure silicone [2].

3. METHDOLOGY

Firstly, BN and SiC were dispersed in ethanol, followed by the preparation of BN/SiC layer using a vacuum filtration method. The silicone and nano BN were mixed and finally impregnated into the BN/SiC layer. The thermal conductivity of the BN/SiC silicone composite was measured using the Laser Flash method by LFA 467 (Netzsch).

4. RESULTS

The resulting BN/SiC silicone polymer composite demonstrated a high thermal conductivity of 2.25 W m^{-1} K^{-1}, representing a 63% increase compared to pure silicone (1.38 W m^{-1} K^{-1}). Additionally, incorporating with

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different weight percentage (1, 3, 5wt%) of nano-BN into the silicone, the thermal diffusivity of the BN/SiC silicone composite increase from 1.004 to 1.642 mm^2/s.

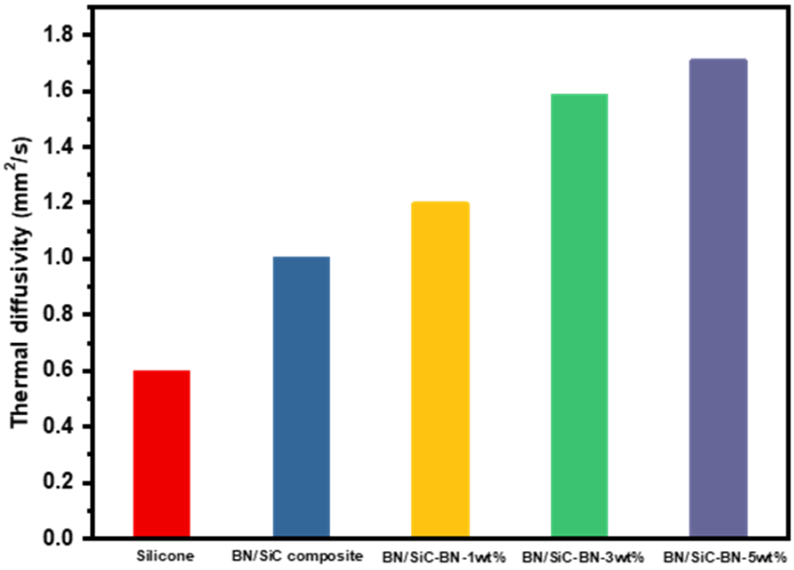

Fig. 1 Thermal diffusivity of pure silicone, BN/SiC silicone composite, BN/SiC-BN-1wt%, 3wt% and 5wt% silicone composites.

5. CONCLUSIONS

These results demonstrate the effectiveness of incorporating multiple filler materials into the silicone matrix to enhance its thermal performance. The silicone polymer composites show promise in addressing heat-related challenges in traditional electronic products.

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