THERMAL CONDUCTIVITY OF BASIC RUBBER COMPOSITE

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Abstract

The aim of the article is to find conductivity threshold for composite consists of the natural rubber filled with different amount of conductive particles

Key words: composite material, thermal conductivity

1 Introduction

Magnetic composites have application in industry as materials for "intelligent tires", magnetic memories in computers, microwave and radar technologies, magnetic refrigerators and other technical application.
Polymeric materials are inherently electrical and thermal insulators. The heat flux is due to the simultaneous diffusion of phonons and electrons. The addition of conductive additives can impart conductivity to plastics. It is well known that such a material may become conducting when the particle concentration is larger than a critical value, called the conductivity threshold. An infinite cluster is then formed allowing the electrons or phonons to flow throughout the material. However, it is still impossible to predict the actual location of the conductivity threshold.
The shape of particle plays a critical role in where percolation occurs. The more structured or elaborately shaped the particle, the more likely it is to contact a nearest neighbor and form a continuous network. But it is still very difficult to characterize the actual structure of the materials.

1.1 Material

Two-phase magnetic composite with polymeric diamagnetic matrix and ferromagnetic filler is used. Ferrite powder particle Sr ferity (particle size 1 μm $SrFe_{12}O_{19}$, Sr :Fe = 1: 11.6). Spherical shape of the particle is showed at Fig. 1 [2].

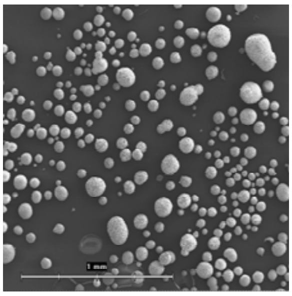
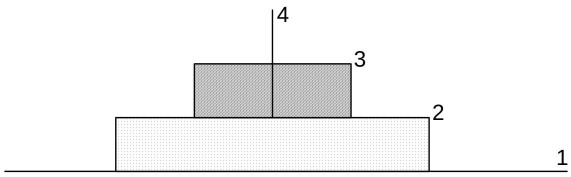


Fig 1 REM: Sr –ferrite FD 8/24

Different weight fractions of filler (20, 30, 40, 50 weight %) is used.
Close to the conductivity threshold, the theory predicts specific behaviors for the macroscopic materials properties which are often well verified by the experiment.

1.3 Method

Pulsed dynamic measurement method was applied using the device ISOMET 2104 (Applied Precision, Ltd.) with the surface probe. Samples were placed at laboratory conditions as shows figure 2.



1 polystyren, 2 sample, 3 surface probe, 4 thermo indicator

Fig 2 Sample geometry

Thermal conductivity of matrix (basic rubber) is 0.316 $W.m^{-1}.K^{-1}$. The thermal conductivity of the filler (ferrite strontium) is greater than 10 times that of polymer matrix.

2 Results

Experimental results verified assumption of percolation threshold of thermal conductivity of composite material.
There is considerable increase in thermal conductivity when the weight fraction of filler exceeded 0.2 - 0.3 weight fraction (see Fig.3.)

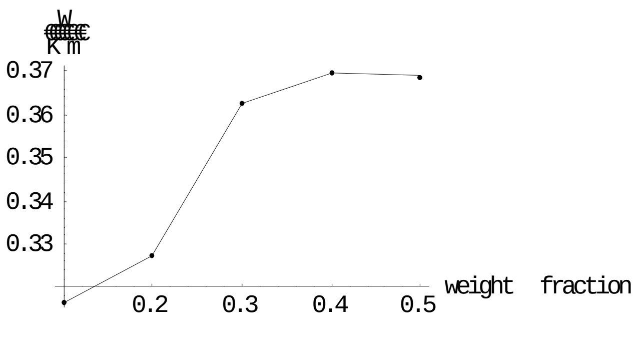


Fig 3 Thermal conductivity versus weight fraction of the filler

References

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