Enhanced Thermal Conductivity of Polyimide Films via a Hybrid of Micro- and Nano-Sized Boron Nitride

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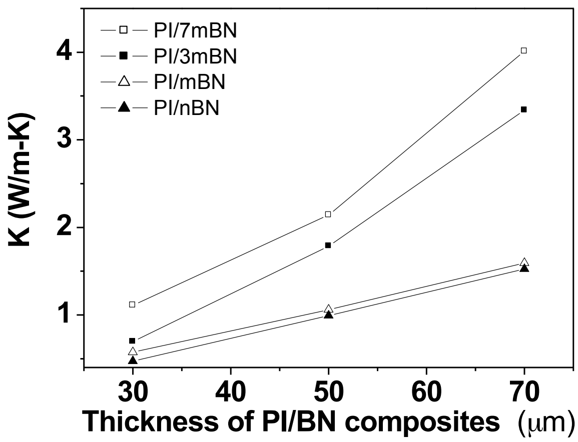
Polymer composites have versatile applications in different fields, because of their unique electrical, thermal, mechanical and optical properties. Especially, the dispersion of thermally conductive fillers in an insulating polymer matrix can result in an increase in thermal conductivity of the polymer. Owing to the demands in denser and faster circuits in electronic devices, the dissipation of heat generated in electronic components has attracted more attention and is considered as a critical issue to be resolved. To solve the heat dissipation problem, ceramic fillers, such as alumina (Al_2O_3), silica (SiO_2), silicone carbide (SiC), silicon nitride (Si_3N_4), aluminum nitride (AlN) and boron nitride (BN), were used as the thermal conductive materials embedded in a polymer matrix.[1-2] Among them, the BN with a hexagonal structure (h-BN) has the greatest potential due to its high thermal conductivity (up to 400 W/m-k) and relatively low dielectric constant (around 4),[18] compared with SiC, Si_3N_4, Al_2O_3 and AlN. However, these polymers are mostly epoxy resins, which cannot be operated at high temperatures, and thin film type thermal conductive composites are seldom discussed.

Here, we report the preparation and properties of high temperature, highly thermally conductive composite materials, containing different proportions of micro-sized and nano-sized BN particles dispersed in the polyimide (PI) matrix. The combination of micro-sized and nano-sized BN particles with an appropriate ratio gives the highest thermal conductivity. To the best of our knowledge, no one has reported this method used in polyimide films before. The surface modification of the BN fillers, and the thermal properties of the thermal conductive PI/BN composite films will be discussed.



References

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