Thermal Conductive and Mechanical Properties of Polycarbonate Polymer Composite Materials reinforced with Aluminum Oxide, Graphite and Boron Nitride

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Abstract

Efficient heat transport along through-plane direction is a primary requisites for thermal interface materials such as microelectronic products, heat sinks for batteries, electronic components, telecommunications products and cooling cell holders, vehicle charging equipment, automotive lighting and LED luminaires.

In this work, thermal conductivity and other mechanical properties of polycarbonate (PC) that reinforced with different ceramic-like materials such as hexagonal boron nitride (BN), aluminum oxide (Al2O3) and graphite were comparatively investigated with different filling ratio.

Thermally conductive polymer composites are prepared by melt mixing using the co-rotating twin screw extruder. For understanding the effects of reinforcing materials on polycarbonate composite materials, different amount of fillers were reinforced with polymer. In addition, to achieve better dispersion of thermal conductive filler materials in polycarbonate composites, polydimethylsiloxane and amino functional silane are used as a lubricant and coupling agent respectively.

Through-plane thermal conductivity of PC/Al2O3(%30) and PC/Graphite (%30) composites reaches 0.6 and 3.01 W mK–1, which are higher than 0.27 W mK–1 thermal conductive pure of PC counterparts, respectively. PC/ Al2O3 has been found to be electrically insulating while PC/Graphite composites have electrically conductive properties. However, it was also determined that by reducing the amount of Al2O3 from %30 to %15 and adding graphite up to %15, PC/ Al2O3/Graphite hybrid composites reflects increasing thermal conductivity while electrical insulation was preserved.

In addition, the best thermal conductive promising results were obtained 3.2 W mK–1 with the PC/BN (15%) composite structure and exhibiting electrical insulation.

Furthermore, it was observed that the tensile strength and Izod impact resistance from mechanical properties decreased depending on the increasing amount of filler, but the highest values for these properties were obtained with PC/BN composites which shows potential application in electronic and automotive industries.

Keywords

Thermal Conductive Polycarbonate, Combined Filler, Hexagonal Boron Nitride, Graphite, Al2O3.