

研究論文

新規扁平状フィラー含有高熱伝導性高分子複合材料の作製およびその特性

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Preparation and Characterization of Novel High Thermal Conductive Composites
Containing Flaky Fillers

by

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Abstract

Novel high-thermal-conductive composite powders were prepared from flaky filler or spherical filler, and powdered polyphenylene sulfide resin (PPS), by mechanochemical synthesis using a ball mill. As flaky filler, graphite (GR) and boron nitride (BN) were used and as spherical filler, aluminum nitrite (AN) were used. A composite sheet was also prepared by melting, mixing and extruding GR and pelletized PPS resin using a twin-screw extrusion machine. Then the powders and the sheet were molded, using a heat press machine, to obtain the molded products which were measured for various properties. As a result, it was revealed that the thermal and electrical conductivities were increased significantly with the concentration of flaky fillers. While, the coefficient of linear thermal expansion was linearly decreased with them, and the mechanical property was maintained even with the high concentration of the fillers in the case of the powder mixing and molding method. The analysis of the microstructure by scanning electron microscope (SEM) suggested entangled structure of flaky filler clusters and PPS resin.

Keywords: flaky filler, PPS resin, polymer composite, thermal conductivity, electrical conductivity, SEM analysis, mechanochemistry

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1. 緒言

パソコン・スマートフォン・自動車・大型照明機器等に用いられる電子・電気機器の高性能化、高機能化、高出力化および小型化に伴って、機器使用時の発熱対策が益々重要視されるようになり、高熱伝導・放熱材料の開発がサーマルマネジメント分野において重要な位置を占めるようになってきている。高分子材料の熱伝導率は $0.15 \sim 0.3 \text{ W/(m}\cdot\text{K)}$ 程度であり¹⁾、金属やセラミックスの熱伝導率と比べて非常に低い ($10^{-1} \sim 10^{-2}$ 程度) が、成形・加工性に優れるため、その高熱伝導化が切望されている。最近では、液晶性高分子を中心に高分子自身の高熱伝導化や、高熱伝導性フィラーを複合する高分子複合材料の基礎研究や開発が盛んに行われている²⁾。

一方、ボールミリングを用いるメカノケミカル合成技術が最近注目を集め³⁾、これは円筒容器内に材料と硬質ボー