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Poly(ether ether ketone)-based hierarchical composites for tribological applications

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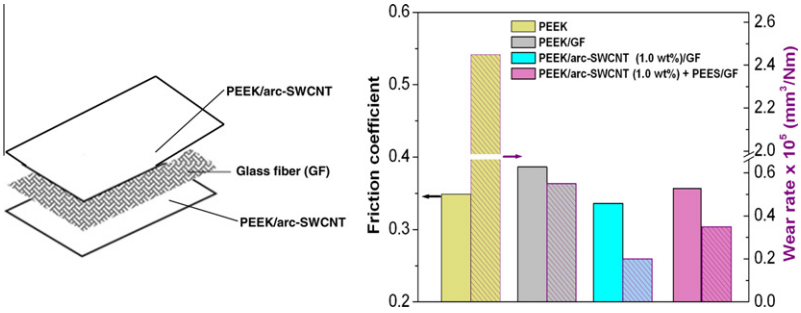
HIGHLIGHTS

- The tribological and rheological behavior of PEEK/SWCNT/GF laminates was studied.
- SWCNTs raised the viscosity, storage and loss moduli while decreased the wear rate.
- Composites with PEES as a compatibilizer showed higher viscosity and moduli values.
- Combination of both fillers led to synergistic effects on enhancing wear resistance.

GRAPHICAL ABSTRACT

PEEK/SWCNT/GF hybrid laminates were manufactured via extrusion and hot-compression. Compared to the neat matrix and binary PEEK/GF, the wear resistance was greatly enhanced.



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ABSTRACT

Poly(ether ether ketone) (PEEK)/glass fiber (GF) laminates reinforced with single-walled carbon nanotubes (SWCNTs) wrapped in poly(ether ether sulfone) (PEES) were manufactured by extrusion and hot-compression processes. The mechanical, tribological and rheological behavior of the hybrid composites and reference PEEK/SWCNT nanocomposites was analyzed. Viscoelastic measurements as a function of frequency ω revealed an increase in the complex viscosity, storage and loss moduli with the addition of the SWCNTs. Composites incorporating PEES as a compatibilizer exhibited higher moduli values and a smaller low-frequency slope of the storage modulus versus ω, indicating a more homogenous SWCNT dispersion. Moreover, they showed improved compression modulus and strength, suggesting a more effective matrix-SWCNT load transfer. The SWCNTs slightly lowered the friction coefficient of the composites while strongly decreased their wear rate. The compatibilizer reduced the lubricant effect of the SWCNTs and the heat dissipation during sliding, reflected in a smaller improvement in the tribological properties. SWCNT-reinforced laminates displayed outstanding wear behavior, attributed to their superior stiffness and strength, the lubrication capability of the SWCNTs, combined with a synergistic effect arising from the presence of the two types of fillers. The combination of conventional fibers with SWCNTs is a promising route to enhance the performance of the resulting hierarchical composites for tribological applications.

1. Introduction

Over the last decades, composites reinforced with carbon, graphite, glass or aramid fibers have been used for making tribological and structural components that encounter harsh operating conditions, such as high stresses, speeds and/or temperatures due

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