GRAPHENE FILLED PTFE COMPOSITES WITH IMPROVED WEAR RESISTANCE AND GAS BARRIER PROPERTIES

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ABSTRACT

Fluoropolymers are used extensively in the gas, oil, and nuclear industries as seals. Polytetrafluoroethylene (PTFE) is normally used as a replacement for fluoro-elastomers due to these elastomers being susceptible to explosive decompression. However, PTFE is prone to creep under load, high wear rates, and high gas permeation rates. Platelet-shaped nanofillers, like graphene, are known to reduce the creep, wear, and gas permeability when incorporated into polymer matrices. Therefore, the incorporation of graphene nanoplatelets into PTFE was investigated as to determine how the filler influenced the shortcomings of the polymer. Furthermore, graphene/PTFE composites are largely under-researched. The correct processing of the graphene/PTFE, its wear resistance and helium gas barrier properties were the focus of the study. Some of the highlights were that a guideline was established as to the correct processing of the composites, and also the improvement of the wear resistance [ultralow wear rates at 1.70×10^{-5} and 6.61×10^{-6} $mm^3/(N.m)$] and gas barrier properties (relative helium gas permeability reduction of 96%) through the incorporation of graphene nanoplatelets and oxyfluorinated graphene nanoplatelets (via oxyfluorination). These results show promise to improving PTFE seal/gasket technology.

Keywords: Graphene, PTFE, Gas barrier, wear resistance, processing and fabrication, oxyfluorination, surface modification