Surface Modification of Polytetrafluoroethylene (PTFE) Fibers Through Methyl Methacrylate (MMA) Polymerization for Self-Lubricating Composites

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Solid lubrication; Tribofilms and 3rd bodies; Friction; Interfacial bonding

ABSTRACT
Polytetrafluoroethylene (PTFE), a highly regarded solid lubrication material, exhibits excellent lubricating properties [1-4]. However, PTFE fibers exhibit strong inertia and possess restricted interfacial compatibility with resin [5-7], thereby constraining the application of PTFE self-lubricating composites. To address this issue, PTFE-g-MMA fibers were synthesized by grafting MMA onto the surface of PTFE fibers using high-energy irradiation and chemical grafting techniques, resulting in the enhancement of the tribological properties (the friction coefficient has been reduced by approximately 42.2% and the wear rate has been reduced by about 87.9%) and mechanical properties (the interlaminar shear strength (ILSS) experienced a substantial increase of approximately 45.8%) of the composites. The influence of grafting modification on the formation of PTFE transfer films and the effect of modification time on the tribological properties of composites were investigated systematically. The results indicated that graft modification disrupted the C–F bond of PTFE and promoted the formation of metal-chelated carboxylates, facilitating the formation of PTFE transfer films on the counter surface. This research could provide a general and feasible strategy for large-scale modification of PTFE fibers with exceptional comprehensive properties.

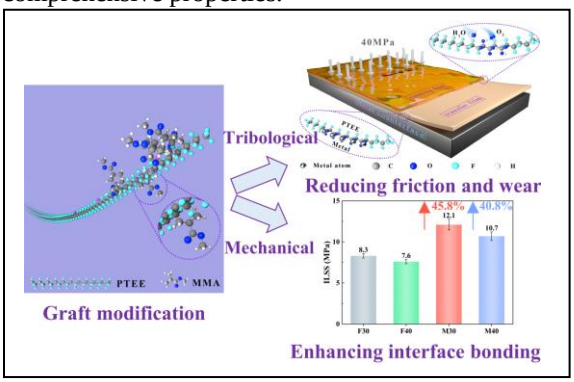

Fig.1 Graphical abstract.

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