

通过上浆技术将 TPU/PEG 渗透氮化硅纤维协同提高其耐磨性能

关键词：氮化硅纤维；浸润剂；耐磨性；热塑性聚氨酯

摘要：近年来，氮化硅纤维因其耐高温、透波性强等特点在航空航天领域被人们所关注，然而，氮化硅纤维（ Si_3N_4 Fiber）的耐磨性较差是导致预制体的成型效率低和性能差的主要原因。在此，我们以丙酮为溶剂，利用聚乙二醇（PEG）对热塑性聚氨酯（TPU）进行改性，开发了一种能够显著改善氮化硅纤维耐磨性能的上浆剂。通过上浆技术制备了氮化硅纤维@热塑性聚氨酯/聚乙二醇（Fiber@TPU/PEG），并同时制备了 Fiber@TPU 为对照组。结果表明：TPU/PEG 能够充分浸润氮化硅纤维，在纤维内外表面均匀分布，并与单丝之间形成良好的界面关系。当 PEG 浓度增加到 2.5wt% 时，Fiber@TPU/PEG-2.5% 表现出比氮化硅纤维更好的集束性、更好的耐磨性和更低的摩擦系数（降低 61.82%）以及经过摩擦后更小的性能损失率（9.74%）。因此，该方法对开发一种有效的陶瓷纤维上浆剂，提高陶瓷纤维增强复合材料的摩擦性能和机械性能具有一定的指导意义。

Abstract: Recently reported silicon nitride fibers have attracted considerable attention for aerospace applications due to their high temperature resistance and wave permeability, however, the properties of the composite material are directly determined by the properties of the prefabricated materials. The poor molding efficiency and poor performance of the prefabricated materials stem from the low wear-resisting property of silicon nitride fibers (Si_3N_4 Fiber). Herein, we developed a sizing agent capable of significantly improving the wear-resisting property of silicon nitride fibers by modifying thermoplastic polyurethane (TPU) using polyethylene glycol (PEG) with acetone as a solvent. Silicon nitride Fiber@Thermoplastic Polyurethane/Polyethylene Glycol (Fiber@TPU/PEG) was prepared by sizing technique and silicon nitride fiber with Fiber@TPU was used as a control. The results demonstrated that TPU/PEG could fully infiltrate the Si_3N_4 Fiber, evenly distributed on the inner and outer surfaces of the fiber, and formed a good interfacial relationship with the monofilament. Fiber@TPU/PEG-2.5wt% exhibited better protonema bunching than Si_3N_4 Fiber when the PEG concentration was increased to 2.5 wt%. Additionally, the wear-resisting property of Fiber@TPU/PEG-2.5wt% was observed to be greater than Si_3N_4 Fiber and the COF value of Fiber@TPU/PEG-2.5wt% was 61.82% lower than that of Si_3N_4 Fiber. Consequently, this method was promising for improving the friction and mechanical properties of ceramic fiber reinforced composites.