EXTRUDABLE COMPOSITES BASED ON POLYETHERETHERKETONE FOR ADDITIVE TECHNOLOGIES

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Polyetheretherketone (PEEK) is an engineering structural plastic that is characterized by high values of thermal resistance, strength, and melt flow index (MFI) which ensure its wide application in aerospace engineering and medicine. Also, additive manufacturing technologies might be attracted for the fabrication of complex shape items, in particular,for medical applications [1]. However, the unfilled PEEK possesses not high enough wear resistance as well as is characterized by high friction coefficient (0.3-0.4) which limits its use in friction units for mechanical engineering and orthopedics.

In order to use the filleras a solid lubricant as well,PEEK-based composites filled with carbon nanotubes (nanofibers), carbon microfibers and polytetrafluoroethyleneparticles were fabricated. Their mechanical properties and tribotechnical behavior under dry sliding friction were studied. A comparative analysis of the effectiveness of loading carbon nano- and microfillers, as well as polytetrafluoroethylenemicron size particles in formation of tribotechnical characteristics of polymer composites based on the extrudable thermoplastic matrix was carried out.

PEEK powder (F450 by Victrex), Taunit carbon nanofibers(outer Ø = 60 nm) and Tuball carbon nanotubes (Ø = 10 nm), short carbon microfibers (Ø = 10 μm, length = 80 μm, aspect ratio ~10), polytetrafluoroethyleneparticles (Ø = 14 μm) were used as fillers. Composites on the basis of PEEK were fabricated by hot compression molding at a pressure of 14 MPa and the temperature of 400°C with subsequent cooling rate of 5 C/min.

The wear resistance of composites under study at dry sliding friction was determined by the "pin-on-disk" scheme at the load of 30 N and a ring sliding velocity 0.3 m/s (according to ASTM G77). Examination of the composite's structure was carried out with the use of scanning electron microscopy, differential scanning calorimetry and IR spectroscopy.

It is shown that loading of small amount of the nanotubes/nanofibers (less than 1 wt. %) makes it possible to twiceincrease wear resistance of the PEEK-based composites. The loading of microfillers (short carbon fibers, polytetrafluoroethylene) in the content of up to 20-30 wt. % gives rise to increasing wear resistance of the PEEK-based composites three-fold while maintaining high enough melt flow index.A comparative analysis of nano- and microcomposites based on PEEK with extrudable composites based on ultrahigh-molecular matrix UHMWPE fabricated with the help of compatibilizers [2] was carried out. It is shown that the PEEK-based composites while having the high flowability are promising for additive manufacturing technologies at fabricating complex shape items for mechanical engineering and medical applications.

Acknowledgments. The work was financially supported by the Russian Federation via the Ministry of Education and Science of the Russian Federation (Agreement No. 14.604.21.0154, project identifier RFMEFI60417X0154).

References

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