

研究论文

水润滑条件下氧化锆颗粒及碳纤维共混增强聚醚醚酮复合材料的摩擦性能研究

钟莹洁, 谢光有, 孙兆松, 隋国鑫

中国科学院金属研究所--沈阳-110016

摘要: 通过熔融共混法制备了碳纤维(CF)和氧化锆颗粒(ZrO2)共混增强聚醚醚酮(PEEK)复合材料, 并对其水中的摩擦学性能进行了研究。实验结果表明, 该混杂增强复合材料在水中具有优异的摩擦学性能, 其摩擦系数随载荷的增加无明显变化, 而磨损率则随着载荷的增加而逐渐降低。该材料在水中的磨损机制主要表现为轻微的磨粒磨损和疲劳磨损, 碳纤维是复合材料耐磨性得到增强的主要原因, 其作为复合材料摩擦面表层的主要承载相, 承担了两摩擦面之间的大部分载荷, 并保护聚合物基体免于受到对磨副的严重磨损。氧化锆颗粒的加入则有效抑制了摩擦过程中碳纤维的破损与脱落, 从而使得混杂增强PEEK复合材料比单纯碳纤维增强的PEEK复合材料具有更加优异的耐磨性能。但过多颗粒的加入会加剧疲劳磨损, 从而降低材料的耐磨性。

关键词: 复合材料 聚醚醚酮 摩擦磨损 混杂增强 碳纤维 水润滑

Study on the Tribological Properties of Polyetheretherketone Composites Reinforced by ZrO2 Particles and Short Carbon Fibers under Water Lubrication

ZHONG Yingjie, XIE Guangyou, SUN Zhaosong, SUI Guoxin

Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016

Abstract: PEEK matrix composites filled with short carbon fibers (CF) and ZrO2 particles were compounded using a twin-screw extruder followed by injection molding. The tribological properties of the PEEK/CF/ZrO2 composites under the water lubrication were systematically studied. It was revealed that the hybrid composites exhibit excellent wear-resistance in the water conditions. The friction coefficients of the composites slightly changed with increasing of the applied load, while the wear rates of the hybrid composites decreased with increasing applied load. Main wear mechanism of the composites in water was mild abrasive wear and fatigue wear. The high wear resistance of the composites should be attributed to the existence of the carbon fibers: the carbon fibers carried the main load between the contact surfaces and protected the soft polymer matrix from further severe impact and abrasion of the counterpart. The incorporation of the ZrO2 particles could effectively inhibit the carbon fiber failure and debonding, which resulted in a better wear resistance property of the hybrid PEEK composites compared with sole CF reinforced PEEK composites. However, high loading of the particles would also aggravate the fatigue wear of the composites and lead to a deterioration of the wear resistance of the composites.

Keywords: composite polyetheretherketone friction and wear hybrid reinforcement carbon fiber water lubrication

收稿日期 2010-05-18 修回日期 2010-06-24 网络版发布日期 2010-12-15

DOI:

基金项目:

通讯作者: 隋国鑫

作者简介:

通讯作者E-mail: gx sui@imr.ac.cn

扩展功能

本文信息

Supporting info

PDF(971KB)

[HTML] 下载

参考文献[PDF]

参考文献

服务与反馈

把本文推荐给朋友

加入我的书架

加入引用管理器

引用本文

Email Alert

文章反馈

浏览反馈信息

本文关键词相关文章

复合材料

聚醚醚酮

摩擦磨损

混杂增强

碳纤维

水润滑

本文作者相关文章

ZHONG Yingjie

XIE Guang-you

Sun Zhaosong

GuoXin SUI

PubMed

Article by

Article by Guangyou,.X

Article by

Article by GuoXin,.S

参考文献:

- [1] JIAO Sujuan, ZHOU Hua, YANG Huayong, GONG Guofang, CHEN Jianmin, ZHOU Huidi, Tribological Behavior of Filled Polyetheretherketone Composites in Sliding against Stainless Steel under Water Lubrication, *Tribology*, 23(5), 385(2003)
(焦素娟, 周华, 杨华勇, 龚国芳, 陈建敏, 周惠娣, 填充聚醚醚酮复合材料在水润滑下的摩擦学特性研究, *摩擦学学报*, 23(5), 385(2003))
- [2] PAN Yusong, XIONG Dangsheng, Rsearch status of tribological properties of PEEK composites, *Engineering Plastics Application*, 34(2), 68(2006)
(潘育松, 熊党生, 聚醚醚酮复合材料摩擦学性能研究现状, *工程塑料应用*, 34(2), 68(2006))
- [3] ZHANG Zhiyi, ZHANG Mingqiu, ZENG Hanmin, LIU Zhengrang, On the tribological behaviour and mechanism of poly(ether ether ketone), *Acta Materiae Compositae Sinica*, 12(4), 49(1995)
(张志毅, 章明秋, 曾汉民, 刘正让, 聚醚醚酮摩擦磨损行为和机理的研究, *复合材料学报*, 12(4), 49(1995))
- [4] R.Prehn, F.Hauptert, K.Friedrich, Sliding wear performance of polymer composites under abrasive and water lubricated conditions for pump applications, *Wear*, 259, 693(2005) [crossref](#)
- [5] Y.Yamamoto, T.Takashima, Friction and wear of water lubricated PEEK and PPS sliding contacts, *Wear*, 253, 820(2002) [crossref](#)
- [6] Y.Yamamoto, M.Hashimoto, Friction and wear of water lubricated PEEK and PPS sliding contacts-Part 2. Composites with carbon or glass fibre, *Wear*, 257, 181(2004) [crossref](#)
- [7] H.Unal, A.Mimaroglu, Friction and wear characteristics of PEEK and its composite under water lubrication, *Journal of Reinforced Plastics and Composites*, 25, 1659(2006) [crossref](#)
- [8] J.P.Davim, N.Marques, A.M.Baptista, Effect of carbon fibre reinforcement in the frictional behaviour of Peek in a water lubricated environment, *Wear*, 251, 1100(2001) [crossref](#)
- [9] L.Chang, Z.Zhang, C.Breidt, K.Friedrich, Tribological properties of epoxy nanocomposites-I. Enhancement of the wear resistance by nano-TiO₂ particles, *Wear*, 258, 141(2005) [crossref](#)
- [10] L.Chang, Z.Zhang, Tribological properties of epoxy nanocomposites-Part II. A combinative effect of short carbon fibre with nano-TiO₂, *Wear*, 260, 869(2006) [crossref](#)
- [11] L.Chang, Z.Zhang, L.Ye, K.Friedrich, Tribological properties of high temperature resistant polymer composites with fine particles, *Tribology International*, 40, 1170(2007) [crossref](#)
- [12] G.Zhang, L.Chang, A.K.Schlarb, The roles of nano-SiO₂ particles on the tribological behavior of short carbon fiber reinforced PEEK, *Composites Science and Technology*, 69, 1029(2009) [crossref](#)
- [13] J.X.Wang, M.Y.Gu, Wear properties and mechanisms of nylon and carbon-fiber-reinforced nylon in dry and wet conditions, *Journal of Applied Polymer Science*, 93, 789(2004) [crossref](#)
- [14] A.Borruto, G.Crivellone, F.Marani, Influence of surface wettability on friction and wear tests, *Wear*, 222, 57(1998) [crossref](#)
- [15] J.Jia, J.Chen, H.Zhou, L.Hu, Comparative study on tribological behaviors of polyetheretherketone composite reinforced with carbon fiber and polytetrafluoroethylene under water-lubricated and dry-sliding against stainless steel, *Tribology Letters*, 17, 231(2004) [crossref](#)
- [16] Z.Y.Jiang, L.A.Gyurova, A.K.Schlarb, K.Friedrich, Z.Zhang, Study on friction and wear behavior of polyphenylene sulfide composites reinforced by short carbon fibers and sub-micro TiO₂ particles, *Composites Science and Technology*, 68, 734(2008) [crossref](#)

本刊中的类似文章

1. 孙守金;张名大.镀Cu-Ni的碳纤维及其复合材料[J]. *材料研究学报*, 1990,26(6): 132-136
2. 夏振海;毛志英;周尧和.液态金属浸渗动力学模型及其应用[J]. *材料研究学报*, 1991,27(6): 138-144
3. 陈新国;郑国斌;沈祖洪;杜海峰.SiC涂层碳纤维增强铝复合丝的机械性能及其界面特性[J]. *材料研究学报*, 1992,28(4): 83-88
4. 陈新国;沈祖洪;郑国斌.K₂ZrF₆助浸SiC涂层碳纤维增强Al复合材料的研究[J]. *材料研究学报*, 1993,29(8): 91-96
5. 王玉庆;郑久红;王作明;周本濂;周龙江;张凤秋.碳纤维表面涂覆SiC层及其用于制备CF/Al复合材料[J]. *材料研究学报*, 1994,30(16): 194-198
6. 凤仪;应美芳;魏光霞;张晓君;王成福.碳纤维不同分布的C_F/Cu复合材料的热膨胀系数[J]. *材料研究学报*, 1994,30(21): 432-434
7. 李润民;贺福.气相处理对碳纤维表面及其复合材料性能的影响[J]. *材料研究学报*, 1993,7(2): 173-178
8. 张跃;职任涛;朱逢吾;肖纪美.碳纤维(LCF)-无宏观缺陷(MDF)水泥基复合材料电学性能的研究[J]. *材料研究学*

报, 1992,6(4): 357-362

9. 林光明;曾汉民;章明秋;张力.短碳纤维增强热塑性树脂的断裂性能[J].材料研究学报, 1992,6(2): 175-179

10. 林广新;林永渭;吴叙勤;诸培南;张元民.碳纤维增强可切削金云母微晶玻璃复合材料的制备及其特性[J].材料研究学报, 1991,5(4): 358-361

Copyright by 材料研究学报