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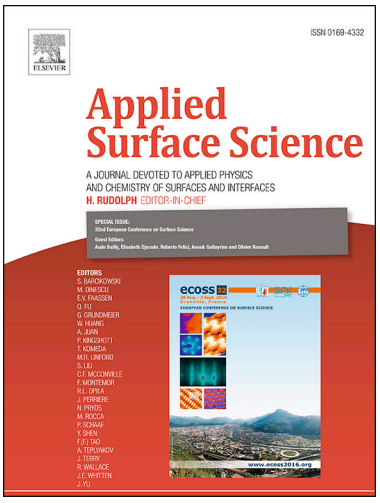

Full Length Article

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Improving the wear and corrosion resistance of CoCrMo-UHMWPE articulating surfaces in the presence of an electrolyte

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Abstract

Metal-polymer articulating pairs are common in engineering applications. The present study aims at improving the wear resistance of the polymeric part and the wear-corrosion resistance of the metallic part in the CoCrMo-UHMWPE (ultrahigh-molecular-weight polyethylene) pair. To achieve this end, magnesia-stabilized zirconia coating was fabricated on CoCrMo alloy via a sol-gel route while multi-layer graphene flakes (G) were incorporated in the UHMWPE matrix. Results of the linear reciprocating wear test between the articulating members in bovine serum at 37 °C for 10^6 cycles show significant improvement in tribological behavior of UHMWPE and in corrosion resistance of CoCrMo under abrasive wear. The coefficient of friction and wear mass loss were both reduced to about one half as compared with those between the untreated members. The improvement in wear resistance could be attributed to the presence of graphene in the UHMWPE matrix, which acted as a reservoir of solid lubricant. Electrochemical impedance spectroscopy (EIS) measurements before and during the wear test showed significantly higher corrosion resistance of CoCrMo-ZrO_2 (about 19.5 times) as compared with bare CoCrMo, attributable to the hard and inert ZrO_2 coating. The present work demonstrates a rational materials design for improving the wear and corrosion performance of the CoCrMo-UHMWPE articulating pair.

Keywords: CoCrMo; Sol-gel ZrO_2; UHMWPE; Graphene; Sliding wear; Corrosion