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Probing the lubrication mechanism of rough Diamond-like carbon films against silicon nitride under water

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Abstract

Water-based lubrication is a very important technology involving many significant water-based applications. However, optimizing the tribological performance of these machines modified with Diamond-like carbon (DLC) films under water is a dramatic challenge. In this present work, we reported that DLC films with rough surface as a lubricant layer sliding against silicon nitride balls showed very low friction (~0.06), low wear rate ($9.5\times10^{-17}m^{-3}N^{-1}mm^{-1}$) and very long wear life (>20,000 cycles) under water. Moreover, we demonstrated that the excellent tribological properties were attributed to the boundary lubrication of the protective lubricating film generated by the tribochemical reaction. This investigation has significant implications for practical water-based applications.

Keywords: Rough DLC films; Silicon nitride; Friction and wear; Boundary lubrication