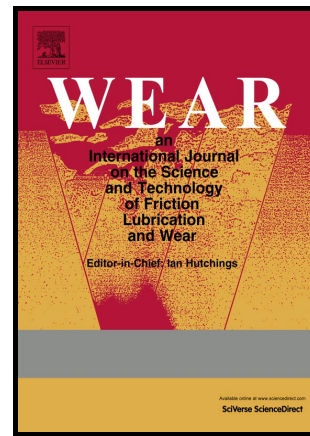


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Reduction in Friction and Wear of Alumina Surfaces as Assisted with Surface-Adsorbing Polymers in Aqueous Solutions

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Abstract

We have investigated the aqueous lubricating effects of various polymers for the sliding contacts of self-mated alumina surfaces in neutral aqueous environment. Given that isoelectric point (IEP) of alumina is ca. pH 9, polyanions can readily adsorb onto alumina surface at neutral pH via electrostatic attraction and form a protective layer. For example, polyacrylic acid (PAA) showed a reduction in coefficient of friction by ca. 28% and wear rate by 50% at a concentration of 10 mg/mL in PBS solution compared to polymer-free buffer solution. This effect was comparable to reported lubricating effects at moderately acidic and or alkaline pH conditions via electrostatic repulsion between opposing bare alumina surfaces. Interestingly, polycations, such as (polyallylamine hydrochloride) (PAH) or branched poly(ethylene imine) (b-PEI) have also shown effective surface adsorption and lubrication at neutral pH, when phosphates (HPO_4^{2-}) are present to mediate the bonding between polycations and positively charged alumina. The present study thus provides various routes to lubricate alumina surfaces in aqueous environment by means of surface adsorbing polymeric additives without shifting from neutral pH.

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