ADSORBED FILM STRUCTURE OF AQUEOUS COPOLYMER LUBRICANTS CONFINED BETWEEN HYDRATED AND UNHYDRATED TiO_2 SURFACES

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Triblock copolymers; aqueous lubricants; thin film lubrication

ABSTRACT

Hydrocarbon based lubricants have demonstrated an impressive tribological performance in rolling. However, their surface cleanliness is poor due to lubricant residues remaining on the strip surface after rolling process. Aqueous copolymer lubricant has been a new potential lubricant that replaces oil emulsion. This lubricant has been used widely in metalworking operations as it satisfies the product surface quality, environmental and economic requirements. Many experimental studies have shown that the lubrication and antiwear properties could be significantly improved by introducing triblock copolymers to aqueous solution [1-3]. The adsorbed film structure on metal/metal oxide surface observed from experiment has driven an effort to study the behavior of triblock copolymers under confided condition.

Molecular dynamics (MD) simulation has been carried out to investigate the adsorbed film structure at atomic scale. The obtained theoretical results show that the PPO segments anchor onto T_iO_2 surface whilst the hydrophilic PEO segments extend away from the surface. The influence of surface property is also considered by including hydroxyl (OH) terminal group caped on T_iO_2 surface. The presence of OH group on the surface has resulted in a change in molecular structure of adsorbed film of copolymer in a manner that a weaker adsorption of PPO segments has been found. Additionally, at 2% of copolymer in aqueous solution, a buoy–anchor–buoy molecular structure has been observed for normal Pluronic (L62 and L64), whilst an anchor–buoy–anchor is found for reverse Pluronic (17R2, 17R4, and 25R2). At higher concentration (16%), a protective adsorbed film of copolymer has been observed on T_iO_2 surface, which is validated by experimental study by Lin et al. [1]. This adsorbed film has improved the tribological performance of tribo-system. Furthermore, the friction level is comparable with oil emulsion lubricants.

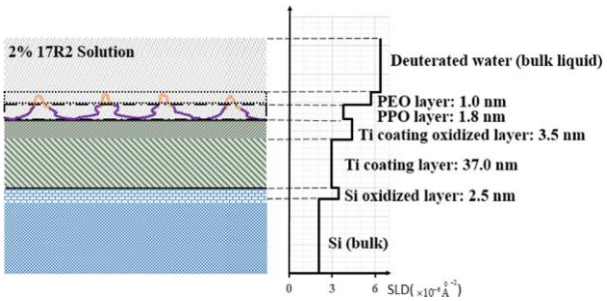

Figure 1 Adsorbed17R2 film thickness proposed adsorption model by Lin et al. [1].

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