TRIBOFILM PRINTING OF ZDDP AND APTES USING SLIDING CONTACTS

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ABSTRACT

The tribo-chemical reactions at the sliding interfaces have proposed an alternative perspective of tribology that can be used in new applications such as electromechanical systems. The single asperity contacts using Atomic Force Microscopy (AFM) were used to print 3d tribofilm [1]. However, the complexity, time, and cost are the drawbacks of the AFM tribofilm printing method. Therefore, the focus of this study will be on using multi-asperities sliding contacts to print tribofilm. This provides an interesting notion of employing tribology to create film for micro/nanoelectromechanical systems (MEMS/NEMS), through tribo-chemical process.

In this work, the printing of films over steel substrates using the ball-on-disc tribometer (MTM) was demonstrated. Two different tribo-printable materials were used i.e. Zinc Dialkyl Dithiophosphate (ZDDP) and 3-Aminopropyl triethoxysilane (APTES). Different test conditions were conducted to print tribofilm on a steel surface avoiding surface damage. The results confirmed the ability to print thick tribofilm using both materials on steel surfaces. The Energy Dispersive X-Ray (EDX) analysis revealed the formation of ZDDP and APTES tribofilms on the substrate. The Transmission Electron Microscopy (TEM) cross-section technique identified the tribofilm thickness. The film thickness of APTES reached up to 300 nm compared to 100 nm of ZDDP tribofilm without damaging the contact surface. The AFM analysis analysed the conductivity of the APTES tribofilm (Fig 1) compared to the ZDDP tribofilm which is non-conductive.

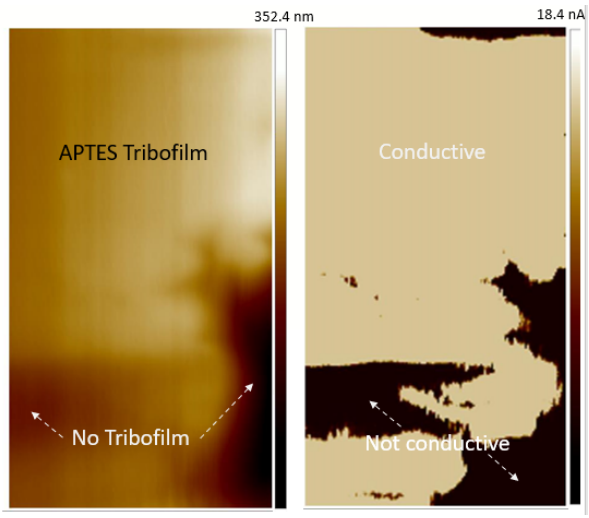

Fig.1 APTES printed tribofilm

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