

EVALUATION OF IONIC LIQUIDS AND NANOPARTICLES FOR NANOSCALE FILM FABRICATION HARNESSING TRIBOCHEMISTRY

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ABSTRACT

3D tribo-nanoprinting methodology by harnessing tribochemistry reactions opened unprecedented future possibilities to utilize the printed nanofilms for the expanding fields of microelectronics, medical devices, flexible electronics and sensor technologies [1]. To explore more tribochemistry reactions for tribo-nanoprinting, Trihexyltetradecylphosphonium bis(2-ethylhexyl) phosphate ([P_{6,6,6,14}][DEHP]) ionic liquid (IL), WS, CuO, BN, Al₂O₃ and TiO₂ nanoparticles (NPs) were dispersed in a carrier fluid (PAO8) respectively to create robust tribofilm so as to form nano-features on microelectronics device. The morphology and the composition of the tribofilm generated under the same working conditions were evaluated.

To characterize the tribofilm distribution and thickness, a new method utilizing Conductive Atomic Force Microscopy (CAFM) was developed. The experimental results obtained after sliding an EN31 steel pin on an EN31 steel plate at an applied contact pressure of 1.6 GPa indicate that tribofilms can be generated for both nanoparticle additives and ionic liquids. However, compared with pure PAO, only [P_{6,6,6,14}][DEHP] IL demonstrated an enhancement in tribofilm generation among all the tested formulations. The paper will discuss the tribofilm generation mechanisms considering each additive in detail, to lead a step forward for the use of those additives on 3D tribo-nanoprinting for the manufacture of high-precision electronics.

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REFERENCES

[1] Dorgham, A., et al., 3D tribo-nanoprinting using triboreactive materials. *Nanotechnology*, 2019. 30(9): p. 095302.