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Enhanced Nanotribology and Optimal Self-lubrication in Novel Polymer-Metal Composites ALISHA SEAM, WITOLD BROSTOW, OSCAR OLEA-MEJIA, University of North Texas — Cheaper to produce, light-weight polymeric materials with improved micro and nano-scale tribological characteristics ar gradually replacing the heavier metals in gears, cams, ball-bearings, chains, and other critical machine components which operate under high stress, experience substantial sliding friction and wear, and require external lubrication regimes. Application of such high-performance synthetic materials in a whole range of machinery, manufacturing, aerospace and transportation industries would produce far reaching economic, energy conservation and environmental benefits. This paper devises and investigates a novel and previously untested method of developing self-lubricating and wear-resistant polymer based materials (PBMs) by blending a polymer with small proportions of a metallic additive. Tribological experiments establish that as increasing proportions of the metallic additive Iron (Fe) are added to the polymeric base polyethylene (PE), the friction and wear of the resulting composite (PE-Fe) experiences significant decline until an optimal value of 3 to 5 % Iron and then stabilize. Theoretical analysis reveals this phenomenon to likely be a result of the nano-structural formation of a lubricating oxide layer on surface of the polymer-metal composite. Furthermore, the oxide layer prevented significant degradation of the viscoelastic scratch-recovery of the base polymer, even with 10 percent metal additive (Fe) in the composite samples.

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