
Coatings that manufacture themselves: Formation and performance of protective coatings in situ via tribosintering

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Abstract

Metal oxides powders typically require temperatures $> 1000^\circ\text{C}$ to coalesce into dense solids. Remarkably, metal oxide nanocrystals, including ZrO_2 and TiO_2 , when dispersed in lubricants can sinter at room temperature due to tribological stresses (compression and frictional shear) in a process known as tribosintering. In this process, the nanoparticles forming solid, surface-bound films that we call tribocoatings. We show that such tribocoatings prevent wear and other common tribological failure mechanisms under a wide range of harsh conditions, rendering this approach promising for applications where harsh mechanical conditions are present. The competition between growth and wear (removal) mechanisms will be discussed, including the role of debris generation vs. gradual atomic scale wear, which appears to play a role in determining the overall tribocoating formation kinetics.

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