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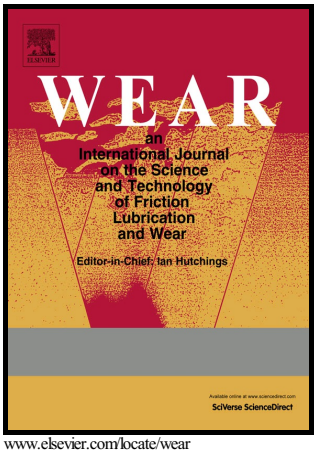

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Wear damage and effects of graphene-based lubricants/coatings during linear reciprocating sliding wear at high contact pressure

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Abstract

The present study reports on the 'wear damages' caused at inner surfaces (and sub-surfaces) of extruded zircaloy-4 tube specimens (as half cylinders) during interactive linear reciprocatory sliding against outer surfaces of D2 steel half cylinders for different durations (up to 120 s) at high contact pressures (of ~1 GPa) in the absence/presence of mineral oil lubricant (having chlorinated extreme pressure additives) and graphene-based lubricants/coatings [*viz.*, CVD-grown films of well-ordered few layers graphene (~7 layers) and thicker graphite (~1400 layers)]. The tests were conducted using a custom-made friction-and-wear tester, which also replicates the conditions (in terms of contact geometry, pressure, stroke length and frequency) relevant to the tribological phenomena occurring at inner walls of tubes subjected to cold pilgering process. Even though none of the lubricants/coatings had any effect on coefficient of friction, presumably because of 'boundary lubrication' at such high contact pressures, only the graphene-based lubricants/coatings slowed down the evolution of surface roughness and wear damage. Observations of worn (top)surfaces and cross-sections indicate that 'wear damages' at such contact pressures are primarily caused by severe sub-surface deformation and defect/crack initiation/propagation, followed by lateral chipping/delamination; which could be suppressed by the graphene-based lubricants/coatings (but not by the oil-based lubricant).

Keywords: high contact pressure tribology, cold pilgering, lubrication, graphene-based lubricants, wear

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