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DISCUSSION

D. Godfrey[2]

I support the authors' deduction that there is no abrasion in fretting wear. In microscopic observation of fretting action between transparent materials and steel and studies of metal-metal fretting scars, I have never observed abrasion as evidenced by a furrow cut by a particle or an agglomerate of particles. In the case of steel, αFe_2O_3 appears to be sheared off the surface and smeared about in the apparent area of contact. In advanced unlubricated fretting of steel, the metal surfaces appear to be completely separated by thick films of oxide.

However, there are two questions about the absence of abrasion that the authors might discuss. Archard's wear equation is based on metal-to-metal adhesion. If there is no metal-to-metal contact due to thick oxide deposits, why does the equation apply? In lubricated fretting wear, the scars are usually brightly polished metal. Also under the αFe_2O_3 in unlubricated fretting the metal is locally polished. Now polishing is commonly thought of as a process of abrasion by small, hard cutting particles. How would the authors account for observed polishing during fretting without abrasion?

Authors' Closure

Dr. Godfrey's comments are clearly relevant. We suspect that Archard's k value of 10^{-4} observed in our fretting tests is basically the characteristic k value for all sliding metals generating oxide particles, while sliding metals generating metal wear particles typically give k values of 10^{-3} or above. Some metal combinations sliding in air (for example low carbon steel against low carbon steel) seem to have two possible wear modes, generating either metal particles or oxide particles. In fretting, only the latter wear mode is encountered.

The polishing phenomenon encountered in fretting may in some cases be produced by fine oxide wear debris. In other cases, it is likely that burnishing, namely material removed on a molecular scale in the absence of abrasive particles, is occurring. Burnishing, of course, can also be produced under ordinary sliding conditions, but Dr. Godfrey's suggestion, that burnishing occurs especially readily under fretting conditions, is worth pursuing.

[2] Chevron Research Co., Richmond, Calif.