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# Role of Third Bodies in Friction and Wear of Coatings

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Friction is usually treated as a two-body problem, in which the two counterfaces move against each other and a "magical" parameter – the friction coefficient – comes into being. Not so. At some scale, from an atomically-thin surface film to a microns-thick chunk of wear debris, third bodies play an important role in friction. Third bodies are usually born in the sliding contact and often grow up to be wear particles. They might come about because the tribologist intended to lubricate one or both counterfaces, or they might arise simply from atmospheric gases. Either way, they play an important role in friction and wear, a role often overlooked in studies of friction and wear found in the literature.

Third body studies have generally emphasized the kinematics and mechanics, the "where" and "how" of velocity accommodation. These processes include surface deformation and particle detachment, third-body formation and circulation, and particle ejection. Our *ex situ* third-body studies have focused on "what" third bodies are produced during sliding in concentrated contacts and "how" they form. We have relied on surface analytical techniques (AES, XPS, Raman, IR, XRD, SEM, TEM, EDX, interferometry and profilometry) to identify composition, structure and thickness of films (1-1000nm) and particles (0.1-100 microns).

This talk will describe recent studies using a new tribometer that lets us focus directly on the contact itself. This *in situ* Raman tribometer allows us (1) to watch third bodies form, break up and move in and out of the contact and (2) to chemically analyze the sliding interface using micro-Raman spectroscopy. Three studies will be presented: one on friction and interface chemistry of $B_2O_3$+C coatings in moist air; a second on effects of moisture on the transfer film and friction of a Pb-alloyed $MoS_x$ coating; and a third on transfer film formation and friction stability of a DLC coating.

**Point of Contact:**



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