An analytical wear model for particles generation during dry sliding

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Abstract

Recent research has shown that when two solid surfaces slide against each other, debris can form if the junction between two protruding microscopic regions on the mating surfaces exceeds a certain critical size. By combining the concept of critical junction size with the Greenwood-Williamson contact model for rough surfaces, we can analytically express the Archard wear coefficient. This model also allows us to predict the size distribution of the wear particles generated during the sliding process. To validate the proposed model, the predicted particle size distributions were compared with experimental data obtained from alumina/alumina dry abrasion at different normal loads. The aerosol particles generated by abrasion have a multimode distribution with three main modes centred at around 80 nm, 165 nm and 1050 nm. With increasing normal load, the third mode became dominating. We found good agreement between the measured and calculated wear volumes and coefficients. Further insight into the mechanisms of nanometric debris generation was made through structural analysis using TEM, SEM and electron diffraction.

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