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A micromechanics investigation of sliding wear in coated components

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Abstract

In this work, the wear behaviour of coated components subjected to sliding contact conditions is investigated using a multiscale micromechanics approach. Periodic unit–cell–type continuum mechanics models are used to predict localized deformation patterns at the scale of the coating thickness (mesoscale) and the rate of material removal due to repeated sliding contact. To that purpose, realistic contact loads determined at the component level (macroscale) are applied at the mesoscopic level. The results indicate that the deformation of the coating is controlled by the cyclic accumulation of plastic deformation, or ratchetting, at the coating subsurface. Based on a ratchetting failure criterion, a wear equation is proposed and applied to investigate parametrically the influence of the principal material, loading and surface roughness parameters on the wear rate. The results reveal that the wear rate increases with contact pressure and depends on coating thickness and the roughness of the counterpart surface. It was also found that a reduction in the friction coefficient and an increase in the coating strain hardening behaviour can considerably improve the wear resistance of coated components.

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