# Adhesive wear law at the asperity level: Did Archard get it right ?

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Macroscopic wear experiments suggest an empirical linear relation between the wear and the product of the load and sliding distance. Recent asperity-level wear experiments and simulations reported a breakdown of this relation, posing a fundamental question: Is the macroscopic wear relation recoverable at the asperity level? Here we show that discrepant observations of wear relations can be reconciled into a unified framework. Using systematic long-timescale coarse-grained molecular dynamic wear simulations, we show that a linear wear behavior can be recovered at the asperity level, only if plastic deformation (by dislocation activity or amorphization) dominates material detachment from the asperity tip, validating the longstanding Archard's theoretical hypothesis. The deviation from the linear wear relation is a direct result of atomic cluster detachment and/or fracture induced material removal at the asperity tip.

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