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<u>**PROCEEDINGS**</u>

A Phase Field Model for Spalling Failure Due to Rolling Contact Fatigue

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ABSTRACT

Rolling element bearings are critical components in modern industrial machinery, with rolling contact fatigue (RCF) emerging as the predominant failure mode even under optimal installation, lubrication, and maintenance conditions [1–5]. In the paper, a phase field model coupling plasticity and fatigue is developed to investigate spalling behavior under RCF loading. Fatigue crack nucleation, propagation, and bifurcation can be effectively predicted using the phase field model based on theories of energy minimization [6–8]. A numerical framework is established by using the finite element method with an explicit integration scheme. The subsurface initiated spalling, the crack evolution, and the RCF lifetime are analyzed. The spalling patterns and the evolution of contact pressure and shear stress are revealed, along with the influence of fracture toughness and the microvoids on RCF behavior. The results indicate that materials with higher fracture toughness yield longer RCF lifetime. Additionally, microvoids near the subsurface region of high stress significantly reduce the material's RCF lifetime due to localized stress concentration. The results may provide insights into the mechanisms of subsurface spalling failure, offering a reliable numerical framework for predicting RCF performance.

KEYWORDS

Phase field; rolling contact fatigue; spalling failure; microvoids; explicit integration

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