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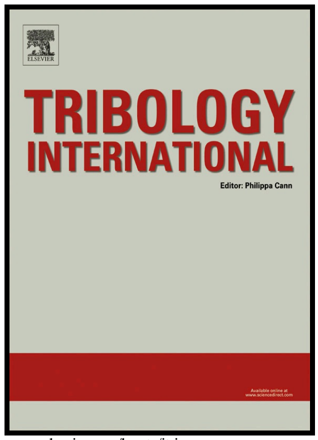

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Fretting wear rate impact on Ti-6Al-4V fretting crack risk: experimental and numerical comparison between cylinder/plane and punch/plane contact geometries

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Abstract

Fretting can lead to surface wear and/or crack nucleation depending on the sliding condition and contact geometry. To formalize this aspect, Ti-6Al-4V cylinder/plane and punch/plane contacts were investigated. The experimental crack nucleation domains in partial and gross slip conditions were established and simulated combining SWT cumulative damage analysis with FEM surface wear simulations. Good correlations were achieved if the experimental boundary conditions including system tangential accommodation and micro-rotations measured using DIC analysis, were considered. Fretting maps were simulated by predicting partial slip and gross slip displacement amplitudes above which cracks were respectively nucleated and removed by surface wear. Finally, it was shown that whatever the contact geometry, the gross slip cracking domain was inversely proportional to the surface wear rate.

Keywords: Ti-6Al-4V; fretting wear; fretting crack nucleation; FEM simulation.

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Nomenclature

b: Semi-inner flat surface for punch configuration (mm)

b_{cn}: Projected crack nucleation length related to the crack nucleation condition (µm)

e1: Thickness of SAP1 for both cylinder and punch (mm)

e2A/B: Thickness of respectively SAP2,A and SAP2,B (mm)

E_d: Dissipated energy by fretting loop (J)

$D_{1111(SAP2\_B)}$: Direction 1 component of material stiffness matrix of SAP2,B (MPa)

$D_{1212(SAP1)}$: Shear (12) component of material stiffness matrix of SAP1 (MPa)

$D_{2222(SAP2\_A)}$: Direction 2 component of material stiffness matrix of SAP2,A (MPa)

$D_{(i)}^{IP}$: Cumulative damage at integration points during the i^{th} numerical fretting cycle

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