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Yield Surface Evolution of Ti-Cu Bimetal under Complex Loading for Multifunctional Engineering Components

Ewolucja powierzchni plastyczności bimetalu Ti-Cu pod złożonym obciążeniem dla wielofunkcyjnych komponentów inżynierskich

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Bimetallic materials have attracted considerable attention for thermostructural and energy-related applications due to their ability to combine complementary material properties within a single structure. Ti-Cu bimetal combines the high mechanical strength and corrosion resistance of titanium with the excellent thermal and electrical conductivity of copper. However, the mismatch in the mechanical response of both constituents may generate complex multiaxial stress states during service. In this work, the initial yield surface and its evolution in a Ti-Cu bimetal were experimentally investigated under proportional axial-shear loading. The yield surfaces were determined in the axial stress-shear stress space from experimental yield points at 0.01% plastic offset strain using sequential biaxial probing paths and fitted with the Szczepiński anisotropic yield criterion.

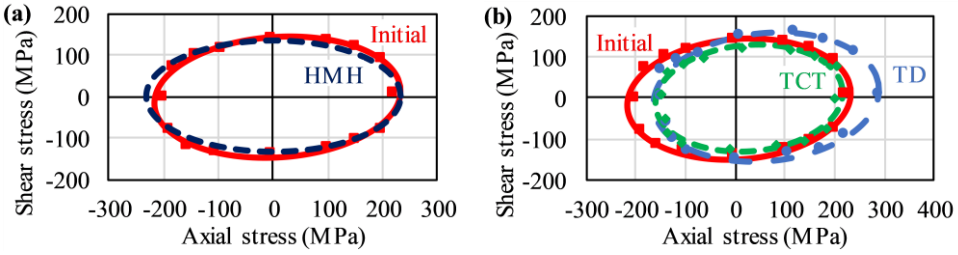

Fig. 1. Initial yield surface (a) of Ti-Cu bimetal and its evolution reflecting pre-deformation (b).

The initial yield locus was found to be close to the Huber-von Mises-Hencky (HMH) isotropic yield surface, although noticeable tension-compression asymmetry and initial anisotropy were observed. Monotonic tensile pre-deformation (TD) resulted in kinematic hardening, whereas combined tension-cyclic torsion (TCT) pre-deformation produced pronounced anisotropic softening and reduction of the yield surface dimensions, particularly in the compressive and shear directions. EBSD and microstructural analyses revealed that the yield surface evolution strongly depended on the deformation mode and interface-driven texture evolution.

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