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PRE-STRAIN EFFECTS ON YIELD SURFACE AND TEXTURE EVOLUTION IN Ti-Cu BIMETAL

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Bimetallic structures are widely employed in advanced engineering applications due to their ability to combine dissimilar material properties while maintaining cost efficiency. Understanding their deformation mechanisms under complex multiaxial loading is essential for designing reliable structural components. In particular, the characterization of the initial yield surface and its subsequent evolution under different pre-deformation paths is critical to capture the anisotropy, hardening, and softening effects that occur during service conditions [1].

This study investigates the yield surface and texture evolution of Ti–Cu bimetal subjected to controlled monotonic tension and combined tension–cyclic torsion pre-deformation. Yield points were determined using the offset strain method at 0.01% plastic strain, and subsequent yield surfaces were measured following up to 1% permanent axial strain. The initial yield surface was found to closely approximate the isotropic Huber–von Mises–Hencky criterion, confirming the nearly isotropic behavior of the as-received state. However, upon pre-deformation, distinct changes were observed as shown in Figure 1: monotonic tension enhanced the tensile yield strength, while combined tension–torsion loading led to softening. In the axial compression direction, subsequent yield surfaces contracted in size, indicating directional degradation of strength.

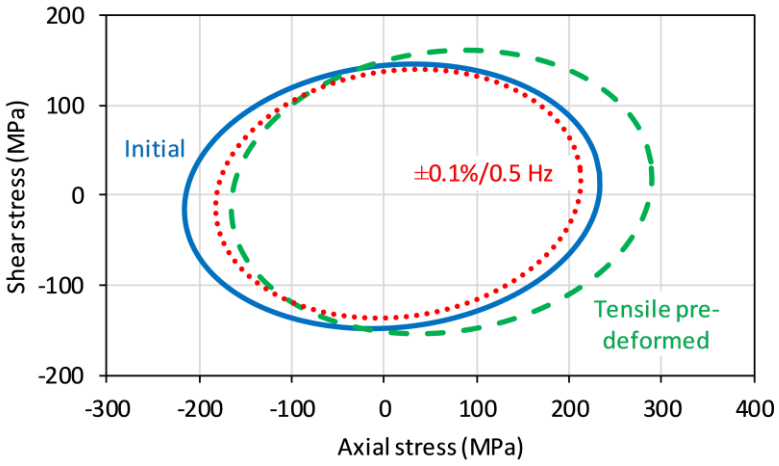

Figure 1. *Evolution of the initial yield surface of Ti-Cu bimetal due to pre-deformation caused by monotonic tension and monotonic tension assisted by cyclic torsion with strain amplitude of ±0.1% and at frequency value equal to 0.5 Hz, respectively.*

Microstructural analyses revealed that shear strain magnitude strongly influenced the activation of slip systems and texture development, particularly in copper, while titanium exhibited more stable grain orientations. These findings highlight that even small pre-deformations can substantially alter yield loci, microstructure, and crystallographic texture in bimetallic systems. Such knowledge supports the development of more accurate constitutive models for functionally graded multi-material systems and guides their application in aerospace, automotive, and structural engineering.

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References

[1] V.P. Dubey, M. Kopec, M. Łazińska and Z.L. Kowalewski (2023). Yield surface identification of CP-Ti and its evolution reflecting pre-deformation under complex loading. Int. J. Plast., 167, 103677.