An Experimental Investigation of Initial and Subsequent Yield Surfaces of Ti-Cu Bimetallic Structure Under Complex Loadings

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Advanced composite materials, such as bimetallic structures formed from two dissimilar constituent materials, offer unique properties ideal for high-tech applications, including aerospace, automobiles, and biomedicine [1]. Conventional mechanical tests conducted under simple stress conditions fail to replicate the real-world engineering applications. Relying solely on the uniaxial testing methods provides only limited results, that are not sufficient to capture all aspects of materials like texture or anisotropy introduced during manufacturing [2]. In this work, an experimental and theoretical investigations are presented to discover the physical mechanisms behind the plastic deformation in titanium-copper bimetal subjected to complex mechanical loading, employing the yield surface method. The complex loadings were executed by the simultaneous application of uniaxial tension with cyclic torsion.

The material characteristics of bi-metal (Ti-Cu) showed a decrease of the yield point under these loading conditions, Figure 1. Yield surfaces were determined through sequential probes along 17 strain-controlled paths in the plane stress state. The material exhibited slight anisotropic behaviour in the as-received state for the plastic offset strain defined. Such anisotropy could be potentially induced during production or specimen manufacturing processes. Yield surface sizes in the pre-deformed state were primarily reduced in the axial direction, especially for the compression. This indicates significant softening due to the plastic anisotropy introduced by complex loading, potentially contributing to a defect initiation and its subsequent growth in the bimetal tested.

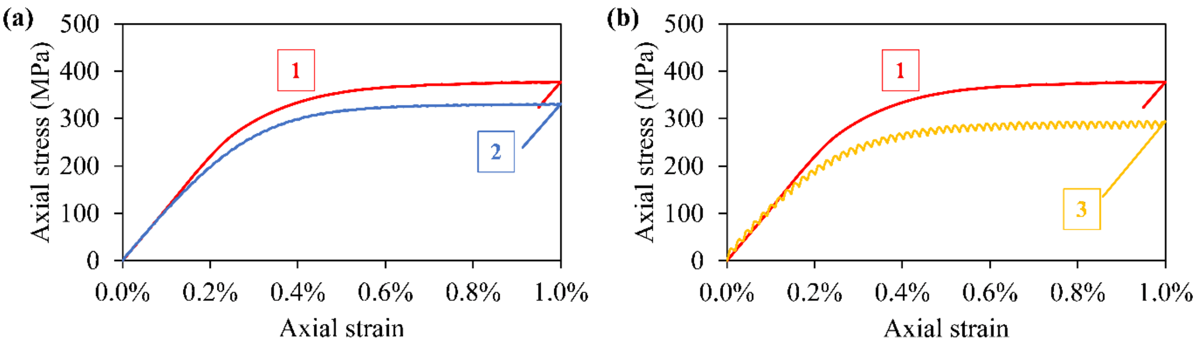

Figure 1. *Material characteristics of Ti-Cu bimetal under monotonic tension only* ***(1)****; simultaneous monotonic tension with cyclic torsion of strain amplitude values equal to 0.1%* ***(2)*** *and 0.15%* ***(3)*** *at 0.5 Hz frequency.*

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References

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