Functional fatigue of $Ni_{50.3}Ti_{25}Hf_{24.7}$ – Heterogeneities and evolution of local transformation strains

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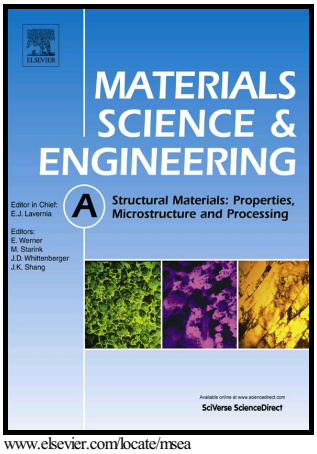

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Abstract:

Shape memory alloys achieve their unique and desirable property of large recoverable strains through phase transformation. The attained magnitudes of transformation strains is strongly affected by the level of deformation heterogeneity during the transformation process and is impacted by plastic deformation and the accumulation of retained martensite/austenite following repeated cycling. This paper is dedicated to study the heterogeneity in the total and transformation strains of the high temperature shape memory alloy $Ni_{50.3}Ti_{25}Hf_{24.7}$ subjected to fatigue loading and aims to provide further insight to the source of transformation strain instability. Under isobaric loading conditions, full field strain measurements were collected during thermal cycling and utilized to assess the local changes in the deformation field. Transformation strains increased globally in the first few cycles of loading followed by a relatively stable response and eventually started to exhibit drop in their magnitudes with continued loading. No homogenization of the transformation strain field was observed as a result of either stress increase or thermal cycling. The transformation strains were localized and the global evolution in their magnitudes was associated with local changes, either increasing or decreasing local strains, in spatially the same regions. The experimental results are discussed with the aim to provide a deeper understanding of the stability of transformations strains, their