

Investigation of Martensitic Transformation Zone at the Crack Tip of NiTi under Mode-I Loading Using Microscopic Image Correlation

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Abstract : A realistic understanding of martensitic phase transition under complex stress states is key for accurately describing the mechanical behavior of shape memory alloys (SMAs). Particularly regarding the sharply changing stress fields at the tip of a crack, the size, nature and shape of transformed zones are of great interest. There is significant variation among various analytical models in their predictions of the size and shape of the transformation zone. As the fully transformed region remains inside a very small boundary at the tip of the crack, experimental validation requires microscopic resolution. Here, the crack tip vicinity of NiTi compact tension specimen has been monitored in situ with microscopic image correlation with 20x magnification. With nominal 15 micrometer grains and 0.2 micrometer per pixel optical resolution, the strains at the crack tip are mapped with intra-grain detail. The transformation regions are then deduced using an equivalent strain formulation.

Keywords : digital image correlation, fracture, martensitic phase transition, mode I, NiTi, transformation zone

Conference Title : ICFMPCA 2017 : International Conference on Fracture Mechanics, Polymers, Composites and Adhesives

Conference Location : Paris, France

Conference Dates : May 18-19, 2017