Proceedings of the 9th Biennial ASME Conference on Engineering Systems Design and Analysis
ESDA2008
July 7-9, 2008, Haifa, Israel

ESDA2008-59187

Deformation Behavior of a Shape Memory Alloy, Nitinol

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Nickel-Titanium, commonly referred to as Nitinol, is a shape-memory alloy with numerous applications due to its superelastic nature and its ability to revert to a previously defined shape when deformed and then heated past a set transformation temperature. While the crystallography and the overall phenomenology are reasonably well understood, much remains unknown about the deformation and failure mechanisms of these materials. These latter issues are becoming critically important as Nitinol is being increasingly used in medical devices and space applications. The talk will describe the investigation of the deformation and failure of Nitinol using an in-situ optical technique called Digital Image Correlation (DIC). With this technique, full-field quantitative maps of strain localization are obtained for the first time in thin sheets of Nitinol under tension. These experiments provide new information connecting previous observations on the micro- and macro- scale. They show that martensitic transformation initiates before the formation of localized bands, and that the strain inside the bands does not saturate when the bands nucleate. The effect of rolling texture, the validity of the widely used resolved stress transformation criterion, and the role of geometric defects are examined.

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