DYNAMICS OF PROPAGATING PHASE BOUNDARIES IN NiTi

J. Niemczura, K. Ravi-Chandar
Center for Mechanics of Solids, Structures and Materials
Department of Aerospace Engineering and Engineering Mechanics
The University of Texas at Austin, Austin, TX 78712-0235, USA

Nickel-Titanium alloys exhibit stress induced martensitic transformation that localizes in narrow zones; such transformation zones may also propagate into untransformed regions under continued loading. Such propagating phase boundaries have been investigated under quasi-static loading by Shaw and Kyriakides [1]; the speed of propagation of these boundaries was dictated by the kinematics of the problem. In contrast, propagating boundaries of phase transformation under dynamic loading conditions do not have such kinematic constraints; determination of the speed of propagation of dynamically loaded phase boundaries requires that a kinetic relation be imposed in addition to the governing equations of motion [2]. In this presentation, we will describe experiments where propagating phase boundaries have been generated in polycrystalline NiTi specimens under a tensile impact loading condition. Multiple strain gages were used to monitor the time evolution of the strain at different spatial locations in the specimen. Nucleation and propagation of multiple phase fronts were detected in these experiments; the phase front speed was found to be in the range between 37 m/s and 370 m/s. The strain measurements were interpreted through the one dimensional analysis of Abeyaratne and Knowles [2] and a model of partial phase transformation in the polycrystalline specimen. The driving force for the motion of the phase front was evaluated from the measurements in order to establish the kinetic relation.

References

[1] J.A. Shaw, and S. Kyriakides, 1995, Thermomechanical aspects of NiTi. *Journal of the Mechanics and Physics of Solids*, **43**, 1243-1281.

[2] R. Abeyaratne, and J.K. Knowles, 1997, On the kinetics of an austenite → martensite phase transformation induced by impact in a Cu-Al-Ni Shape-Memory Alloy. *Acta Materialia*, **45**, 1671-1683.

Keywords: Shape memory alloys, phase fronts,