Stain monitoring with NiTi SMAs

F. Braz Fernandes [1] , J. P. Oliveira [1]

[1] *CENIMAT – Centro de Investigação de Materiais, Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, Campus da Caparica, 2829 - 516 Caparica, Portugal*

Introduction

Phase transformations in NiTi shape memory alloys can occur either by thermal and/or mechanical stimulae. A change in the electrical resistivity during these transformation gives a clear indication of these phenomena. Thus, one can use information related with electrical resistivity measurements to monitor strain/stress in different systems with a simple approach.

According to the Clausius-Clapeyron relationship it is possible to know the influence of the temperature on the stress required to induce the austenite to martensite transformation and thus correlating with electrical resistivity measurements have clear understanding of the surrounding medium where NiTi can be embedded.

In this work a fundamental approach was tested: track, in-situ, the change in the electrical resistivity of NiTi during mechanical solicitation to understand the viability of use such kind of measurements to know the stress state of NiTi.

Results

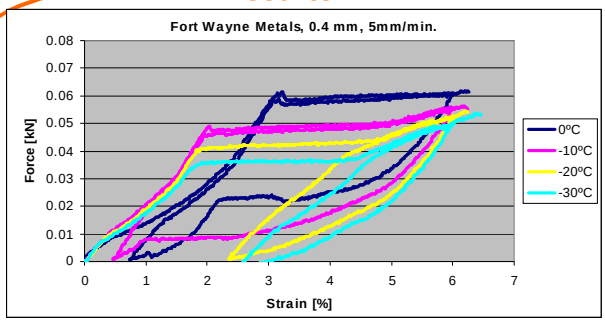

Fig. 1 - Effect of temperature on the mechanical cycling behavior of NiTi wires.

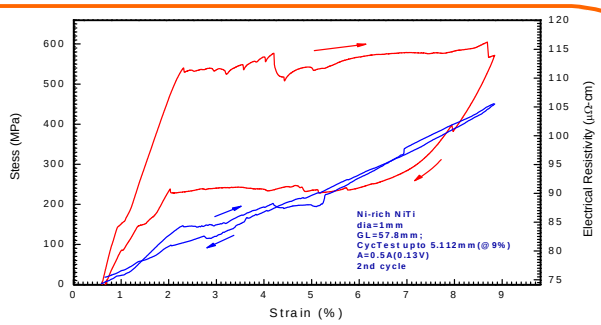

Fig. 2 - In situ, electrical resistivity measurements during a load/unload cycle of superelastic NiTi. The electrical resistivity varies approximately in a linear way with the imposed deformation.

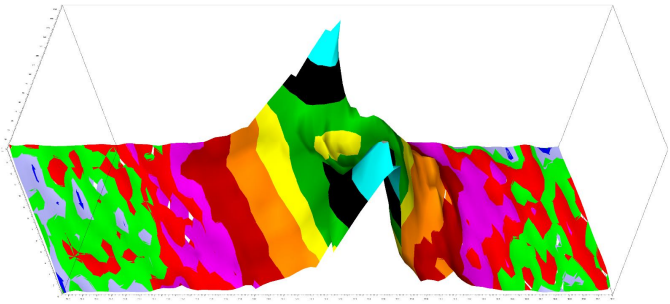

Fig. 3 – XRD measurements performed with temperature variation to structurally characterize NiTi: High temperature phase: austenite; low temperature phase: martensite; intermediate phase: R-phase.

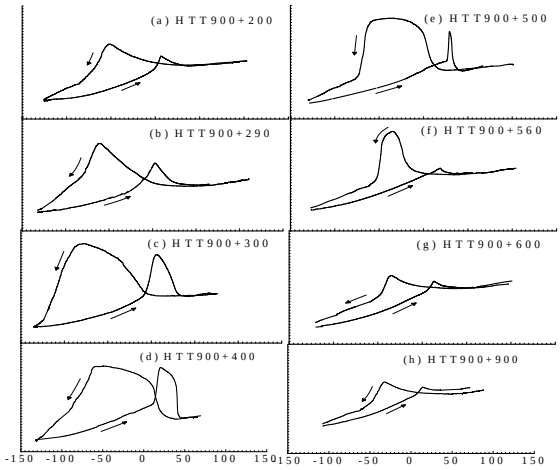

Fig. 4 – Electrical resistivity measurements at different for several heat treatments performed on NiTi wires

Conclusions

NiTi can be successfully embedded in other structures to provide a good feedback on the strain/stress monitoring by a simple electrical resistivity measurement.

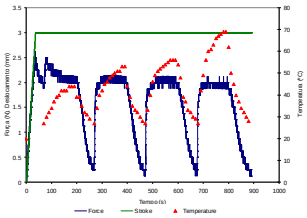

Fig. 5 - Use of NiTi in a polimeric matrix

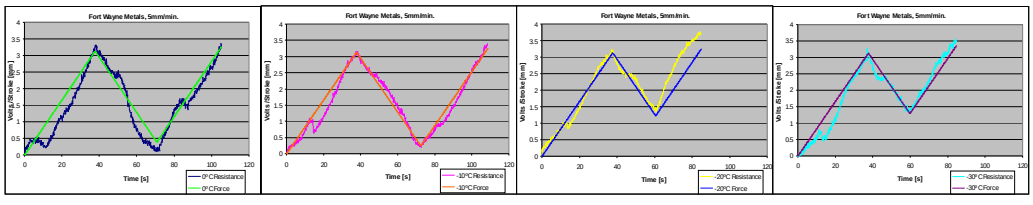

Fig. 6 – Variation of electrical resistivity with applied force at different temperatures in NiTi wires

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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

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