FZU
Institute of Physics of the Czech Academy of Sciences

SEMINAR

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Meeting Room 2NP 1.32 in the Solid Building

Na Slovance 1999/2, Prague 8

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Aging and Thermomechanical Loading of Superelastic NiTi Wires

Shape memory alloys (SMA) have already been used in a wide range of engineering applications in medicine, aerospace, robotics, and the automotive industry, owing to their unique superelastic and shape memory properties. However, some of these applications are still limited by the fatigue life and functional degradation of NiTi alloy.

In the first part of my talk, I will review the results of fatigue tests obtained during my PhD thesis. A scheme allowing for estimating the instability of various NiTi wires in a wide range of cyclic thermomechanical loading tests was introduced. A suitable strategy to improve the fatigue performance of superelastic NiTi is to create a microstructure that allows for moderate plastic deformation while suppressing the formation of deformation bands/twins leading to microstructure refinement.

The second part of my talk includes follow-up experiments performed in the time frame after my PhD defense and a six-month stay in Antwerpen as a continuation of heat treatment/aging research of Ni-rich NiTi. These experiments are focused on material properties and functional stability altered by aging processes at higher (400 °C) and lower (250 °C and 300 °C) temperatures. TEM analysis was performed to determine the mean size and distribution of Ni-rich precipitates in the NiTi matrix. Precipitation occurs predominantly on grain boundaries during aging at 400 °C, and functional stability in cyclic loading remains insufficient. Thus, aging at low temperatures (~ 300 °C) was employed, which yields approx. 5nm precipitates and substantially improves the homogeneity of precipitate distribution. Low-temperature aging is beneficial, especially in microstructures with large grain sizes, as these would be otherwise severely unstable in cyclic thermo-mechanical loading owing to their low tensile strength. Moreover, I will discuss the analysis of the microstructure after thermomechanical loading using TEM observation of in-situ heated NiTi, and ASTAR mapping

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