ESRF	**Experiment title:** Microsecond-scale depth-resolved detection of the martensitic phase transformation at high driving forces	**Experiment number**: MA-5014
Beamline:	**Date of experiment**: from: 2022.02.17 to: 2022.02.21	**Date of report**: 2023.09.19
Shifts: 12	**Local contact(s)**: Veijo Honkimäki	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Prof. Dr. Klaus dieter Liss, Guangdong Technion, Shantou, China (*)

Dr Robert Littlewood, Sydor Technologies LTD., USA

Asaf Dana, Faculty of Mechanical Engineering, Technion, Israel (*)

Prof. Doron Shilo, Faculty of Mechanical Engineering, Technion, Israel (*)

Dr. Veijo Honkimaki, ESRF, France (*)

Emil Bronstein (*)

Report:

The experimental results of MA-5014 have been published in (Dana et al. 2023).

Abstract:

The martensitic transformation in shape memory alloys is known to be very fast. However, its rate in bulk materials that serve in common actuator applications is still an open question. In this study, the martensitic transformation is induced by a high-voltage microsecond superheating pulse in a polycrystalline NiTi shape memory alloy wire and its rate is tracked using time resolved X-ray diffraction by synchrotron radiation. The study employs a novel experimental technique that allows for multi-frame time-resolved detection with a temporal resolution below 1 μs, demonstrating an order-of-magnitude improvement compared to previous time-resolved synchrotron studies. Results show that the transformation begins at the moment the wire temperature reaches the transformation temperature and the transformation rate follows the rate of heating, completing most of the process within approximately 1 μs. Yet, part of the transformation continues at much slower time scales of several tens of microseconds.

Reference:

Dana, Asaf, Emil Bronstein, Eilon Faran, Veijo Honkimäki, Klaus-Dieter Liss, and Doron Shilo. 2023. “Uncovering the Rate of the Martensitic Transformation in Superheated Shape Memory Alloy Wires.” *Scripta Materialia* 223 (2023): 115074. https://doi.org/10.1016/j.scriptamat.2022.115074.