Nucleation and development of stress-induced martensitic transformation in Shape Memory Alloys investigated by various experimental techniques

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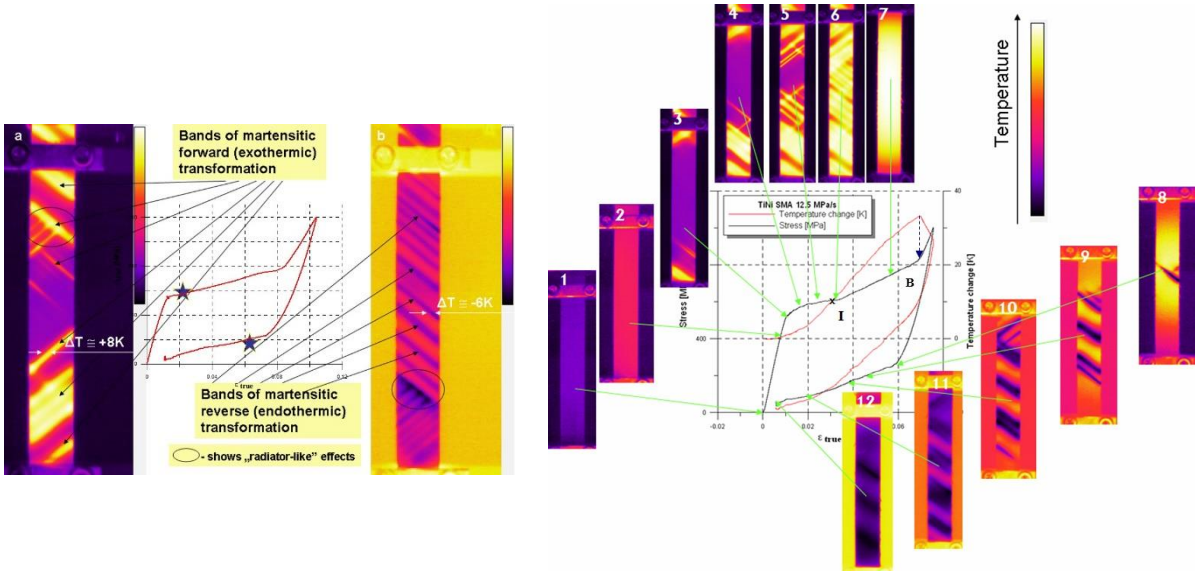
Shape Memory Alloys (SMA) belong to the group of functional materials. Their interesting properties, such as the shape memory effect (SME) and pseudoelasticity (PE), are associated with a reversible martensitic transformation, induced by mechanical loading or temperature changes. SME and PE are related to large recovery strain, stress, as well as energy storage and dissipation, which are important for the alloys biomedical and industrial applications as actuators, medical implants, guidewires, orthodontic braces or elements of dampers and earthquake protection systems.

Example of the stress and average temperature changes in TiNi SMA subjected to loading-unloading accompanied by infrared imaging is presented in the figure: on the left - 2 directions of the localized stress-induced phase forward and reverse transformation recorded by IR camera are presented; on the right - stress-strain and average temperature changes vs. strain curves obtained during the SMA complete loading-unloading tension cycle, accompanied by infrared imaging [1, 2].



The research topic proposed for the PhD project concerns investigation of nucleation and development of the martensitic forward and reverse transformation in SMA by using various advanced experimental techniques, such as infrared camera IR, digital image correlation DIC, electron microscopy SEM, etc.. The research will be conducted in collaboration with a Japanese research center which provided us with SMA samples.

1. Pieczyska E.A., Tobushi H., Kulasiński K., Development of transformation bands in TiNi SMA for various stress and strain rates studied by a fast and sensitive infrared camera, Smart Materials and Structures, Vol.22, No.3, pp.035007-1-8, 2013
2. Pieczyska E.A., Analiza doświadczalna właściwości termomechanicznych stopów TiNi oraz poliuretanu z pamięcią kształtu, *IPPT Reports on Fundamental Technological Research*, 3, 1-214, 2008 (*in Polish, diagrams in English*)