Tensile deformation of stainless steel and shape memory alloys inspected by acoustic emission and full-field techniques - a focus on old and new results

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This paper presents how the acoustic emission (AE) method allows for the study of phase transformations in austenitic steel and shape memory alloys (SMA), in relation to the results obtained from other experimental methods. We will demonstrate how the AE research methodology has evolved over the past 30 years and how other methods have emerged or evolved at that time for comprehensive diagnostics of newly developed materials with properties of interest for the applications. We will present results for four different materials subjected to tensile loading under various conditions. Interestingly, we will begin and end with results obtained for austenitic steel: formerly 1H18N9T - a steel used in the food industry, including milk churns, and more recently, 316L, 304, and N50 stainless steels – the steels operating under cryogenic conditions and used for nuclear reactor components, tested at 4 K. We will compare the results obtained for two types of titanium-based SMAs - a commercial TiNi, manufactured by Furukawa, and Ti-26 Nb with addition of O or N, elaborated in laboratory of the *University of Tsukuba*, Japan. We will also discuss the field research methods used: infrared (IRT) measurements and digital image correlation (DIC).

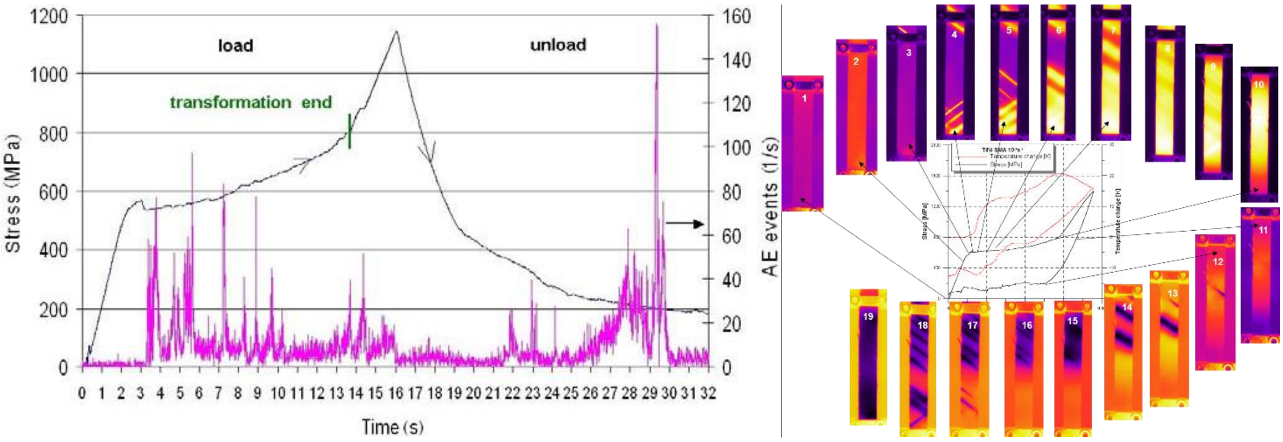

Fig. 1. TiNi SMA results obtained during loading- unloading tension at strain rate 10^{-3} s^{-1} . Left - Stress and AE counts rates vs. time. Right - the related stress and temperature changes vs. strain. Thermograms show in infrared a nucleation and evolution of macroscopic transformation bands, related to martensite forward (1–10) and reverse (11–19) transformation.

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