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THERMOMECHANICAL BEHAVIOR OF GUM METAL UNDER TENSION

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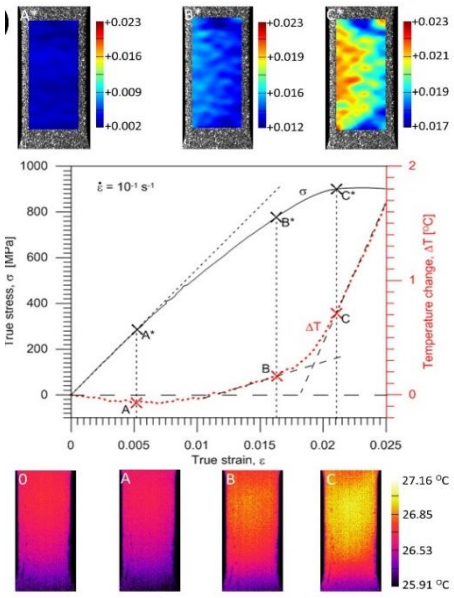
1. INTRODUCTION

Investigation of the superior properties of β Ti - Gum Metal is presented. These properties are related to the specific chemical composition Ti-23Nb-0.7Ta-2Zr-1.2O (at.%) and significant cold working up to 90% in area reduction. The properties, in particular high strength, high elasticity and good biocompatibility, enable various applications, e.g.: in automotive, biomedical, aircraft or fitness industry [2]. a combination of Digital Image Correlation (DIC) and Infrared Thermography (IR) was used during the alloy loading and deformation [4]. Recently, constitutive models describing the Gum Metal unique behaviors in various loading conditions, including cyclic loading [5] have been also proposed.

2. EXPERIMENTAL

Mechanical characteristics were determined with high accuracy by digital image correlation DIC, whereas the related temperature changes of the Gum Metal specimens during the deformation process was obtained by using a fast and sensitive infrared camera. Specimens with sizes of gauge part 7 x 4 mm were subjected to tension at 2 strain rates $10^{-2}s^{-1}$ and $10^{-1}s^{-1}$. More details is presented in [4].

3. RESULTS AND DISCUSSION



Based on the obtained mechanical and thermal characteristics, the subsequent stages for the Gum Metal loading can be distinguished:
0 - A* ; elastic deformation stage, accompanied by drop in temperature, like for other solid materials,
A* - B*; superelastic-like deformation, a dissipative
B* - C* ; yielding and fast growth of temperature.
Elastic limit, recoverable strain and development of the strain localization were studied. It was found that maximal drop in temperature, corresponding to the yield limit of solids, was referred to significantly lower strain value in the case of Gum Metal in contrast to its large recoverable strain. The temperature increase proves a dissipative character of the process, related to ω and α" phases induced during the alloy fabrication and their exothermic phase transformations activated under loading. The research confirmed that the unconventional properties of the Ti alloy occur due to activity of the martensite-like nanodomains.

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