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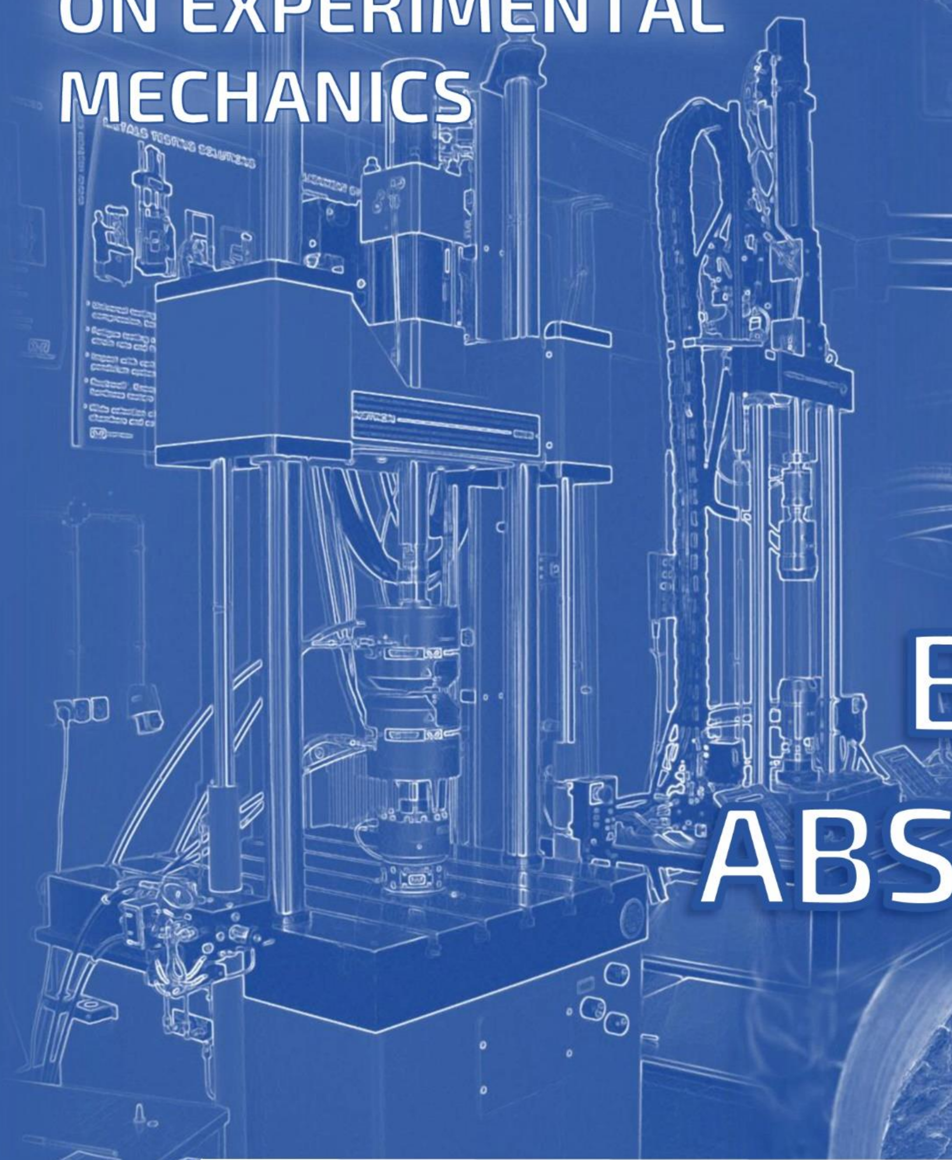

BOOK OF ABSTRACTS

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EFFECT OF OXYGEN ON MECHANICAL BEHAVIOR OF Ti-25Nb BASED SHAPE MEMORY ALLOYS

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1. Introduction

Ti-Nb based alloys are very attractive candidates for biomedical shape memory alloys (SMAs) [1]. Their Ni-free composition is a solution to the issue of hypersensitivity and toxicity of Ni (e.g. in Ti-Ni SMAs) [2]. Shape memory and superelastic properties of Ti-Nb alloys are associated with martensitic transformation from β to α″. However, oxygen-added Ti-Nb SMAs significantly change their mechanical behavior due to formation and activity of nanodomains [3, 4]. In this work, the effect of oxygen on superelastic properties of Ti–25Nb–*x*O (at. %, $x = 0, 0.3, 0.5, 0.7, 1.0$) SMAs under tension is discussed.

2. Methods

The Ti–25Nb–*x*O (at. %, $x = 0, 0.3, 0.5, 0.7, 1.0$) alloys were prepared using the Ar arc melting method. The ingots were sealed in a vacuumed quartz tube and homogenized at 1273 K for 7.2 ks, and then cold-rolled with a reduction in thickness of 95%. Specimens for X-ray diffraction (XRD) measurements and mechanical tests were cut using an electro-discharge machine. The damaged surface was removed by mechanical polishing and chemical etching. The specimens were solution-treated at 1173 K for 1.8 ks in an Ar atmosphere, followed by water quenching. The oxidized surface was removed by chemical etching. XRD measurements were conducted at room temperature with Cu Kα radiation. Displacement-controlled load-unload tensile tests were carried out using an MTS 858 testing machine at room temperature. The gauge area of each specimen (4 mm x 6 mm) was covered with speckle pattern. The deformation process was monitored by a visible range camera Manta G-125B. A function of virtual extensometer was used to measure elongation. The displacement rate was 0.06 mm·s−1 which corresponded to strain rate of 10−2 s−1.

3. Results and discussion

A comparison of stress-strain curves of Ti–25Nb–*x*O (at. %, $x = 0, 0.3, 0.5, 0.7, 1.0$) SMAs under load–unload tension is shown in Fig. 1(a). The yield stress tends to increase with an increase in oxygen content. The Ti–25Nb alloy shows a shape memory behavior associated with the martensitic transformation from β to α″. In oxygen-added alloys, the β–α″ martensitic transformation is suppressed by generation of nanodomains. Oxygen atoms expand the surrounding Ti and Nb atoms, then generate and promote the shuffling and shearing processes of the β–α″ martensitic transformation [3,4]. A comparison of XRD profiles of Ti–25Nb and Ti–25Nb–0.3O alloys is presented in Fig. 1(b). Only the α″ martensite phase was observed in the Ti–25Nb alloy, whereas only the β parent phase was observed in the Ti–25Nb–0.3O alloy. The addition of oxygen stabilizes the β phase in Ti-25Nb alloys. It results in the reduction of the hysteresis loop causing the nonlinear superelastic-like deformation and the increase of flow stress. Similar phenomena are observed in the mechanical behavior of Gum Metal (Ti–23Nb–0.7Ta–2.0Zr–1.2O, at. %) [5, 6].

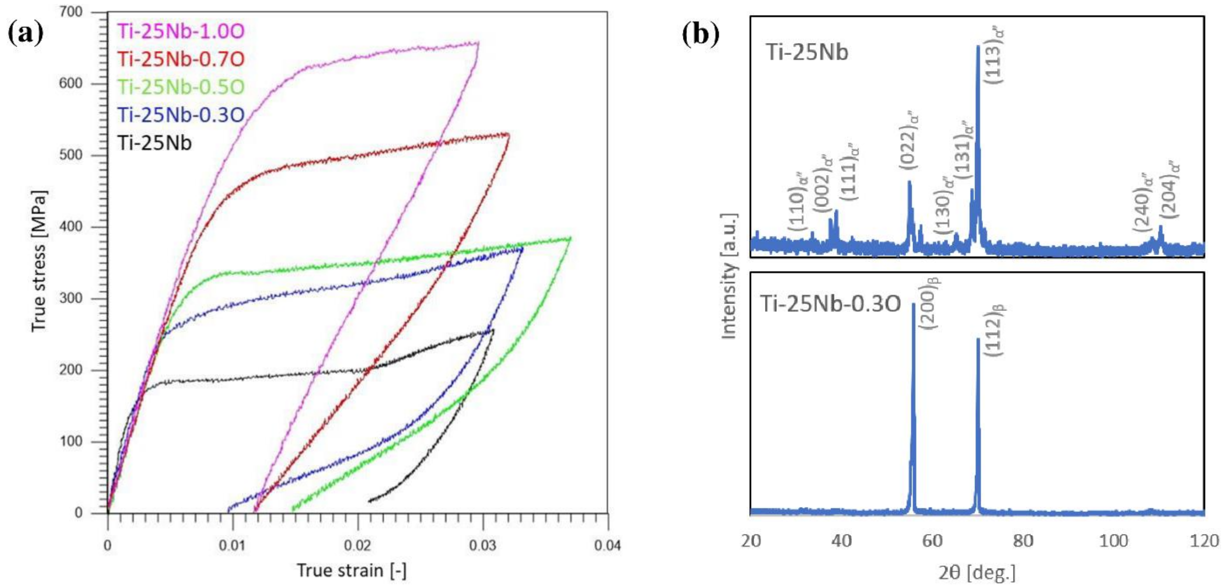

Fig. 1. Comparison of (a) stress-strain curves of Ti–25Nb–*x*O (*x*=0, 0.3, 0.5, 0.7, 1.0) SMAs under load-unload tension; (b) XRD profiles of Ti–25Nb and Ti–25Nb–0.3O SMAs

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