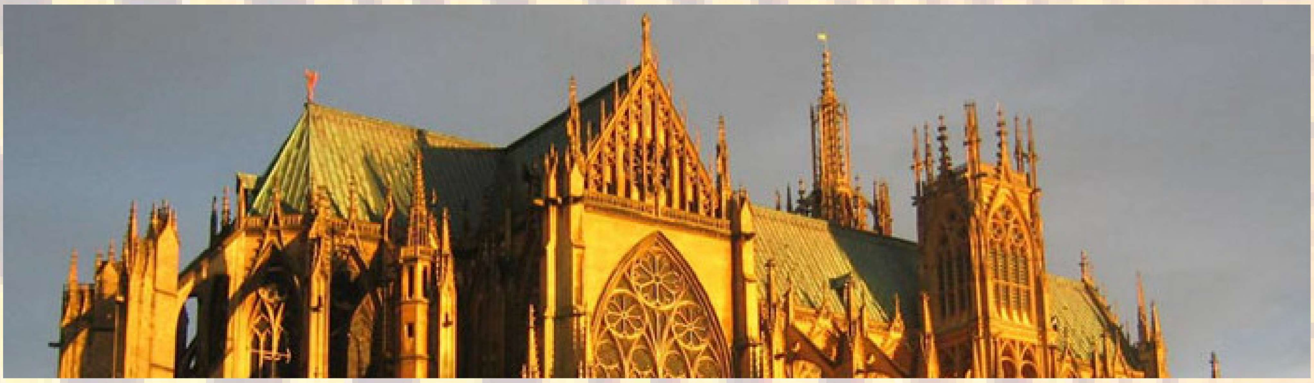

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Book Of Abstracts

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28 Aug
2:00pm
Poster
Session A

Superelastic-like behavior of Gum Metal under compression inspected by infrared thermography

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Gum Metal (Ti36Nb2Ta3Zr0.3O in mass%) is a beta titanium alloy developed at Toyota Central R & D Labs., Inc. The alloy has attracted remarkable attention due to its exceptional properties, i.e. low elastic modulus, high strength, nonlinear superelastic-like deformation, excellent cold workability, as well as Invar- and Elinvar-like performance. This set of outstanding properties has been extensively discussed in the literature in the context of structural, compositional and thermal analyses. Specifically, unconventional deformation mechanisms occurring in Gum Metal under load have been a focal point in several publications. Recent studies confirmed that the nonlinear superelastic-like deformation of Gum Metal is mainly caused by two microstructural features martensite-like α nanodomains and ω phase precipitates.
In this work, Gum Metal cube samples were machined out of a Gum Metal rod, texturized along <110> direction. The samples were subjected to monotonic and cyclic compression with an increasing strain step on a testing machine. The deformation was simultaneously monitored by an infrared camera and a CCD camera for determining a thermal response of the alloy and strain changes, respectively. Stress-strain curves confirmed the superelastic-like deformation and high plastic performance of Gum Metal. The thermal response of the alloy under compression, determined within the large recoverable strain, gave an insight into the nature of the deformation mechanisms of Gum Metal. In this regime, significant changes in the growth rate of the thermal response were observed. As in conventional materials, the first stage of compression is a linear, fully elastic deformation accompanied by a temperature growth. The second stage is a nonlinear deformation which is reflected by change of the temperature growth rate. The change can be associated with martensite-like α nanodomains and ω phase precipitates activated during the loading of Gum Metal. Next stage of deformation is yielding, which was represented by a clearly pronounced yield point. Further high plastic deformation without hardening is accompanied by a rapid growth in temperature.
The technique of infrared thermography was successfully applied to register thermomechanical nature of the unconventional deformation mechanisms namely α'' martensite-like nanodomains and ω phase precipitates activated in Gum Metal under compression. The changes of the temperature rate can precisely indicate subsequent stages of Gum Metal deformation especially during the large superelastic-like deformation.
Acknowledgments
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28 Aug
2:00pm
Poster
Session A

Deformation-induced α variant selection during β to α phase transformation in a metastable β Ti alloy

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The mechanical properties of titanium alloys are thought to be related to α phase produced via the β to α phase transformation during thermomechanical process. Previous works have evidenced that there happens α variant selection during thermomechanical process. The formation of α variant could form the microtextures, leading to the modification of the mechanical properties of the alloy. The rules and mechanisms of this variant selection are still need to be illustrated. Thus, based on this, a study was conducted, in the present work, on the α variant selection in a metastable β Ti alloy under isothermal compression. It is found that two Burgers orientation variants with a disorientation of 90°around <1 1.38 0> α appeared concomitantly and often intersect each other, forming ¨cross - shaped¨ clusters. The selection of such variants is governed by the compatibility of the lattice deformation of the phase transformation to the imposed compressive strain. The selected variants are able to effectively accommodate the external compressive strain by their compatible normal lattice strain.
