MARTENSITE CHARACTERISTIC TEMPERATURE (M_f) and MECHANICAL PROPERTIES of SUBZERO QUENCHED and AGED TC21 α/β TITANIUM ALLOY

By

Rania Mohamed Sayed El-Shorbagy

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
METALLURGICAL ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Approved by the Examining Committee

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Title of Thesis:

Martensite characteristic temperature (M_f) and mechanical properties of subzero quenched and aged TC21 α/β titanium alloy

Key Words:
TC21 α/β titanium alloy microstructure; Subzero hardening; Titanium martensite characteristic temperature; Aging; Mechanical properties.

Summary:
Titanium alloys are known to experience martensite transformation, their martensite and its transformations upon subsequent heat treatment proved to be an important tool to obtain controllable properties. The martensite characteristic temperature (M_s) has received some attention as regards its dependence on composition. On the other hand, no similar attention was given to the dependence of the other important martensitic characteristic temperature (M_f) on composition. In view of the foregoing, this work was thus planned to fulfill this lacking information via subzero hardening treatments of TC21 α/β alloy. Additionally, the hardening effect of those subzero hardening treatments was studied. Significant findings were reached which are expected to help reaching useful property levels such as strength, wear resistance and damage tolerance. Correlation between strength and Vickers hardness values were obtained by means of least squares mathematical analysis. Simple empirical equations were suggested to evaluate the strength using bulk hardness. The present largest tensile strength values approach 1200 MPa in the quenched condition and 1700 MPa in the aged condition. This prominent hardening of the subzero quenched and post aged microstructures can lead to useful overall properties of this TC21 α/β titanium alloy.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Rania Mohamed Sayed El-Shorbagy Date: / /

Signature:

Dedication

I dedicate this thesis to my family.

Acknowledgments

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