



**QUEEN'S  
UNIVERSITY  
BELFAST**

## Comments on “High-temperature creep resistance and effects on the austenite reversion and precipitation of 18 Ni (300) maraging steel” by dos Reis et al. [Materials Characterization 107 (2015) 350- 357]

Sha, W. (2016). Comments on “High-temperature creep resistance and effects on the austenite reversion and precipitation of 18 Ni (300) maraging steel” by dos Reis et al. [Materials Characterization 107 (2015) 350- 357]. Materials Characterization, 118, 302-303. DOI: 10.1016/j.matchar.2016.06.012

**Published in:**  
Materials Characterization

**Document Version:**  
Peer reviewed version

**Queen's University Belfast - Research Portal:**  
[Link to publication record in Queen's University Belfast Research Portal](#)

### **Publisher rights**

© 2016 Elsevier Inc.

This manuscript version is made available under the CC-BY-NC-ND 4.0 license <http://creativecommons.org/licenses/by-nc-nd/4.0/>, which permits distribution and reproduction for non-commercial purposes, provided the author and source are cited.

### **General rights**

Copyright for the publications made accessible via the Queen's University Belfast Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

### **Take down policy**

The Research Portal is Queen's institutional repository that provides access to Queen's research output. Every effort has been made to ensure that content in the Research Portal does not infringe any person's rights, or applicable UK laws. If you discover content in the Research Portal that you believe breaches copyright or violates any law, please contact [openaccess@qub.ac.uk](mailto:openaccess@qub.ac.uk).

## Letter

Comments on “High-temperature creep resistance and effects on the austenite reversion and precipitation of 18 Ni (300) maraging steel” by Reis et al. [Materials Characterization 107 (2015) 350-357]

Wei Sha\*

School of Planning, Architecture and Civil Engineering, Queen’s University Belfast, Belfast BT7 1NN,  
UK

\*Corresponding author. Tel. +442890974017; Fax +442890974278; E-mail w.sha@qub.ac.uk

## Abstract

This letter attempts to comment on two articles by Reis et al., in the aspects of creep consideration, chemical analysis, and phase transformation measurements in maraging steels.

Keywords: Maraging 300 steel; Creep; Reverted austenite; Intermetallic precipitates

This short paper comments on a number of incorrect or inaccurate aspects of a paper by Reis et al. [1]. All quotes of figure, table, equation and section numbers refer to those used in the original papers.

Reis et al. considered creep behaviour of 18Ni maraging steel in microstructural unstable condition at temperature higher than the ageing temperature. This consideration is meaningful for some specific exploitation cases (for instance, emergency rating of aviation engine). Scientific value of the work [1] is attributed to information of creep-induced coarsening of  $\text{Ni}_3(\text{Ti},\text{Mo})$  and Laves phase.

The first comment is that the creep times before fracture are too short for the studies in [1] to be considered creep in its commonly regarded sense. In Table 4 in [1], the shortest time to rupture ( $t_r$ ) is 0.05 h, i.e., 3 min. How is this creep time meaningful? Normal tensile tests use about 1% strain/min, which would last much longer than 3 min before rupture.

Maraging steels have “poor” creep performance at the temperatures, 550-650 °C, used in [1], because the ultra-high strength of these steels is achieved by an ageing treatment at temperatures below such temperatures [2]. If held at a temperature higher than the ageing heat treatment temperature, whether under loading or not, the microstructure of the steel will change substantially over a short period of time, in minutes and hours. So, the “constant” A in Eq. 1 in [1] will change substantially over a short period of time, in minutes and hours. Indeed, the creep rate Eq. 1 in [1] is for diffusion creep [3, 4], and not applicable to creep during which a phase transformation takes place. The conventional creep theory, for example Eq. 1 in [1], cannot be applied to such a case. It is also stated in [1] that A depends on temperature and applied stress. This is a further mistake. Figs. 5 and 6 in [1] were plotted on the assumption that A does not depend on temperature and applied stress.

A proof of the conventional creep theory not applicable to the maraging steel at such temperatures higher than the ageing heat treatment temperatures is the finding by Reis et al. [1] that the stress exponent  $n$  and the creep activation energy  $Q_c$  both change substantially (Section 2.2 in [1]). The plotting of the diagram in Fig. 5 in [1] assumes that  $Q_c$  is constant. The plotting of the diagram in Fig. 6 [1] assumes that  $n$  is constant. Neither are turned out to be true from the results.

The second issue is concerned with phase chemistry. The Ni contents in both the matrix and  $Ni_3(Ti,Mo)$ , given in Table 3 in [1], are lower than the Ni content in the steel overall, given in Table 1

in [1]. This does not satisfy the materials balance for Ni, and suggests that there is another Ni-rich phase missed in the microstructural characterisation or there are large errors in the composition analysis. On the other hand, calculations based on materials balance using the Ti, Co, and Mo contents in Tables 1 and 3 in [1] give the percentage of Ni<sub>3</sub>(Ti,Mo) in the steel as 5% (from materials balance of Ti), 5% (Co) and 39% (Mo). This means that the measurement of Mo concentrations also has large errors.

Reis et al. evaluated chemical composition of Ni<sub>3</sub>(Ti,Mo) particles using foils. As a result, they received chemical composition from the particles and surrounded matrix. This is why Table 3 in [1] is incorrect.

## References

- [1] Adriano Gonçalves dos Reis, Danieli Aparecida Pereira Reis, Antônio Jorge Abdalla, Jorge Otubo, High-temperature creep resistance and effects on the austenite reversion and precipitation of 18 Ni (300) maraging steel, Mater. Charact. 107 (2015) 350-357.
- [2] Wei Sha, Steels: from materials science to structural engineering, Springer, 2013.
- [3] Michael F. Ashby, David R.H. Jones, Engineering materials 1: An introduction of their properties and applications, 1st edition 1980, reprinted 1986, Pergamon, p. 174.
- [4] Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, The science and engineering of materials, 6th edition 2011, SI edition, Cengage Learning, p. 278.