Modeling of thermomechanical behavior of Al3003 with unified constitutive models

Daniel Bedoya[a,b], Eric Fleury[a], Jérôme Serri[a], Thierry Mazet[b], Gaëtan Bergin[b]

[a] *Laboratoire d'Etude des Microstructures et de Mécanique des Matériaux (LEM3), CNRS UMR 7239, Université de Lorraine, 57070, Metz, France*

[b] *Fives Cryo, 25 bis rue du Fort, 88190 Golbey, France*

[a]*daniel.bedoya-vallejo@univ-lorraine.fr*

Al3003 is an aluminum alloy in which manganese is the principal alloying element. It is the most popular general-purpose aluminum alloy, used for applications such as sheet metal work, stampings, fuel tanks, chemical equipment, pressure vessels and electronics, among others [1]. In many of these applications, the assemblies made of this alloy are subjected to thermomechanical solicitations in a wide range of strain rates and temperatures. Finite element (FE) simulation of the response of these structures allows design optimization and critical phenomena identification. Hence the importance of characterizing the variability of Al3003 mechanical properties as a function of strain rate and temperature, and to have reliable constitutive model parameters to be implemented in FE code. For that purpose, a series of compressive and tensile tests have been performed over Al3003 test specimens at varying temperatures within ambient temperature and 550°C (the melting point of Al3003 is in the range of 643°C - 654°C [1]), and at varying strain rate. The results of the tests are going to be used to determine and compare the predicted thermomechanical behavior of the material using unified constitutive models based on formulations such as those of Chaboche [2] and Sehitoglu [3].

Keywords: unified model, Al3003, viscoplastic behavior.

References:

[1]   J.R. Davis, "Aluminum and Aluminum Alloys," in *Alloying: Understanding the Basics*, 2001, pp. 351–416.
[2]   J. L. Chaboche, "A review of some plasticity and viscoplasticity constitutive theories," *Int. J. Plast.*, vol. 24, no. 10, pp. 1642–1693, 2008, doi: 10.1016/j.ijplas.2008.03.009.
[3]   D. Slavik and H. Sehitoglu, "Constitutive Models Suitable for Thermal Loading," *J. Eng. Mater. Technol.*, vol. 108, no. 4, pp. 303–312, Oct. 1986, doi: 10.1115/1.3225887.