Fatigue Strength Evaluation and Microstructural Characterization of Extruded and Rotary Swaged Al 7050 Wires Recycled by Spray Forming

J. G. J. Salvo[1,2,*,#], C. Bolfarini[3], C. R. M. Afonso[3]

[1]Materials Division of Aerospace Institute (IAE-CTA), São José dos Campos – SP, Brasil.
[2]Programa de Pós Graduação em Ciência e Engenharia de Materiais (PPG-CEM), Universidade Federal de São Carlos (UFSCar), São Carlos – SP, Brasil.
[3]Departamento de Engenharia de Materiais (DEMa), Universidade Federal de São Carlos (UFSCar), São Carlos – SP, Brasil.

[#]Corresponding author: joaodesalvo@gmail.com

High strength 7XXX precipitation hardened aluminum alloys are widely used in aircraft structural components. The machining process applied in the fabrication of these components presents very low efficiency regarding material utilization, generating a solid waste composed by a great amount of noble alloy machining chips with great recycling and later application potential. However, this material is usually sold as scrap for the secondary Al industries, which use it for low performance applications in casting products. The present work is a continuation of others researchers effort [1-3], who have been searching a higher value-added destination for this material through its reintroduction as a high quality and high strength final product, whose proprieties are compatible with the original alloy composition. Although, traditional foundry practices are unsuitable for this purpose, resulting in a poor quality recycled material. Hence, this work aims to characterize the wire produced by a process route comprising AA7050 machining chips remelted by spray forming, followed by hot extrusion and cold rotary swaging, resulting in a 2.7 mm diameter wire as final product. The microstructural characterization was carried out in a scanning electronic microscope (SEM), coupled to energy dispersive spectroscopy (EDS) and electron backscattered diffraction (EBSD) and in a transmission electronic microscope (TEM), combined with x-ray diffraction (XRD) and differential scanning calorimetry (DSC). The mechanical properties were evaluated by Vickers microhardness, tensile and fatigue tests. Fracture surface analysis was carried out by SEM. The results allowed correlating wire microstructure, through intermetallic phase's characterization, with its monotonic and cyclic mechanical properties. Additionally, it was possible to verify the microstructural influence in fracture behaviour of tested wires. The AA7050 alloy wires presented high tensile and fatigue (HCF) strength, with possible applications in power transmission cables and, even, its reintroduction in the aerospace sector.

[1] A. Hyodo, C. Bolfarini, T. T. Ishikawa, Mat. Res. **15**, (2012), 739-748.
[2] E. M. Mazzer, C. R. M. Afonso, C. Bolfarini, C. S. Kiminami, Intermetallics. **43**, (2013) 182-187.
[3] A. P. de Bribean Guerra, N. Ellendt, V. Uhlenwinkel, P. S. C. Pereira da Silva, C. Bolfarini, Mat.-wiss. u. Werkstofftech. **45**, N.7. (2014) 568-573.