Mechanical and electrical properties of a nanostructured Al-Ca alloy

X. Sauvage[a], F. Cuvilly[a], A. Russell[b,c], K. Edalati[d]

[a] *Normandie Université, UNIROUEN, INSA Rouen, CNRS, Groupe de Physique des Matériaux, 76000 Rouen, France*

[b] *Department of Materials Science and Engineering, Iowa State University, Ames, IA 50011, USA*

[c] *Ames Laboratory of the US Department of Energy, Ames, IA 50011, USA*

[d] *WPI, International Institute for Carbon-Neutral Energy Research (WPI-I2CNER), Kyushu University, Fukuoka, Japan*

[a]*xavier.sauvage@univ-rouen.fr*

The solubility of Ca in Al is extremely low, which makes this alloying element very attractive to stabilize a nanoscaled grain structure thanks to GB segregations and to achieve a unique combination of high strength, low electrical resistivity, good thermal stability and low density material. To achieve this goal, an Al-Ca metal matrix composite was processed by severe plastic deformation (SPD), and the resulting nanoscaled structures were characterized with a combination of TEM and APT analyses. We show that the SPD led to a progressive dissolution of Ca grains and a mean Al grain size of only 25nm, which is stabilized by Ca segregation at GBs and a low supersaturated solid solution of Ca in Al. This gives rise to a hardness up to 300HV but an electrical conductivity lower than 10% IACS. Upon aging, the grain growth is relatively limited, nanoscaled Al_4Ca particles nucleate at GBs and the electrical conductivity is significantly recovered.

Keywords: Aluminium alloy; nanograins; grain boundary; segregation; mechanical strength; electrical conductivity