ABSTRACT

Al–Cu–Li–Mg based alloys exhibit an excellent combination of low density, high elastic modulus and high specific strength and have already been used as structural materials for aerospace applications. The mechanical properties of these alloys are often associated with the addition of Li which enables the formation of several strengthening precipitates including $\delta'$ (Al$_3$Li), $\theta'$ (Al$_2$Cu), $\delta$ (AlLi) and $T_1$ (Al$_2$CuLi). Other precipitates have also been reported in these alloys that include GP zones, $\theta$ (Al$_2$Cu), $\Omega$ (Al$_2$Cu), $S'$ (Al$_2$CuMg), and $\beta'$ (Al$_3$Zr), e.g. [1-3]. Nevertheless, the quasi-static mechanical properties of AA2198 are scarcely reported in the open literature while quite few for the fracture toughness. For example, Chen et al. [4] performed tests on two different heat treated AA2198 (namely T351 and T851) and investigated their plastic and fracture behavior. Steglich et al. [5, 6] investigated experimentally and analytically the anisotropic deformation of AA2198-T8 occurred during mechanical loading with and without the presence of artificial notches. In a recent publication [7], a combination of transmission electron microscopy, atom probe tomography and high-energy X-ray diffraction was employed to investigate the influence of local microstructural changes on strengthening in AA2198 in different aging conditions.

As AA2198 is supposed to replace AA2024 in aerostructures designed with the damage tolerance philosophy, the authors in the present work report and compare their tensile mechanical and fracture toughness behavior under different aging conditions to simulate the natural aging parameter. To this end, a comparison of both alloys of their tensile mechanical behavior is reported for different stages of aging, including conditions of under-aging (UA), peak-aging (PA) and over-aging (OA). Typical
results of yield stress as well as elongation at fracture for the case of AA2024 can be seen in the diagrams of Figure 1. The effect of artificial aging on the fracture toughness is also assessed for both alloys. Although the peak-aged temper of AA2198 is of application interest, a detailed investigation of the structure–property relationships of other temper states is attempted since it provides the basis for understanding the influence of process-induced microstructural changes on the post-processing properties of the alloy. To this end, structural characterization as well as relationship between yield stress, elongation at fracture and fracture toughness is reported and discussed in the manuscript for all investigated aging conditions.

Figure 1: (a) Yield stress and (b) elongation at fracture values for the different artificial ageing conditions of AA2024.

REFERENCES