CRYOGENIC ASYMMETRIC ROLLING APPLIED TO AA6061 AL ALLOY: AGING KINETIC, MICROSTRUCTURE AND MECHANICAL BEHAVIOR

Danielle Cristina Camilo Magalhães[1,*,#]; Vitor Luiz Sordi[1]; Maurizio Ferrante[1]

[1]Department of Materials Engineering, Federal University of São Carlos, São Carlos 13565-905, Brazil.

[#]Corresponding author: danielle_camilo@yahoo.com.br

In recent years, several efforts have been directed towards the optimization of rolling. At this point, two strategies can be highlighted: processing at low temperature and changes in the rolling process, as is the case of the Asymmetric Rolling (AR). In the first case, the drastic reduction of the processing temperature, also called cryogenic rolling (CR) aims at the partial suppression of mechanisms related to dynamic recovery, thus altering the work-hardening rate. The second strategy, which includes AR, constitutes changes in the geometry of the rollers or their rotation frequency. Thus, in addition to the application of a deformation by direct compression, there is also a shear component, increasing the deformation by pass. In the present work, a comparative study was made between conventional rolling and AR on the AA6061 alloy. Solution-treated samples were rolled up to equivalent strains of 0.5 and 2.0, at room- and cryogenic temperatures. In the latter, the sample was dipped in liquid nitrogen for 10 minutes before each pass. After rolling, precipitation heat treatments were performed at 100 ºC in oil bath (T6) and natural aging (T4). The results indicated that cryogenic processing accelerated the aging kinetic, leading to higher hardness levels. After cryogenic AR followed by T6 treatment (48 h), the uniform elongation increased without reducing the yield stress, i.e., a simultaneous enhancement of tensile strength and ductility. The microstructures showed a more intense refinement for higher levels of deformation, besides a greater heterogeneity between the surface and the center of the specimens processed by AR. This work is directed to determine processing conditions for AR of aluminum alloys, combined with precipitation treatments, aiming for stable microstructures with the pair strength-ductility optimized.