Superplasticity of a Friction Stir Processed 7075-T651 aluminum alloy

Abstract

Superplastic forming is a technological process used to produce metallic components with very complex shapes. In the last two decades it has been a topic of major development. In Fine Structure Superplasticity (FSS), the initial grain size exerts a strong influence on the superplastic behavior, affecting the Grain Boundary Sliding (GBS) mechanism. Refining grain size (GS) the parameters of superplastic forming (temperature and strain rate) could be optimized. Thermal stability of grain structure is also an important factor to obtain superplasticity. FSP is technique recently developed used to refine GS. The optimum FSP processing parameters are still under study for different materials. In the present work a 7075-T651 aluminium alloy was friction stir processed in order to improve superplastic behavior. Friction stir processed specimens were tensile tested at temperatures between 350 and 450 °C and initial strain rates between $5x10^{-3}$ and 2.5 $x10^{-2}$ s^{-1}. A strong influence of both temperature and initial strain rate on the test results was observed. The maximum superplastic elongation was 900% at 400°C and $1x10^{-2}$ s^{-1} strain rate. Due to the low temperature and high strain rate used in the tests these results are better to those obtained in previous works and would be associated with the processing conditions and the design of the tool used.

Keywords: friction stir processing; 7075-T651 aluminum alloy; superplasticity; grain size