The Influence of Warm Forming on Corrosion Susceptibility and Mechanism of AA7075 Aluminium Alloy

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Abstract Plastic forming is widely employed in aluminium alloy manufacturing to form components with various geometry. To increase forming efficiency. Warm forming (T < 0.6Tm) is increasingly used in aluminium alloy manufacturing. However, forming at elevated temperatures inevitably result in microstructure modification, leading to changes in properties. Although the effect of warm forming on mechanical properties is extensively investigated, the literature on corrosion performance of warm forming is scarce. The present study investigates the influence of warm forming on the corrosion behaviour of AA7075 aluminium alloy. The microstructure evolution during forming under different temperatures is characterized by using analytic electron microscopy. Further, the influence of plastic deformation introduced by forming on the corrosion behaviour of the alloy is investigated by correlative corrosion testing in acidified sodium chloride solution and quasi-in-situ electron microscopy, with the aim of establishing the correlation between the corrosion initiation and propagation processes and the microstructure features introduced by warm forming.

It is observed that warm forming with 30% strain at 320°C introduces significant dislocation structures in grain interior and discrete sub-grain boundaries (SGBs). However, recovered structure is observed in the alloy deformed at an increased temperature of 420°C. Further, η phase precipitates with high Cu content are formed on the SGBs during the forming processes. Zn and Mg segregations along the DWs and SGBs are also observed in the alloy after forming. Such microstructure modifications lead to the changes in the corrosion behaviour of the alloy. The presence of high population of DW/SGB in the alloy deformed at 320°C plays an essential role in the development of the intragranular corrosion. Further, the higher forming temperature of 420°C led to more severe intergranular corrosion. The corrosion initiation and propagation mechanisms associated with the specific microstructural features introduced by the forming process is discussed.

Keywords Aluminium alloys; forming; intergranular corrosion; intragranular corrosion