Research on Corrosion Fatigue Short Crack Initiation and Growth Behavior of Aluminum Alloy Welded Joints

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The corrosion fatigue crack initiation and short crack propagation behavior of aluminum alloy welded joints in 3.5wt.%NaCl solution has been researched. Corrosion fatigue short crack was directly monitored using a digital camera and 250 μm as a critical value of fatigue crack initiation. An 810 Material Test System low-frequency fatigue test machine was used in fatigue test and the specimens were loaded with the stress ratio R = 0.4, 0.5, 0.6 and 0.7 at frequency of 5 Hz. On the basis of calculation, fatigue crack initiation threshold value 〖(Δσ_eqv)〗_thcf and fatigue crack initiation resistant factor C_icf were 49 MPa and 6.97×1012, respectively. So the fatigue crack initiation life curve of A7N01P-T4 welded joints can be described as Ni=6.97× 〖10〗^12 〖[〖Δσ〗_eqv^1.739- 〖49〗^1.739]〗^(-2). A JSM-6490LV QUANTA FEG 250 scanning electron microscopic(SEM), electron back-scattered diffraction (EBSD) and JEM-2100F transmission electron microscopy (TEM) were used to research the mechanism of corrosion fatigue crack initiation. SEM and TEM tests revealed that several corrosion fatigue cracks formed asynchronously and the first crack does not necessarily develop into the leading crack. A uneven reticular dislocations produced by fatigue-loading was prone to piling up and tangling near the grain boundaries or the second phases and form the “High Dislocation-Density Region (HDDR)”, which acted as an anode in micro batteries and dissolved to form small crack. Thus the etching pits, HDDR near the grain boundaries and second phases were confirmed as the main causes inducing the initiation of fatigue crack.