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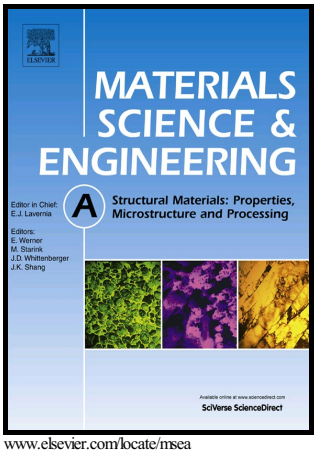

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Microscopic investigation of failure mechanisms in AA5182-O sheets subjected to electro-hydraulic forming

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Abstract

In this study, damage mechanisms in AA5182-O aluminium sheets are investigated using quasi-static (QS) Marciniak tests and high strain-rate electro-hydraulic forming (EHF) process. The results confirm that void nucleation, growth and coalescence are the main damage mechanisms of AA5182-O at both high and low strain rates. The EDS analysis suggests that cracking of Al_3(Fe-Mn) intermetallic particles is the main source of void nucleation, whereas Mg_2Si particles do not majorly influence void formation. Void growth analysis suggests that specimens deformed under QS conditions contained more voids in areas away from the sub-fracture surface but specimens deformed at high strain rate exhibit more significant rate of void growth close to sub-fracture areas. Void formation is suppressed by increasing the applied energy in EHF. And more significantly, the growth of voids is suppressed due to the high-velocity impact of the sheet against the die which plays an important role in increasing formability of AA5182-O aluminium sheet in EHF process. When the void percentage increase remains less than about 0.5% AA5182-O can be formed safely. However, when the void percentage increases beyond 0.6-0.8% fracture becomes inevitable.

Keywords: High strain rate, Electrohydraulic forming, 5000-series aluminium alloys, Void nucleation and growth, Fracture mechanism

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