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The influence of grain size and strain rate effects on formability of aluminium alloy sheet at high-speed forming

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Abstract: In order to investigate the coupling influence of grain size and strain rate on formability, a series of limit dome height (LDH) tests were conducted at four different speeds ranging from 0.012m/s to 11.04m/s via stamping and electro-magnetic forming process. Aluminium sheets A5052 H32 with 0.5mm thickness were used for experiments and annealed in different conditions to obtain different microstructures ($T/D= 6.99 \sim 27.17$). The strain data of FLD were compared with the limit dome height measurement to clarify the influence of various grain sizes on formability. Furthermore, the fracture surface and microstructure of tested samples were observed by SEM and OM to understand the damage mode. The results show that the influence of decreased grain size at high-speed forming not only enhances material strength but also increases the probability of grain boundary fracture that could impair the formability. This new finding can be used in predicting the occurrence of fracture and as a reference for product design and processing simulation analysis.

Keywords: grain size; strain rate; limit dome height; electromagnetic forming; forming limit diagram (FLD)

1. Introduction

In recent years there has been a rapid growth in applications of smart hand-held devices and wearable electronic products. The requirement of aluminium alloy

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