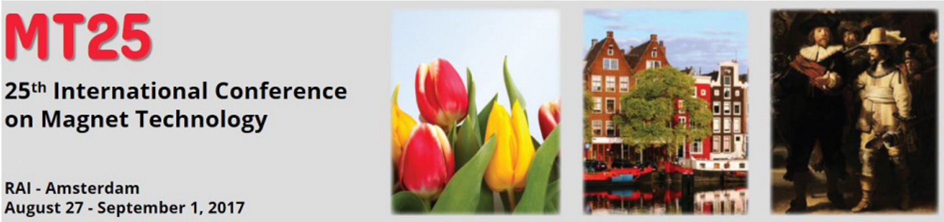

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Decoupling Velocity and Thermal Effect in the Electromagnetic Ring Expansion Test

Monday 28 August 2017 13:15 (1h 45m)

Electromagnetic forming (EMF) is acknowledged as a potential forming method because of its advantages relative to traditional forming technique. However, the multi-physics coupling process makes it a daunting task to analyze the forming mechanism. It is necessary to decouple the effects of velocity and thermal in EMF. Since the electromagnetic ring expansion is used as a one-dimensional simplification of EMF process, a dual-ring expansion experiment is designed and performed on AA5083 aluminum alloy, in which a copper ring (known as driving ring) is placed between the aluminum ring (also known as workpiece) and the driving coil side by side. Copper rings can shield part of the eddy current in the workpiece, so the thermal effect in the workpiece caused by the eddy current can be decoupled. According to the simulation, while the thickness of copper rings (0.5 mm, 0.8 mm and 1.2 mm) increases, the eddy current in the copper ring and electromagnetic force increases significantly. Then the different deformation strain rates can be achieved. The dual-ring expansion experiment with three different thicknesses driving rings were carried out, and the single aluminum ring expansion experiments were performed comparatively as well. The experiments results show that the average strains to failure at different strain rates appear positive related to the strain rate. The ductility of AA5083 aluminum alloy can be improved from 17% to 25% due to the high strain rate, and from 17% to 30% due to the high strain rate and thermal effect. This study suggests that the forming behavior is influenced by the high strain rate in addition to joule heat caused by the eddy current.

Submitters Country

China

Primary authors: Ms WU, Jiawei (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology); CHEN, Qi; QIU, Lei; HAN, Xiaotao (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology); CAO, Quanliang; LI, Liang

Presenter: Ms WU, Jiawei (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology)

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