Contribution ID: **995** Contribution code: **WED-PO2-306-09** Type: **Poster**

Relaxation of residual stress in the aluminum alloy ring by electromagnetic bulging method

Wednesday 17 November 2021 10:30 (20 minutes)

Aluminum alloy rings are the key component to realize the lightweight and improve the mechanical properties of aerospace vehicles and devices. However, the residual stress is inevitably introduced by uneven heating and mechanical load having a negative effect on the dimensional accuracy and performance of the rings. Therefore, the elimination of residual stress is of great significance to improve the dimensional stability and fatigue strength of the alloy rings. The common methods to relieve the residual stress are mainly annealing treatment and mechanical method. But these methods have some shortages, as their machining ranges are limited, contact stress is too concentrated, and the temperature rise may soften the strength of components. To avoid the above disadvantages, a novel method using electromagnetic driving force to bulge the alloy ring into the plastic phase and eliminate the residual stress is proposed by this paper. Compared with traditional mechanical force, the spatiotemporal distribution and working area of electromagnetic force can be controlled by high field magnets flexibly. The target of this paper is relieving the residual stress of 2 and 5 series aluminum alloy rings with 720mm external diameter, 60mm thickness and 60mm height by pulsed electromagnetic force. Firstly, a high-performance magnet was designed and produced to generate a strong enough electromagnetic force. And it can provide about 2%-3% plastic deformation to the rings after electromagnetic bulging. On this basis, by changing the time constant and damping factor of the circuit, the effect of joule temperature rise and periodic vibration on the relaxation of residual stress are studied. Finally, to verify the effect of this method, hole-drilling method and x-ray diffraction were used to measure the changes of residual stress field in the rings. Moreover, the shape and size of lattice were studied by EBSD to explore the elimination mechanisms from microcosmic perspective.

Author: Dr LI, Xiaoxiang (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology)

Co-authors: Mr TANG, Yinghao (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology); Mr ZHANG, Yi (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology); Mr LIU, Haixiang (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology); Prof. LI, Liang (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology)

Presenter: Dr LI, Xiaoxiang (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology)

Session Classification: WED-PO2-306 Resistive and Pulsed High-Field Magnets