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Metal and Ceramics session

Investigation of Healing Ability of 6XXX Series Based Al Alloy Produced by Friction Stir Processing.

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During the service life of an aluminum part, damage occurs due to the presence of large intermetallic particles and it leads to significant economic loss for their replacement. However, healing strategies could be developed to extend their lifetime. In the present work, a new class of healable 6XXX series based Al alloys is processed using Friction Stir Processing (FSP). The processed Al alloy shows a healing ability during heat treatment due to the presence of well-distributed healing particles in the matrix. FSP has already proven as a perfect method for redistribution and size reduction of Fe-rich intermetallic particles [1]. In situ tensile Scanning Electron Microscopy (SEM) tests have shown that the damage mechanism in the produced healable Al alloy is changed as new healing particles are damaged first, while Fe-rich intermetallics are mostly remaining intact. The pre-damaged samples produced by a micro-tensile machine were further investigated by in situ heating transmission electron microscopy (TEM) including EDX analysis in order to track healing evolution of damaged particles and reveal healing mechanism. In situ X-Ray nano holotomography experiment carried out at ESRF on the beamline ID16B with a resolution of 35 nm provided additional statistical data on the healing ability of the bulk material. The tests were performed using a dedicated furnace with a quartz chamber available at the beamline [2]. The samples were annealed at various temperatures for 8 hours in total and scanned in between each heat treatment step. It was found that small damage (up to 1 µm size) can be healed at 400°C within 10 min of heat treatment.

[1] F. Hannard et al. Acta Materialia 130 (2017) 121-136

[2] J. Villanova et al. Materials Today 20 (2017) 354-359