

Friction stir processing of selective laser melted AlSi10Mg for mechanical behaviour enhancement. Study on damage mechanism evolution

Juan Guillermo Santos Macías (UCLouvain), Lv Zhao (UCLouvain), Chola Elangeswaran (KUL), Brecht Van Hooreweder (KUL), Jérôme Adrien (INSA Lyon), Jean-Yves Buffière (INSA Lyon), Eric Maire (INSA Lyon), Aude Simar (UCLouvain)

The friction stir technique has potential to be useful in the additive manufacturing field. Indeed, its use can be convenient not only from the more practical aspect, e.g. as a way of locally improving mechanical behaviour in highly solicited regions of structural parts made of selective laser melted aluminium alloys (AlSi10Mg being the most representative one), but also to help understand the mechanisms involved in the behaviour of these AM materials.

In this research, friction stir processing (FSP) was applied to selective laser melted AlSi10Mg. Through mechanical testing and in situ characterisation techniques, the critical aspects affecting mechanical behaviour of the additive manufactured material and their evolution after FSP were studied. In situ and ex situ mechanical and microstructural characterisation, including static and fatigue testing, microscopy (LOM, SEM) and tomography analyses, have helped in identifying and understanding the key aspects involved in the damage mechanisms. In more detail, the Si-rich eutectic interconnected network that dominates static mechanical behaviour and the relatively large (that is, compared to the very fine microstructure) porosity are both significantly affected by FSP. From a scientific perspective, coupled with heat-treated samples (only thermally affected) analyses, it offers the possibility of wholly understanding the mechanisms behind the material behaviour. Moreover, the consequent ductilisation and fatigue enhancement prove FSP post-treatment as interesting from a practical point of view.