1390 Enhancement of the mechanical behavior of SLM AlSi10Mg by optimized thermomechanical post-processing routes

<u>Camille van der Rest</u>, Juan Guillermo Santos Macias, Lv Zhao, Matthieu Marteleur, Pascal J. Jacques, Aude Simar
UCLouvain, iMMC-IMAP, Louvain-la-Neuve, Belgium

Selective Laser Melting (SLM) processed AlSi10Mg is known for having high strength but low ductility behavior, with the interconnected Si network being the initiation point of damage. In this work, various thermomechanical post-processing treatments have been envisaged to tailor the microstructure and the mechanical properties of AlSi10Mg processed by SLM: heat-treatments, hot isostatic pressing and friction stir processing. Both the static and fatigue properties were investigated and compared to the performances of the as-built material. In-depth microstructural and damage analyses complete the study.
Optimized stress relieve heat-treatments (SRHT) allow to reach larger ductility thanks to a (partial) globularisation of the Si phase. Depending on the temperature and duration of the SRHT, a compromise is reached between high strength and large ductility.
Hot isostatic pressing (HIP) combines the effect of SRHT with isostatic pressure. It is commonly used in the aerospace industry on cast parts in order to improve their fatigue life thanks to a reduction of porosity. However, up to now, there is no consensus in the literature on the efficiency of HIP on SLM AlSi10Mg. This work tried to highlight the advantages and disadvantages of HIP on such SLM microstructures and their resulting mechanical properties.
Friction stir processing (FSP) of SLM AlSi10Mg brings locally globularised Si particles, homogenized microstructure and lower porosity levels. While the resulting tensile behavior is similar after FSP and after SRHT, the fatigue life is promisingly improved after FSP.

1391 Interfaces to move atoms and moved atoms to stop interfaces

<u>Sybrand van der Zwaag</u>
Delft University of Technology, Delft, The Netherlands

Solid state phase transformations in steels not only involve a local transition in crystal structure but my also lead to the partitioning of alloying elements given their different solubilities in the fcc and bcc crystal structure. So, the kinetics of the phase transformation is not only function of the kinetics of the structural change (the intrinsic interface mobility) but also the partitioning of the alloying elements. The relative role of both can not be distinguished in conventional thermal cycles based on (combinations of) controlled cooling and isothermal holding. In contrast, the Cyclic Partial Phase Transformation concept relatively easily separates the effect of intrinsic kinetics and alloying element partitioning (in particular the substitutional alloying elements).
Using dedicated cyclic transformations and understanding how to release the locally enrichment at the moving interface from the interface, it is possible to leave behind nanometer wide layers in the steel structure which can be used in the final thermal treatment to create a nano-sized multiphase structure leading to exceptional mechanical properties (UTS> 2200 MPa and UE > 15%) for lean Mn containing steels. Unlike the case of superbainitic steels these properties are reached in very short and industrially realistic times.