

**Travail de fin d'études et stage[BR]- Travail de fin d'études : Fabrication and
characterization of AISI S2 Tool Steel + SiC by Laser Powder Bed Fusion[BR]-
Stage d'insertion professionnelle**

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Faculté : Faculté des Sciences appliquées

Diplôme : Cours supplémentaires destinés aux étudiants d'échange (Erasmus, ...)

Année académique : 2022-2023

URI/URL : <http://hdl.handle.net/2268.2/17799>

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Fabrication and characterization of AISI S2 Tool Steel + SiC by Laser Powder Bed Fusion

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Academic year 2022 – 2023

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The present study evaluates the processability of AISI S2 plus 10% in volume of SiC through the Laser Powder Bed Fusion (LPBF) technology. It is the continuation of the work “Fabrication and characterization of low-alloyed tool steel obtained by Selective Laser Melting,” 2023 [1] carried out by the same team. This S2 low-alloyed tool steels have been rarely studied in Additive Manufacturing (AM) due to poor welding properties. Using alloying methods to create Metal Matrix Composites (MMCs) can improve several properties of these steels though. For instance, adding SiC nanoparticles to AISI S2 enhances both the hardness and wear resistance among other properties, but in the meantime, this will increase the carbon content which has been found to promote crack appearances. Therefore, a careful evaluation of the processability of the MMCs is needed.

In order to analyse the capability of fabricating these samples, two different batches were considered, one with and another without preheating the baseplate of the printer. Achieving crack-free fully dense samples is demonstrated to be possible under some premises. There is a tendency for SiC nanoparticles to agglomerate, thus leading to non-homogeneous properties. Therefore, optimizing the powders preparation is required. Different kind of defects may be observed on parts processed by LPBF depending on processing parameters. Therefore, optimizing the parameters of the LPBF laser process is also mandatory to set a defined processing map for each batch of samples. Nevertheless, preheating of the baseplate seems to be required since all the samples without preheating exhibit cracks.

Moreover, taking advantage of both batches, the influence of the preheating on both the microstructure and the mechanical properties is highlighted. Furthermore, the effect of SiC nanoparticles addition is enhanced when comparing the MMCs to S2 samples obtained from LPBF process.

Some revealing images of the thesis are the following:

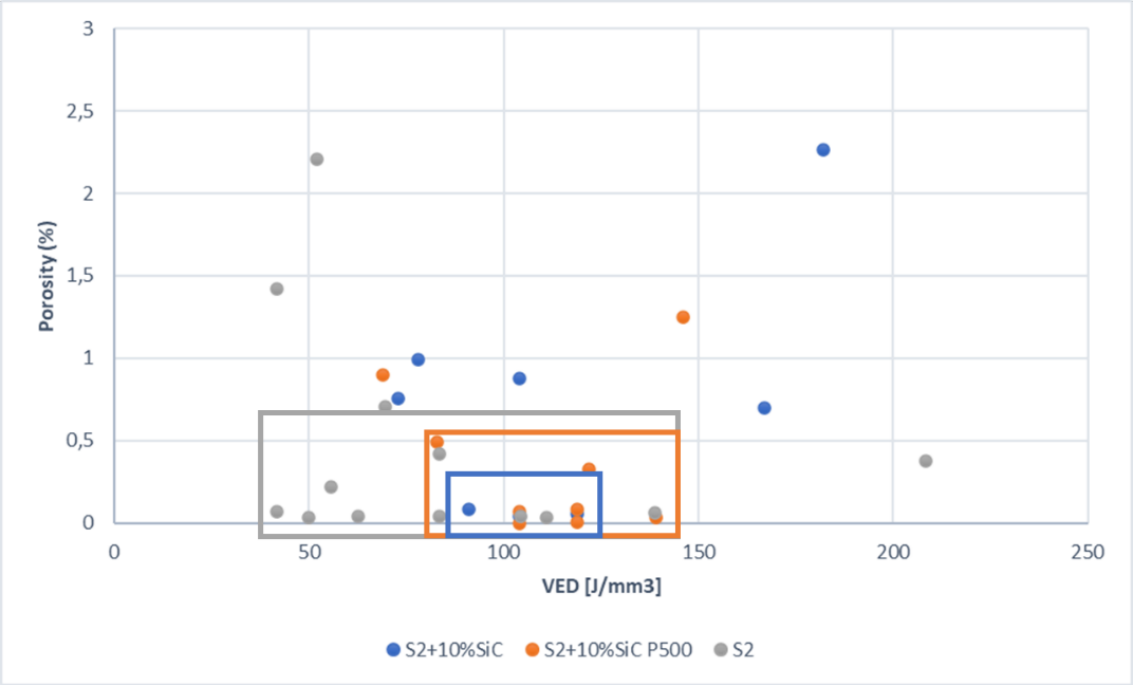


Figure 1. Porosity values of only S2 and S2 + 10%SiC with and without preheating batches

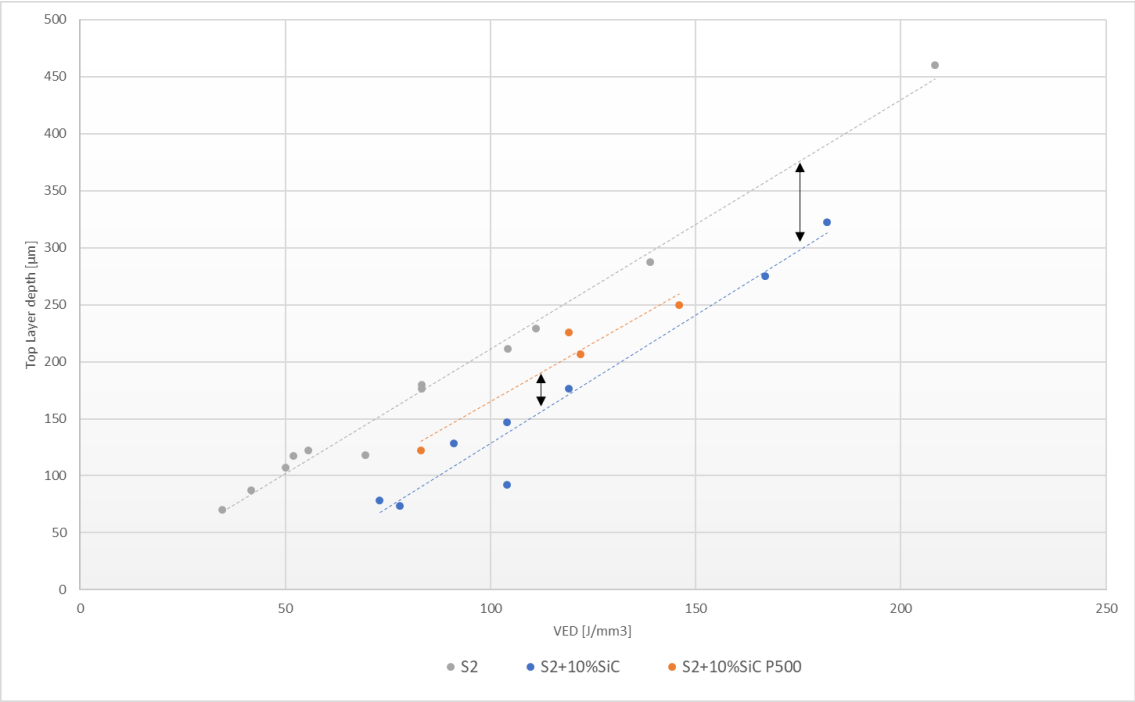


Figure 2. Top layer depths as a function of VED in only S2 and preheated and non-preheated S2 + 10%SiC samples

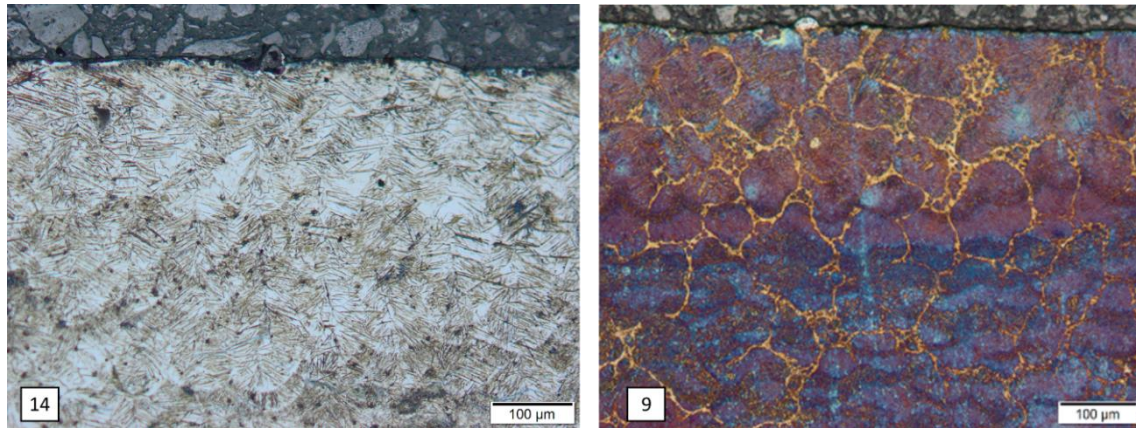


Figure 3. OM of sample number 14 with no preheating and sample number 9 with preheating

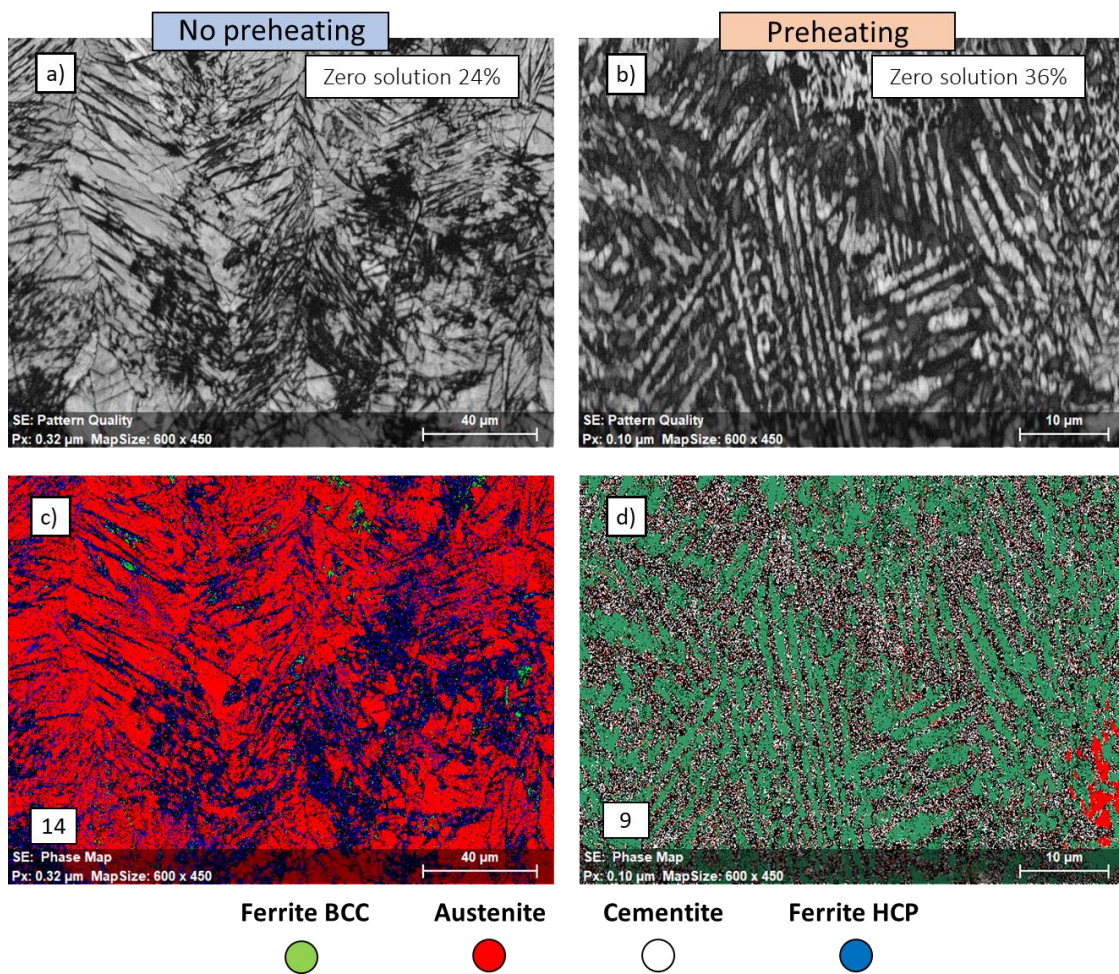


Figure 4. EBSD images a) Pattern Quality of non-preheated sample b) Pattern Quality of preheated sample c) Phase Map of non-preheated sample d) Phase Map of preheated sample

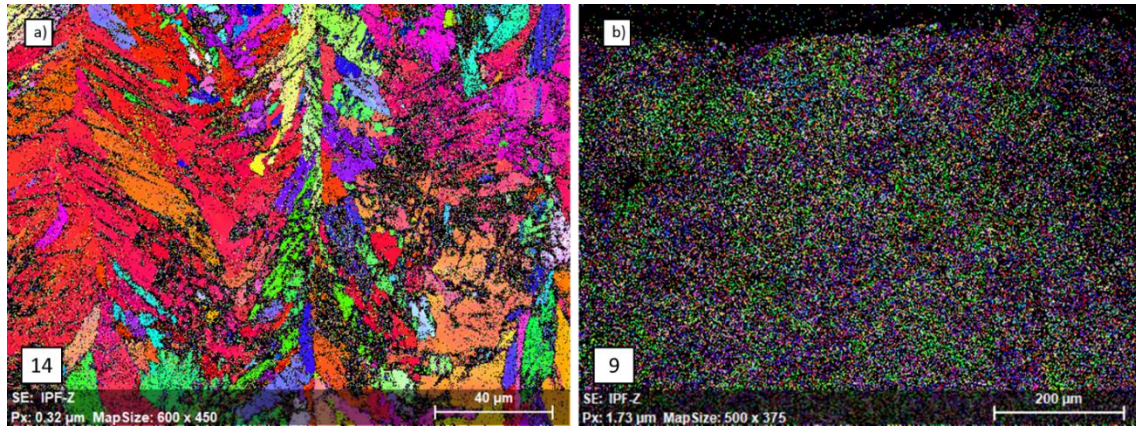


Figure 5. IPF in Z direction of a) non-preheated sample 14 b) preheated sample 9

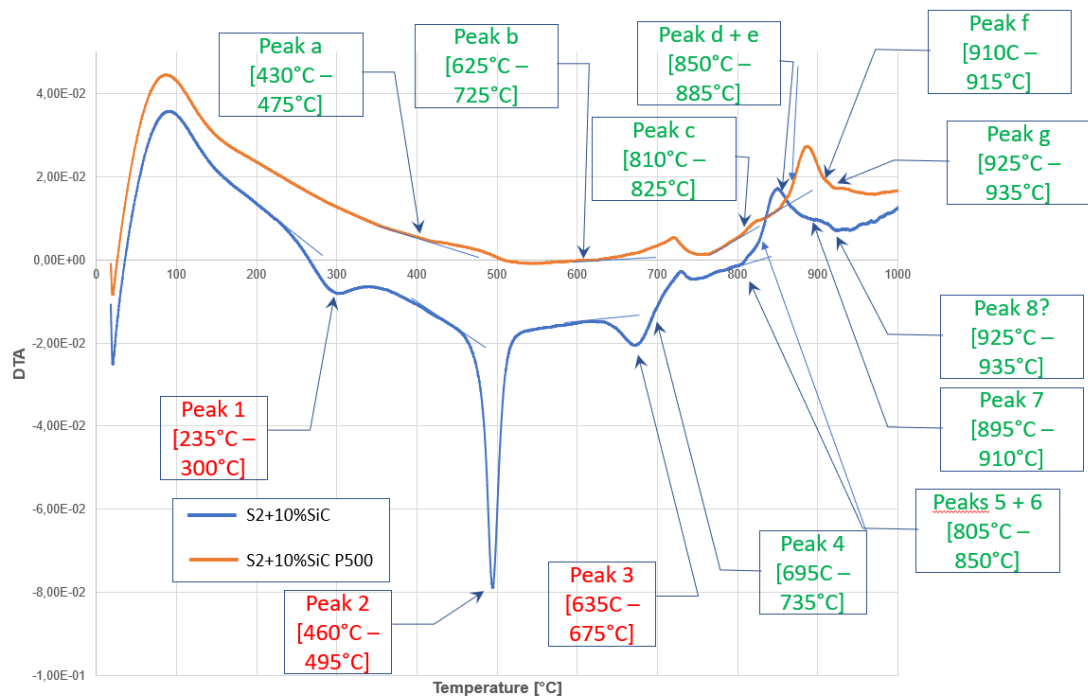


Figure 6. DTA of preheated and non-preheated samples