ESRF	**Experiment title: Microstructural characterization and phases transformation identification of highly complex self-fluxing alloy NiCrBSi obtained via low and high cooling rates**	**Experiment number**: MA-5643
Beamline: ID11	**Date of experiment**: from: 29/03/2023 to: 30/03/2023	**Date of report**: 26/06/2023
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Report:

As mentionned in the proposal, the aim of this experiment was to understand the complex microstructure of NiCrBSi parts obtained by L-PBF.

These alloys microstructures are known to be very complex with several low symmetry phases. Furthermore, the microstructure of NiCrBSi produced by L-PBF is not described yet in the literature. According to our investigations combining SEM-EDS and EBSD, the microstructure is considerably finer than in castings or hardfacing coating. Micrometric crystals are located at the periphery of melting pools, and within melt pools. Precipitates are so small that they are difficult to resolve. Global XRD analysis has been completed at ID22 providing global information concerning phase identification. However, in order to investigate which crystal are located in the core or the peripheral zone of the melt pool, local diffraction data are required. Therefore, we asked the ID11 team to perform XRD-CT.

We studied one sample obtained by standard L-PBF parameters exhibiting microstructure gradient at melting pool boundaries (Fig.1 a and c) and one obtained with a highly preheated baseplate which does not exhibit microstructure gradient (Fig.1 b and d). XRD-CT was performed with a beam size of 150 nm and one slice every 10 µm.

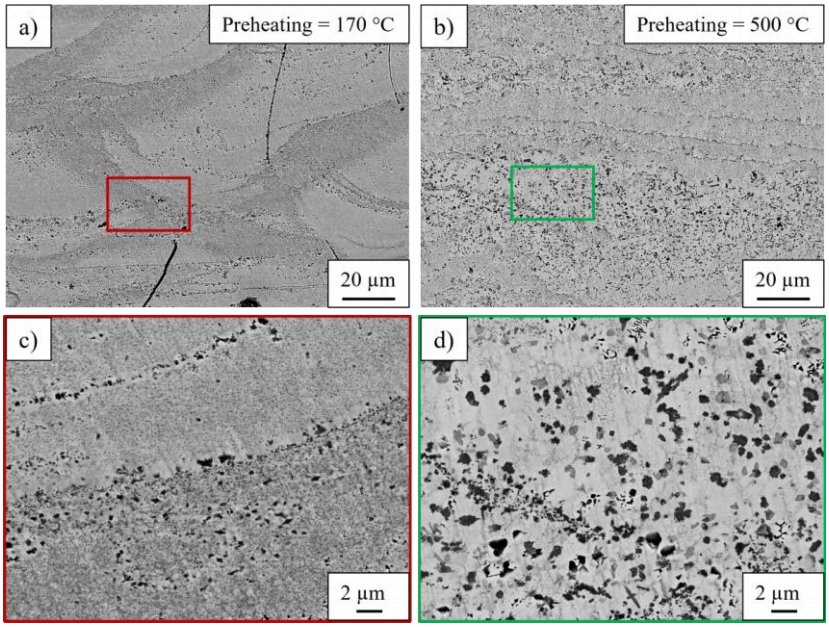

Fig.1 SEM-BSE micrographs of studied samples a) Standard preheating fabrication b) High temperature preheating fabrication. c) and d) higher magnification of resp. a) and b)

According to our previous experiment at ID22, samples are composed of the Ni-rich matrix, CrB, Cr_7C_3, Ni_3B, $Ni_{31}Si_{12}$ crystals. Further small Ni_3Si precipitates are identified in the sample obtained with a highly preheated baseplate. The spatial distribution of Ni grains was reconstructed according to this phase identification.

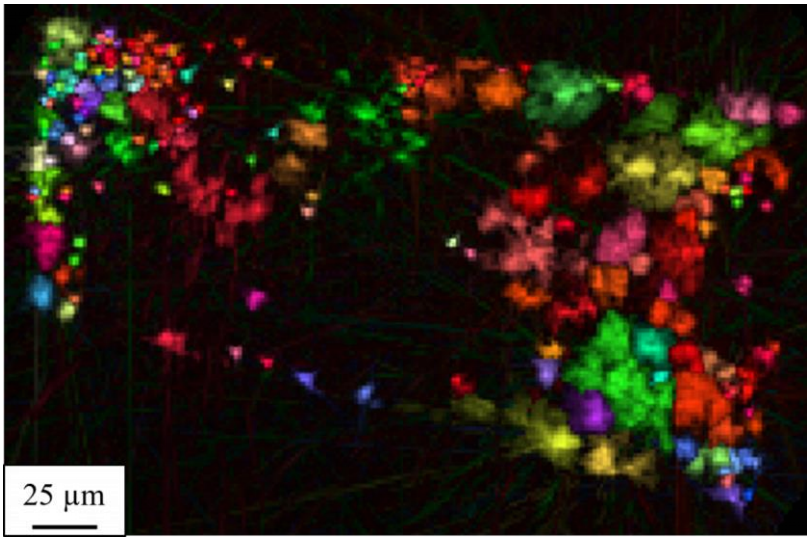

Fig. 2 Mapping of nickel grains across one slice of the sample obtained with standard parameters.

Small nickel grains are arranged at the periphery of the sample (Fig.2). However, peaks related to the other phases are superimposed making spatial repartition reconstruction challenging. Therefore, the spatial dispersion of phases other than nickel has not been plotted yet. We are still working on the spatial repartition reconstruction for the phases other than nickel but we cannot guarantee that it will be successful given the complexity of the diffraction pattern. Furthermore, complementary TEM-SAED analysis will be performed.
Once spatial dispersion will be ploted, this work will be part of an article dealing with the microstructure of NiCrBSi obtained by L-PBF. Finally, these results will form part of my PhD thesis on the NiCrBSi alloy.