	Experiment title: SiO2 exsolution in Fe-Si-O ternary system	Experiment number: ES-1102
Beamline: ID24/HPLF	**Date of experiment**: from: 12/07/2022 to: 23/07/2022	**Date of report**: 10/09/2023
Shifts: 15	**Local contact(s)**: R. Torchio ; J.-A. Hernandez	*Received at ESRF:*

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Report:

This proposal was part of the first effort to use the full performance of the HPLF installation combined with ESRF-EBS and optical diagnostics (VISAR). The global setup used in this experiment is presented in the Figure 1. The main laser drive is interacting with the ablator (50µm Black Kapton) to produce a shock wave in the sample located in the rear surface. The sample consisted of FeSiO prepared by Plasma Vapor Deposition with two different nominal compositions (#1 : 75 wt% Fe, 16 wt% Si, 9 wt% O ; #2: 73 wt% Fe, 11 wt% Si, 16 wt%O). The grain size as well as the exact composition will be measured using Transmitted Electron Microscopy (measurement planned in late September 2023).

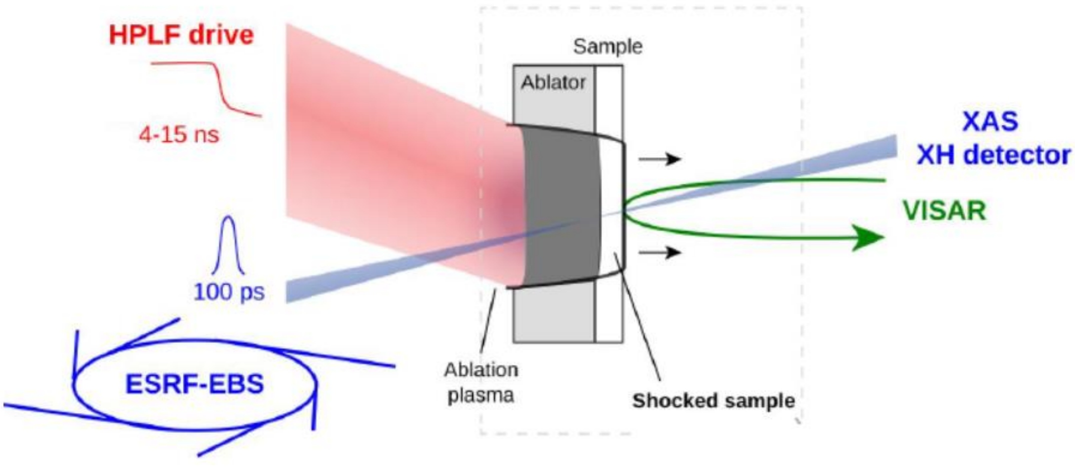

Figure 1 : Experimental setup available on the ID24/HPLF beamline

The analysis of the acquired XAS data, as well a sthe discussion around the hydrodynamic conditions have been performed by Gabriele Garofalo (master student from Politecnico di Milano) during his internship at ESRF between October 2022 and May 2023.

The XAS signal evolution as a function of pressure along the Hugoniot is presented in Figure 2. Changes are relatively small on the composition #1 samples, due to the high Si content which weakens the oscillations of the EXAFS signal (Boccato et al., 2020). On the contrary, increasing O content is giving a better XANES signal, and a clear change is observed around 200 GPa on the Hugoniot. This modification could be related to melting of the sample along the Hugoniot.

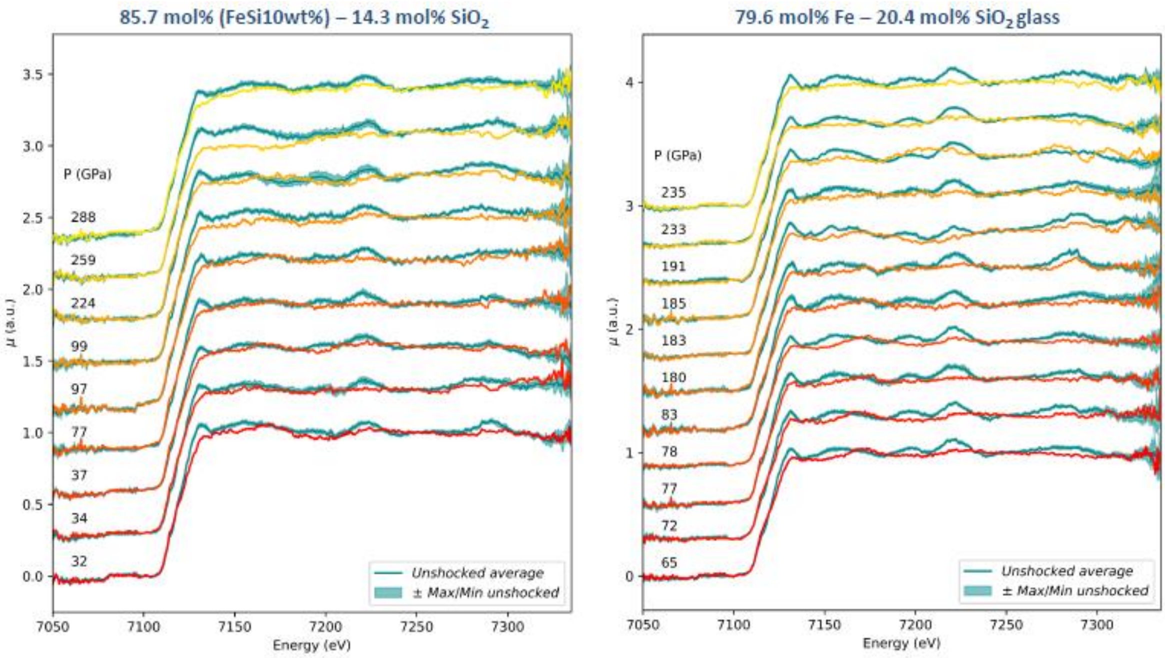

Figure 2: Comparison between cold and shock compressed FeSiO samples (composition #1 on the left; composition #2 on the right) for different pressures along their respective Hugoniot.

In order to pursue the analysis of the expartimental data, different tasks have to be completed. At first, we adopted a mixed EoS between SiO2 and Fe or FeSi alloys, based on the nominal compositions (Figure 3). Mixing different EoS during shock compression is still an open question and further investigation (Smith et al., 2022).

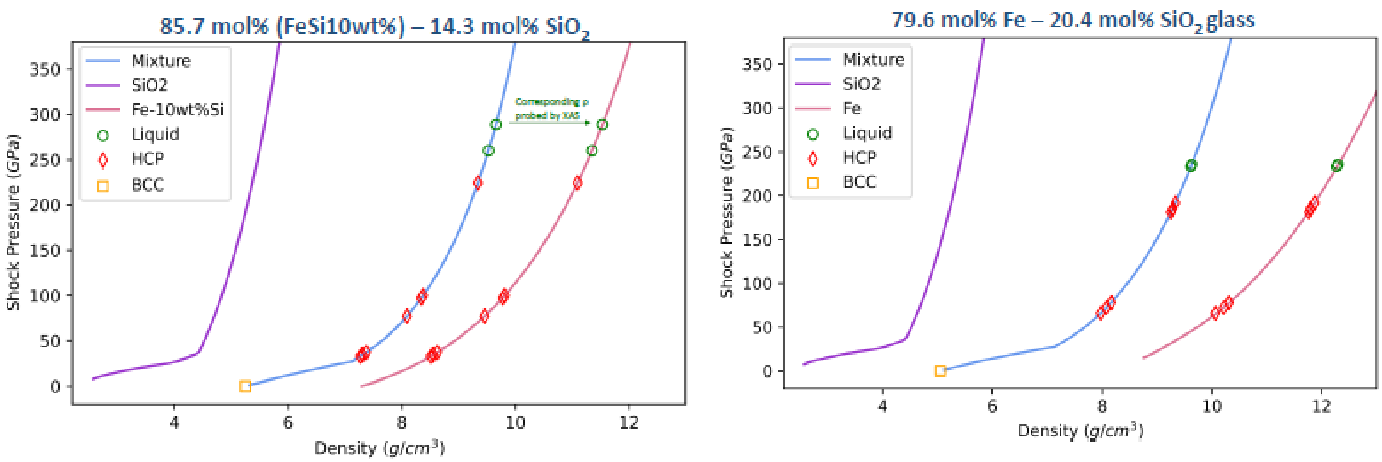

Figure 3: Hugoniot relation (pressure versus density) for the two Fe alloys, defined by the mixing between Fe or Fe-Si and SiO2 Hugoniots. The averaging method has been done following Batsanov model (Batsanov, 1994).

The characterization of the starting material is mandatory to determine the Hugoniot P-T path followed during shock compression. For this, Transmission Electron Miscroscpy will be performed to better constrained the texture of PVD samples. From then, we would better constrain the possible Hugoniot paths followed during the shock experiment, by defining the SiO_2 and Fe alloys contribution using the different grain sizes. This work will be done during this fall. At the end, we expect to be able to have enough material for a publication for early 2024.