ESRF	**Experiment title:** Gamma Ray Burst (GRB) melting of millimeter sized dust particles to form chondrules - simulation of astrophysical conditions using synchrotron radiation.	**Experiment number:** MI–527
Beamline: ID11	**Date of experiment:** from: 11/3/2002 to: 13/3/2002	**Date of report:**
Shifts: 6	**Local contact(s):** Dr. Gavin Vaughan, Dr. Åke Kvick, Dr. Ann Terry	*Received at ESRF:*

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Report:
This experiment was awarded six shifts from March 11th to 13th, 2002. It is a direct continuation of MI–392 (February 2th to 4th, 2000) and was expected to proceed smoothly because the method had been proven. The initial setup required significant effort in constructing the lead castle, beam alignment, etc. Much of this work was done on March 10th. The samples were inserted into the beam and blasted with X-rays from the wiggler. The samples did not heat up and melt as expected. Instead the beam tended to punch holes in the samples. This was rarely observed in the previous run. Samples with the same composition that was used in MI–392 were inserted into the beam. They heated up and melted as expected. This was as important diagnostic result that focused attention on the samples in this run MI–527. In preparing the samples there was one major change in composition i.e. Fe_2O_3 was used instead of Fe_3O_4. The changes in composition was enough to turn the new samples into almost perfect insulators and hence the heat was not conducted throughout the samples. In the cosmic case however the samples would be uniformly irradiated and have no need to rely on the thermal conductivity of the material.

There are two changes that should be made for the next run.
1) irradiate the full sample and check the thermal properties of the sample.
2) make significant changes to the pressure container to make monitoring of the temperature, TV camera, samples more efficient.

Overall the run was not as expected but the reasons are well understood.

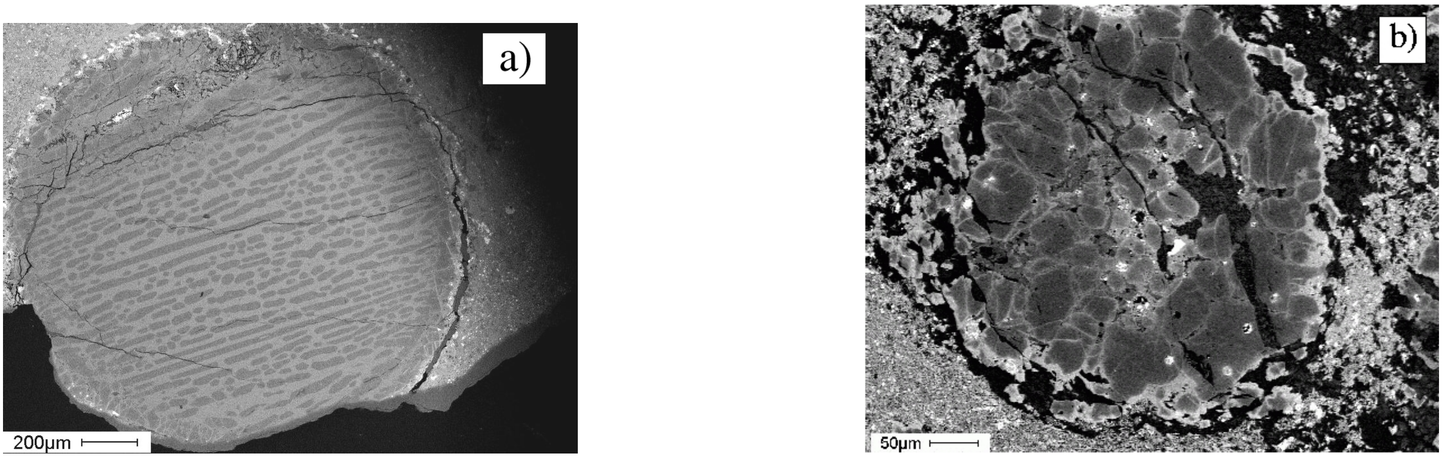
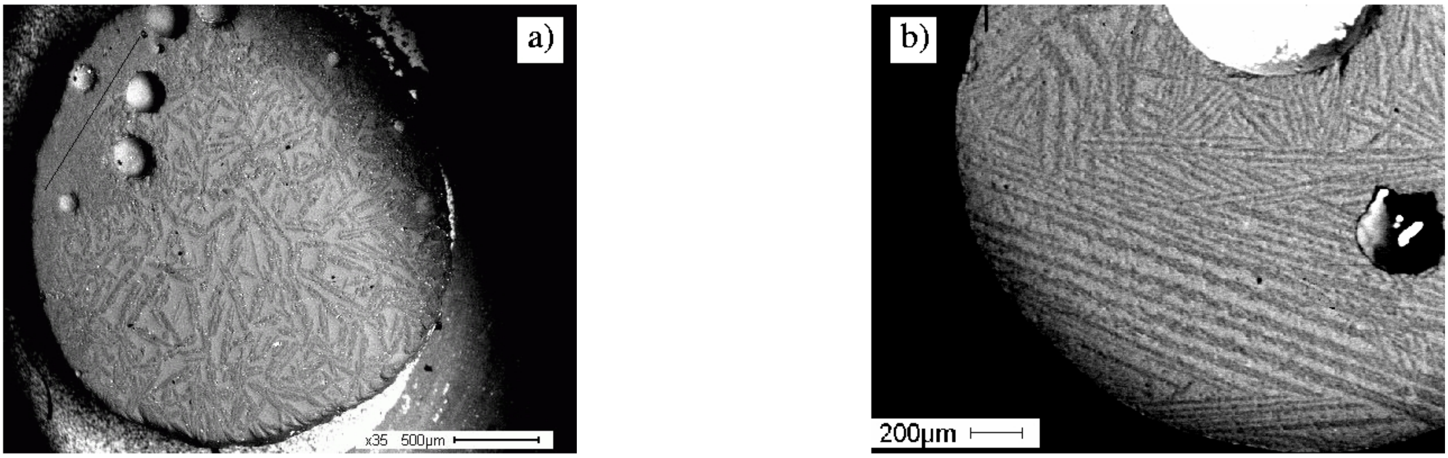


Figure 1: Backscattered electron microscope images of two chondrules from the Allende meteorite. Phases with higher atomic number are brighter in color. The dark grey grains are elongated olivine crystals in (a) and porphyritic crystals in (b) where the brighter regions are the interstitial glassy material. The diameters of the chondrules are about 1 mm and 0.6 mm and are surrounded by matrix material in the meteorite.



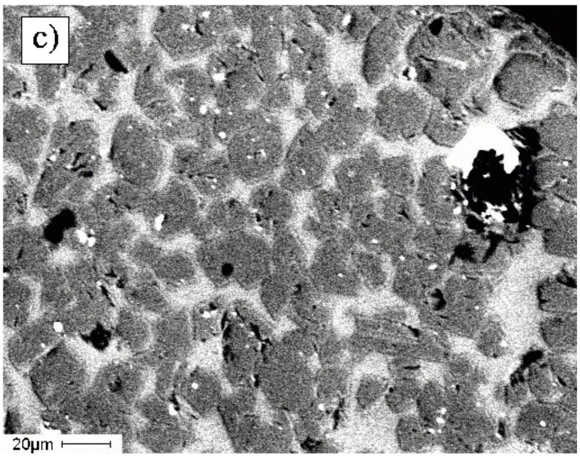


Figure 2: Backscattered electron microscope images of three melted samples from the synchrotron experiment. (a) and (c) are from Run MI–392 and (b) is from MI–527. (a) cross section of a complete sample with randomly orientated olivine crystals and type IA precursor composition. (b) section of a sample with barred olivine crystals and type II precursor composition. (c) section of a sample with porphyritic crystals and type IAB precursor composition. The samples in (a) and (c) have cavities of size < 500 mm that are caused by trapped gases.

Publications resulting from the work carried out at ESRF

P. Duggan, B. McBreen, A. J. Carr, E. Winston, G. Vaughan, L. Hanlon, S. McBreen, L. Metcalfe, A. Kvick, and A. E. Terry. Gamma-ray bursts and x-ray melting of material to form chondrules and planets. *Astronomy and Astrophysics*, In press.

P. Duggan, B. McBreen, L. Hanlon, L. Metcalfe, A. Kvick, and G. Vaughan. The Effects of a Gamma-Ray Burst on Nearby Preplanetary Systems. In E. Costa, J. Hjorth, and F. Frontera, editors, *Gamma-ray Bursts in the Afterglow Era*, pages 294–297. Springer Verlag, 2001.