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-392
Beamline: ID 11	**Date of experiment:** from: 2/2/2000 to: 4/2/2000	**Date of report:** 27/2/2000
Shifts: 6	**Local contact(s):** Dr. Gavin Vaughan, Dr. Ake Kvick, Dr. Ann Terry	*Received at ESRF:* 1- MAR. 2000

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ESRF Scientists

Provisional Report:

In the current cycle this experiment was allocated 6 shifts from February 2 to 4, 2000. Over 30 samples were irradiated in a gas at low pressure, usually air but for 10 samples molecular hydrogen was used. The reason for molecular hydrogen is that it is the dominant element in the Universe and also in the preplanetary solar system, The first major result is that the samples melted and did not disintegrate because of charging or gas escape. The pyrometer recorded the temperature (although the glass window darkened from radiation damage) and a TV camera viewed the sample through the pyrometer. The samples boiled and often had several eruptions as small pieces were ejected. The cool remnant generally had the correct characteristic of chondrules. Many of the samples have now been analysed with an electron microscope. They crystallised in a way approximately consistent with that of chondrules. In general the samples fired in low pressure molecular hydrogen are a better match to meteoritic chondrules that those fired in air. In some cases the cooling cycle was too quick because the percentage of glassy material in the remnant is more than 50%, there was not sufficient time for the crystals to grow (see attached figures). The analyses of all the samples will be completed in May and we plan to submit a letter to Nature on the results of this experiment.

These results imply that a further experiment be carried out with (a) similar composition to the first run but in at least some cases with graphite powder, at 5% by weight, added to the samples to better simulate chondrule formation conditions. (b) that most of the samples be irradiated in low pressure molecular hydrogen (c) that a larger range of cooling cycles be investigated from 5 minutes to at least 30 minutes.

In the first run not all the substrates worked. In general the graphite and Al_2O_3 substrates gave the best results.

We are indebted to the excellent facilities provided at ESRF and to the enthusiastic welcome and continuous support provided by ESRF staff. It was our first visit to ESRF and one that we shall treasure.

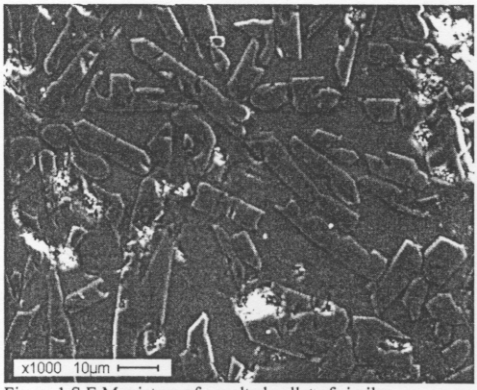

Figure 1 S.E.M. picture of a melted pellet of similar composition to type IAB chondrules. Note the crystals are aligned similar to Barred Olivine chondrule.

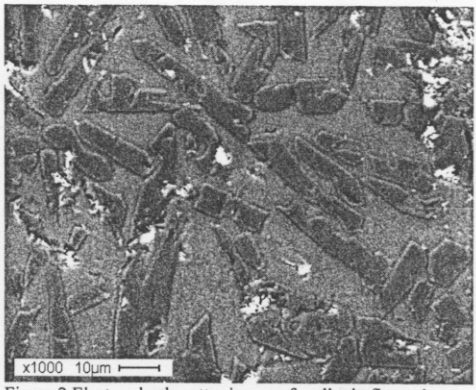

Figure 2 Electron backscatter image of pellet in figure 1.

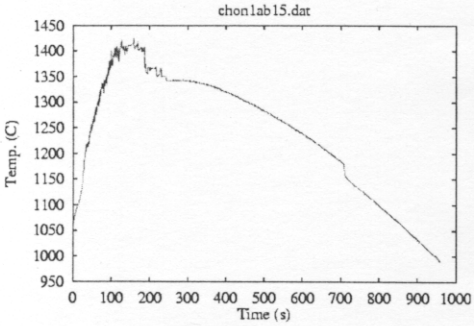

Figure 3: Temperature profile of firing cycle for temperatures above 1000 degrees Celsius as recorded by the pyrometer.

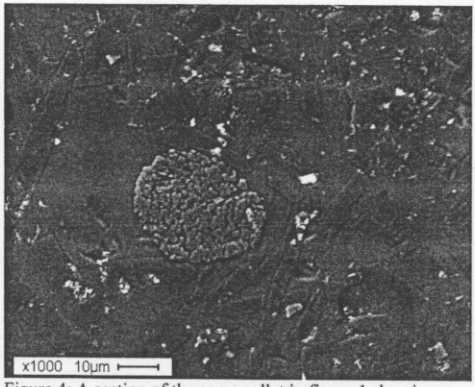

Figure 4: A section of the same pellet in figure 1 showing an unusual crystaline structure that is rich in magnesium.