	Experiment title: Dual Superlattice Superalloys	**Experiment number**: MA4765
Beamline: ID11	**Date of experiment**: from: 29 Sep 2021 to: 1 Oct 2021	**Date of report**: 27 Feb 2022
Shifts: 6	**Local contact(s)**: Eleanor Lawrence-Bright	*Received at ESRF:*

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Report:

This experiment sought to gain insight into the stability and precipitation sequences of the reinforcing phases in a novel class of γ-γ'-γ'' dual-superlattice superalloys that offer exceptional mechanical properties at elevated temperatures. To this end, a series of 6 alloys were prepared with varying Fe, W, Mo, Nb and Al contents. These alloys were selected as ex situ examination with labrotory characterisation methods had indicated differences in the precipitate morphologies and the temperatures at which precipitation was likely to have occurred. Unambiguous separation of the precipitation events was not possible with these laboratory based methods, necessitating the use of synchrotron X-ray diffraction.

In the experiment, a Linkam 1500 furnace was mounted on ID11 and used to heat small disc shaped samples of the alloys from room temperature to 1000˚C at 5˚C/min and cool at the same rate. During these thermal cycles, powder diffraction data were acquired in transmission from which it was hoped to determine the solvus temperatures, lattice parameters and volume fractions of the reinforcing precipitates.

Regrettably, experimental issues were encountered that prevented suitable data being acquired. On the first night of the experiment, the Bliss software crashed and could not be restarted by the users. The EHO could not help. The local contact restarted the system the following morning as it could not be restarted remotely. Throughout the following day, all scans were interrupted by periods where data collection ceased without warning on the Bliss system. This required the users to continuously watch the control terminal. In each occurrence, data collection was lost for a minimum of 5 minutes before the data acquisition could be resumed.

The Bliss system again crashed the following night and, once again could not be recovered until the local contact restarted the system the following morning. As with the previous night, the local contact attempted to restart the system remotely, but this was again unsuccessful.

Additional issues were encountered with the azimuthally integrated data obtained from the detector for some samples, which included regions of data loss. This did not affect all samples, nor did it occur reproducably from image to image on the same sample. An example of a good dataset and a dataset affected by the loss of data are included in Figure 1.

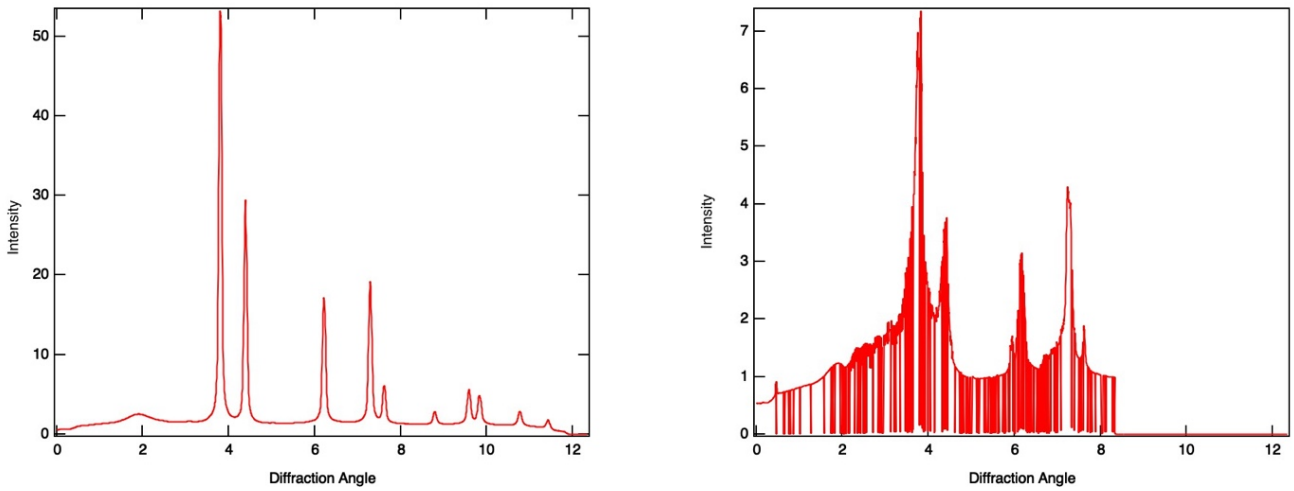

Figure 1: Examples of good (left) and bad (right) diffraction data acquired during the experiment.

Assessment of the data acquired is still ongoing. However, at the time of writing it is believed that good quality data was successfully acquired on the three reference samples only and that compromised data was acquired from all of the samples with varying alloy composition that were the central purpose of the experiment.

Given the issues encountered with the control system and detector it is not ancipated that any publication will arise from this experiment.