ESRF	**Experiment title:** **Microfocus synchrotron studies of stress distribution in turbine blades**	**Experiment number**: ME 759
Beamline: BM 05	**Date of experiment**: from: 07/07/2004 to: 11/07/2004	**Date of report**: 07/09/2004
Shifts:12	**Local contact(s)**: **Eric ZIEGLER**	*Received at ESRF:*

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Report:

The aim of the proposed experiment was to determine the lattice mismatch in nickel-based single crystal superalloys, which can be as small as ≈ 10^{-4}, with a spatial resolution around 10 µm in order to follow the lattice mismatch distribution along a dendrite. In a first stage we would study the distribution of the lattice mismatch across different dendrites and relate this distribution to our measurement of re-distribution of chemical composition change. In a second stage, we would measure the evolution of the lattice mismatch distribution after a creep test and after operation of the blade.

The first step of the experiment was to get a beam size of less 10 µm in diameter. After selecting beam energy of 10 keV and with the aim of Kirkpatrick-Baez optics we obtain a focus spot of 3.86*4.19 µm. Fig. 1 and 2 show the intensity attenuation according to the z and y direction after the scanning of an edge through the beam. Fitting this curve with an error function leads to the determination of the size of the beam spot which is 3.86 µm for the z direction and 4.19 µm for the y direction.

We have then place a superalloy sample in the focus plane of the beam and look for the (200) reflection which is located around 20.7° for this alloy at 10 keV. Diffractogram obtain in this case are reported Fig 3. In this case, the peaks are too broad to calculate any lattice misfit, and measurements are not reproducible from one measure to another. We think that problem occur due to the converging nature of beam which is around 0.2°. As we would like measure a lattice misfit around 10^{-3}-10^{-4}, at diffraction angle of 20° with a beam convergence of 0.2° the better accuracy we can get is 10^{-1} which is to low to resolve the lattice misfit in our alloy.

The intensity of the beam with such small size is high enough to get a well defined diffractogram of the (200) reflection of our material but the convergence of the beam limits the accuracy and doesn't allow to determine the lattice misfit in our superalloy.

We have then to think about a way to produce a beam with a small size (below 10 µm) a high energy and well parallel.

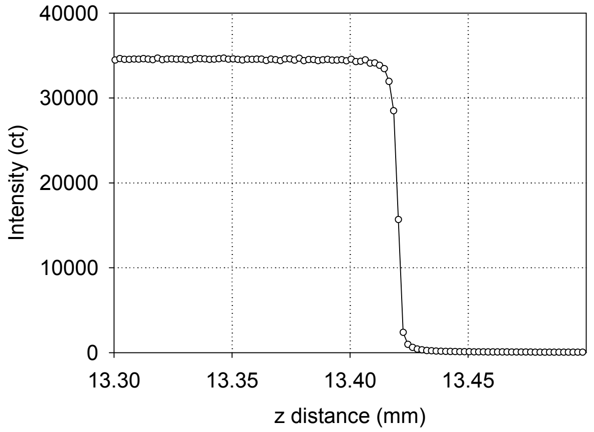

Fig. 1: z scan with a slit through the beam

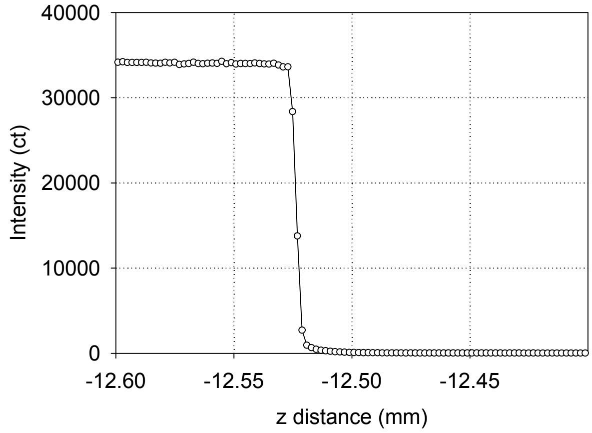

Fig. 2: y scan with a slit through the beam

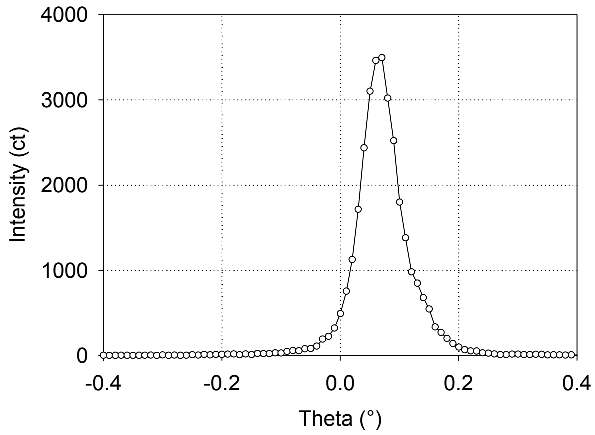

Fig. 3: (200) reflection of a nickel-based single crystal superalloys obtain with a probe size of 3.9*4.2 µm.