**Development of an in-chamber EBSD detector system for material characterization in a table top SEM.**

Hjelen, J.[1], Breivik, T.[2], Sunde, T.[3] and Eriksson, M.[3]

[1] Dept of Materials Science and Engineering, NTNU, Norway, [2] Dept of Geoscience and Petroleum, NTNU, Norway, [3] Hitachi High-Technologies GmbH, Sweden

Since the first CCD-based Electron BackScatter Diffraction (EBSD) detector for conventional SEM chambers was developed by Hjelen et.al. in 1994 [1] such EBSD detectors have been common on standard SEM chambers. However, up to now no EBSD detector has been compatible with table top SEMs since such SEMs do have very small specimen chambers. The table top SEMs usually do not have any suitable EBSD port.

An in-chamber EBSD detector has been developed and implemented directly in the specimen chamber of a Hitachi TM3030 Plus table top SEM. An assembly of a CCD sensor, fixture, optics and a phosphor screen was placed close to a nickel specimen which was fixed to a pre-tilted specimen holder, see Figure 1. The main electronics was located outside the chamber with an electrical feedthrough on the Deben door, Figure 2. A NORDIF beam control hardware was connected to the Hitachi table top SEM. An external lap top PC with NORDIF 3.0 software for pattern acquisition and streaming was connected to the SEM for the EBSD data acquisition.

The accelerating voltage was set to 15kV which is maximum for this table top SEM, the operating mode was EDX mode. This mode has the highest available probe current. The working distance was 15.4 mm, tilt angle 75° and the diffraction pattern resolution 96 x 96 pixels. The scanned area was 200 x 150 $\mu m^2$, the step size was 2 µm giving a total number of 7500 acquired patterns in 10 minutes and 25 seconds. The frequency was then 12 patterns per second. An example of a background subtracted calibration pattern, resolution 120 x 120 pixels, is shown in Figure 3. The diffraction patterns were indexed off-line by EDAX/TSL OIM DC indexing software version 7.3b. Figure 4 is an Inverse Pole Figure (IPF) map of the 200 x 150 $\mu m^2$ area showing the recrystallized grains in the nickel specimen. As can be seen from the figure, only a very small fraction of the patterns was non- or misindexed. By optimizing the EBSD optics, electron primary beam current and camera binning, the pattern acquisition frame rate can be significantly increased. Based on this experiment, by implementation of a dedicated in-chamber EBSD detector, reliable EBSD analysis in a table top SEM is feasible.

[1] J.Hjelen, A.Qvale and Ø.Gomo, Materials Science Forum Vol. 157-162,137-142 (1994).

Figure 1 NORDIF In-chamber EBSD detector in a Hitachi TM3030 Plus.

Figure 2 EBSD detector hardware mounting on Deben door.

Figure 3 IPF map of grains in nickel.

Figure 4 120x120 pixels resolution background subtracted calibration pattern.

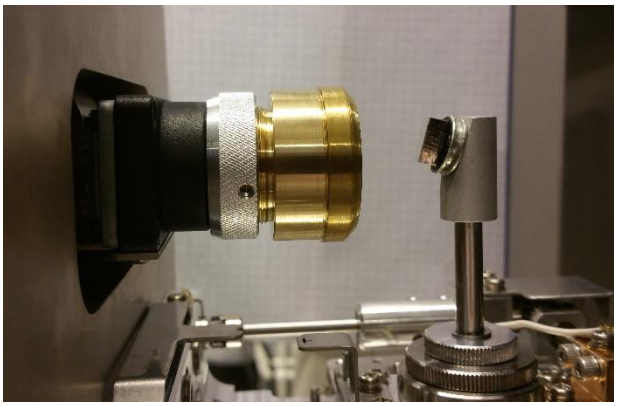

Figure 1


Figure 2

Figure 3

Figure 4