Tata Institute of Fundamental Research
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Seminar

UHR FE-SEM Analysis in Material Science

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The development of FE-SEM is now focused to improve low voltage imaging, to analyze surface structure with high spatial resolution. According the results, using low incident voltage is quite useful to analyze surface structure. However along with that, generally chromatic aberration effect is increased, and it causes degradation of resolution. An electron beam deceleration system can reduce mainly chromatic aberration and spherical aberration effect especially at low voltage. Using beam deceleration method a high spatial resolution is achieved even at extremely low voltage.

On the other hand, there is a growing need as EDS mapping at low voltage for tens nm particles, with improvement of SEM performance. Generally, high electron probe current is needed to generate characteristic X-rays from a specimen for EDS analysis, and the diameter of electron beam becomes larger. However, the diameter of electron beam must be kept small to have high spatial resolution for EDS analysis, and also low voltage is needed for reducing interaction volume. For the reasons set forth above, detection solid angle of EDS detector should be designed as large as possible to efficiently detect small amounts of generated characteristic X-rays at low voltage and small electron probe current.

Recently, we have developed a new UHR schottky FE-SEM, JSM-7900F (JEOL). JSM-7900F has an electron beam deceleration system which is called GBSH (GENTLEBEAM for Super High resolution) mode. It can apply a maximum -5kV specimen bias in GBSH mode. This GBSH mode also can be combined with the EDS system. Especially in combination with a window-less EDS detector, this SEM/EDS system can provide high spatial resolution EDS analysis at low voltage.

The 150 mm^2 size window-less EDS detector, X-Max Extreme (Oxford Instruments), is designed to detect low energy characteristic X-rays without any absorption. The front part of this EDS detector is like an ellipse shape, and therefore can be inserted close to the specimen surface with no interference to the SEM. Therefore, detection efficiency for characteristic X-rays is improved dramatically at small probe current. Comparing the results of EDS mapping acquired by new the SEM/EDS system and conventional EDS, Oxford Instruments X-MaxN 150 mm^2, for a Be-Cu-Co alloy, both measurement conditions are 3kV of incident voltage, 950pA of electron probe current, and 20min of acquisition time, EDS mapping using the new system shows distribution of Be in the alloy, much more clearly than conventional EDS. There is concentration of Be at darker contrast area on SEM BSE image.

In this presentation, we will report UHR FE-SEM analysis for material science by using JSM-7900F in combination with windowless EDS.

Tuesday, Oct 10th 2017

12:30 PM (Tea/Coffee at 10:45 AM)

Class Room – 4 (G Floor), TIFR-H (FReT-B)