Design Of Detector Optics For A Low Energy SEM

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A LESEM using cathode lens allows imaging with very low energy electrons. Although many adaptations of existing SEMs work satisfactorily with a cathode lens, for surface physics applications we need UHV and related sample preparation methods [1]. In order to produce images of competitive quality/information contents to a LEEM, we need an objective lens of similar quality as that used there [2] as well as a better utilization of all the information contained in the signal electrons. The cathode lens not only determines the optical properties of LESEM but it also accelerates the signal electrons into the column, where they have to be separated and detected.

We have decided to modify our UHV SLEEM using a commercial electrostatic two-lens column with a Schottky cathode (2LE of FEI) [1]. This column will be used as an illumination part of a low energy SEM. The crucial element in the new electron-optical setup is the weak Wien filter [3], which separates the signal electrons by deflecting them by 15 degrees from the primary beam. The signal from the SEM will be spread over the detector area of a fast 80x80 pixel back-side illuminated CCD detector [4], and so it will allow the utilization of the angular and energy distribution of the signal beam. The optimum energy at the detector is 4.2 keV, and so we made all elements electrostatic and working close to this beam energy. Because of the energy dispersion of the Wien filter, we have to position the beam crossover into the center of the filter for high resolution imaging with an auxiliary condenser lens. The objective lens resembles the design of LEEM by Adamec et al [2].

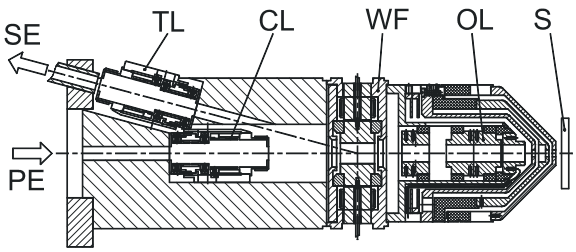

Fig. 1. The setup of the lower part of the LESEM.

Figure 1 shows the critical part of the system. The primary beam electrons (PE) are focused by an auxiliary condenser lens (CL) into the center of the Wien filter (WF); the objective lens (OL) with electrostatic deflectors can be combined with a cathode lens if the primary electrons are decelerated by an electrostatic field between OL and the specimen (S). The signal electrons (SE) are deflected from the primary beam and with an electrostatic transfer lens (TL) they are transferred in the direction of the detector; its ground electrode is split into four sections that allow centering of the beam. Because of the small deflection, the CL and TL lenses must be close to the beam axis, as shown in Fig. 1 [5].

References:
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