

ACQUISITION OF ANGULAR DISTRIBUTION OF SIGNAL ELECTRONS IN VLESEM

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Summary:

The aim of our work is to detect angular distribution of signal electrons in the back-focal plane of the objective lens in a very low energy SEM (VLESEM) as described in [1]. At this stage we have a prototype of the area-selective directly bombarded detector of electrons based on the CCD. Now we have been testing this detector in a position below the objective lens and near to the optical axis in a cathode lens equipped SEM.

1. Area-selective detector of electrons

The detector is based on the Virtual-phase CCD TC211 made by Texas Instruments (192 (H) by 165 (V) pixels) working in the front side bombardment mode. The chip faces toward the specimen (Fig. 1). The signal electrons released from the specimen and accelerated by the cathode lens can impact the CCD pixels. The sensor is encapsulated and shielded in a metal box. This box creates the anode of the cathode lens while the cathode is formed by the specimen. The anode is grounded and has two holes of $\varnothing 2$ mm - one axial for primary beam and one under active CCD area (6 mm off the axis). Going out of the measured values of noise signal, dark current nonuniformity and gain, we can calculate the minimum beam current density of 4.5 nA/cm^2 for electron energy 5 keV. This corresponds to $1 \times 10^{-16} \text{ A/pixel}$ or 0.14 nA at the whole sensor in the case of normal distribution.

2. Electron trajectory simulation

To get any observable image from CCD, we need high primary current and all signal rays concentrated onto the active area. To achieve this we must use very low landing energy. As follows from simulation in SIMION, most suitable configuration is with non-tilted specimen and tilted primary beam (1.9° toward sensor) together with landing energy close 1 eV (Fig. 2).

3. Conclusion

The new version of the area CCD detector based on thinned back-side bombarded sensor with the estimated sensitivity improved by more than two orders of magnitude is under development. The experiment is supported by the grant no. 102/00/P001 provided by the Grant Agency of the Czech Republic.

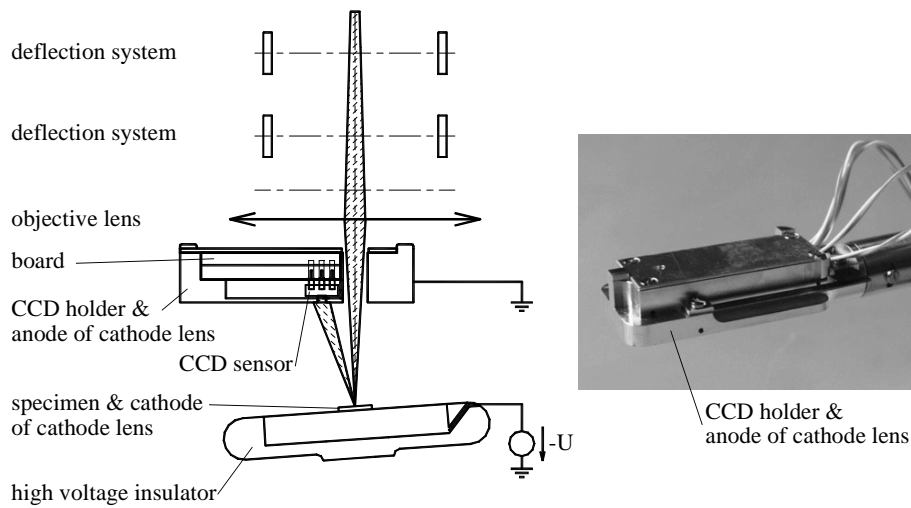


Figure 1: Experimental configuration.

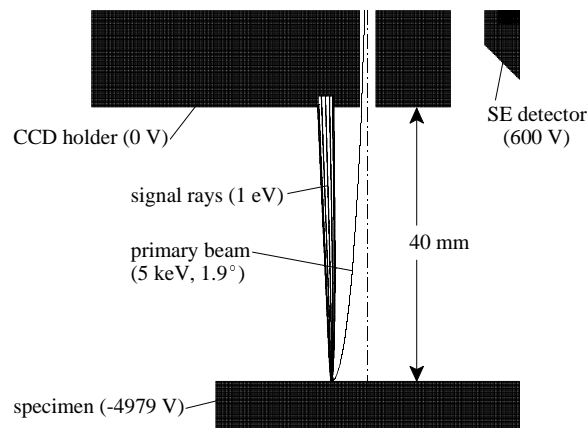


Figure 2: Electron trajectory simulation.

References

- [1] M. Horáček, Journal of Computer-Assisted Microscopy, **Vol. 10**, No. 1 (1998) 23.
- [2] L. Frank, I. Müllerová, K. Faulian, E. Bauer, Scanning **21** (1999) 1-13.