Micro-deflectors with two axes for a double micro-mirror aberration corrector

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Scanning Electron Microscopes (SEMs) play an important role in semiconductor fabrication. One of the essential demands for such SEMs is high resolution at low electron acceleration voltage in order to avoid damage to the semiconductor devices. The resolution of SEMs is then mainly limited by the chromatic aberration of the objective lens. Recently, H. Dohi and P. Kruit proposed a micro mirror aberration corrector that has two mirrors and several deflectors with small deflection angles[1]. This corrector, called a double micro-mirror corrector, is one of the strongest candidates in order to go beyond the present resolution limit of SEMs in semiconductor fabrication.

We have started the construction of their K-type corrector shown in Figure 1. The symbol of K means the trajectories of the electrons in the corrector. It has three layers with optical elements and two separated axes, an original axis and a mirror axis. Two mirrors are placed along the mirror axis. In the system, the electron beam is deflected and reflected many times. It is likely that aligning the electron beam in each deflector and mirror is one of the most important challenges in this technology.

In the present study, we report first steps to introduce the corrector into a SEM. We have made practical designs after calculating chromatic and spherical aberrations of micro-mirrors and we have fabricated a deflector system for the K-corrector without mirrors. The system consists of two electrostatic deflectors, a Wien-filter type deflector and additional electrostatic lenses with the help of micro electro mechanical systems (MEMS) technology. The axis of the Wien-filter is separated from the original axis to be applicable to the final correction system. The deflectors produce two-dimensional deflection fields for alignment of the electron beam. The deflector system has been installed and tested on a Hitachi SU8000.

[1] H. Dohi and P. Kruit, Ultramicroscopy **189**, 1-23 (2018)

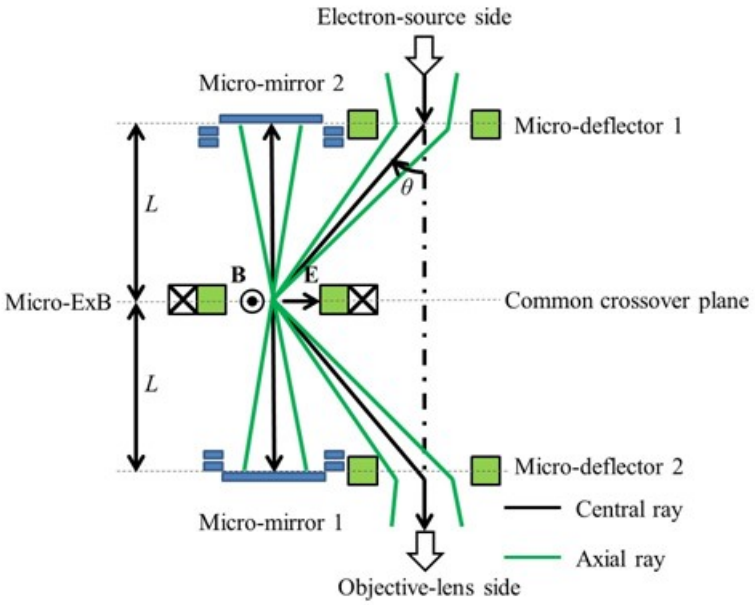

Figure 1. Schematic of the K-type double micro mirror corrector and ray daiagram