Time evolution simulation of scattered electrons in scanning electron microscope specimen chamber

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Scanning electron microscopy (SEM) is used to observe nanometer-sized surface structures in various fields such as medicine and biology, metals and semiconductors. Conventionally, electron scattering inside a specimen by electron beam irradiation has been discussed much, but fogging electrons generated by collision of backscattered electrons once emitted from the specimen surface with the bottom surface of the objective lens are detected by beam irradiation Secondary electrons spread out to positions more than a few tens of millimeters away from the position and there is a possibility that secondary electrons made there will enter the detector and form a noise of a level that can not be ignored and in the evaluation of the resolution of the SEM it is not electron scattering only in the sample The necessity of developing global electron orbit simulation considering the entire inside of the sample chamber has been recognized. Fogging electrons spread to a part several centimeters away from the beam irradiation position and there is a possibility that the charging phenomenon of the sample is affected. In addition, research on temporal change of scattered electrons in the sample chamber has not been conducted.

Therefore, in this study, the electron scattering simulation was performed on the time change of FGEs. Since the parameters are adjusted so that the acceleration voltage dependence of the yield of secondary electrons (SEs) or backscattered electrons (BSEs) agrees with the experimental value, the number of electrons moving in the space in the sample chamber is considered to be reasonable. Monte Carlo simulation is used for tracking the electron trajectory incident on the specimen. The time taken to irradiate the sample with the electron beam was set to 0 second, and the trajectory of the BSEs and SEs emitted from the sample surface was also tracked in the space inside the sample chamber, and electron settling time was found It was.

Figures 2, 3, and 4 are simulation results in which the acceleration voltage is varied. Figures 2 and 4 show changes in the working distance (WD) of FGEs and BSEs, respectively, showing that the settling time is shortened as the acceleration voltage increases. Figure 3 shows the change in FGEs and primary electrons (PE) with WD = 10 mm and FGEs peaks on the order of

1 eV, which is the effect of SEs yield of Figure 5 and BSEs of Figure 4. PEs can increase in proportion to the acceleration voltage.

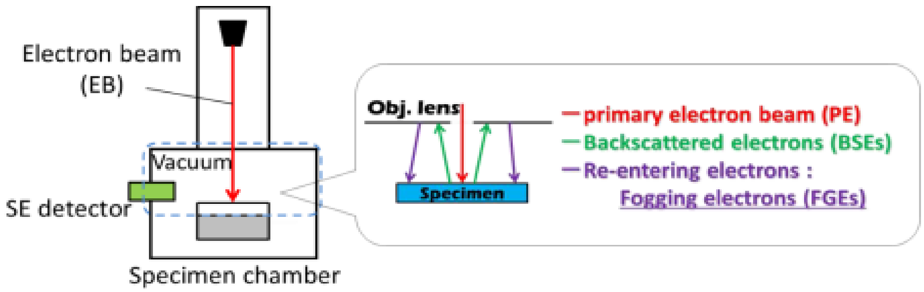

Fig1. The Schematic diagram of SEM.

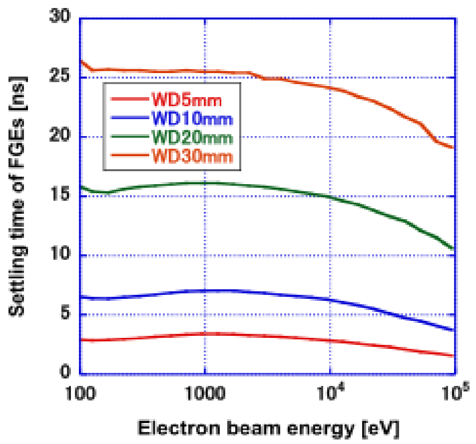

Fig2. Energy dependence of FGEs settling time

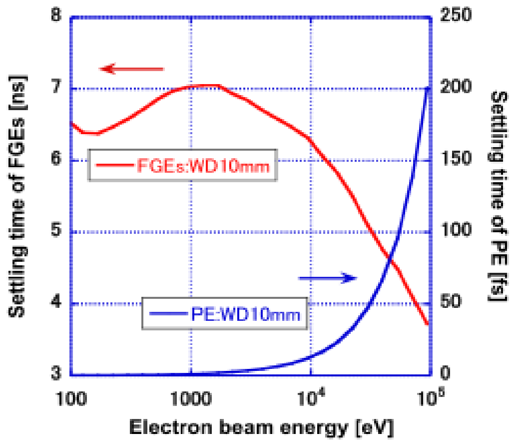

Fig3. Energy dependence of settling time.

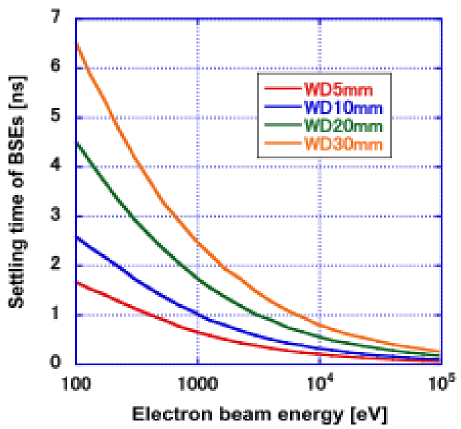

Fig4. Energy dependence of BSEs settling time

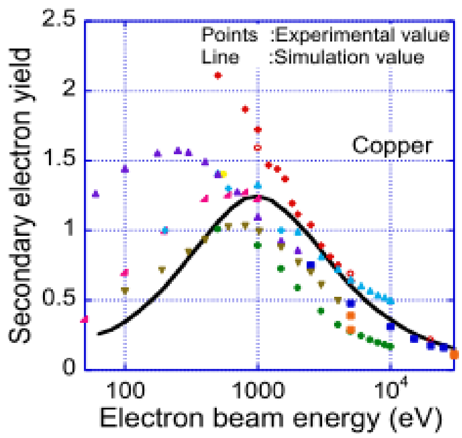

Fig5. Energy dependence of SEs yield.

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