

## Development of fountain detectors for low energy secondary electron detection in SEM

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The low energy secondary electrons (SEs) are sensitive for the surface potential and/or surface charging. Thus, if effective low energy SE detector is developed, the application field of scanning electron microscopy (SEM) will be significantly expanded. For such purpose, we have developed new low-pass secondary electron detector (LP-SED), named as "Fountain Detector (FD)" as shown in Fig. 1 (a). [1] This detector is composed of a bias grid above and an electron detector below the specimen. A negative field  $V_1$  is applied on a bias grid, so that upward electrons emitted from a specimen with energies lower than  $V_1$  are reflected and go downward to be detected the detector. On the other hand, higher energy SEs may penetrate the bias grid. Thus, this detector can act as LP-SED. Since the electron trajectories collected this detector are parabolic, we call this detector as "Fountain".

We have devoted much effort to improve the detector characteristics. Such effort includes, (1) sandwiching the bias grid with ground grids, (2) replacing the planar grid with spherical one, and (3) increasing the aperture ratio of grids to suppress the SE3s generated by BSE collision on the grids. After such developments, the signal intensity and S/N ratio have been significantly improved. [2] After taking SE images of different bias voltages, the LP-SE images are obtained by subtracting the images taken with different bias voltages.

Using this fountain detector, we have observed various specimens, such as pn junctions in SiC, charged ceramic powders. We will demonstrate the potential of low energy SE imaging using this fountain detector.

[1] Sekiguchi T and Iwai H, Jpn. J. Appl. Phys. 54 (2015) 088001

[2] Agemura T. Iwai H and Sekiguchi T, Phys. Status Solidi C 14 (2017) 1700057

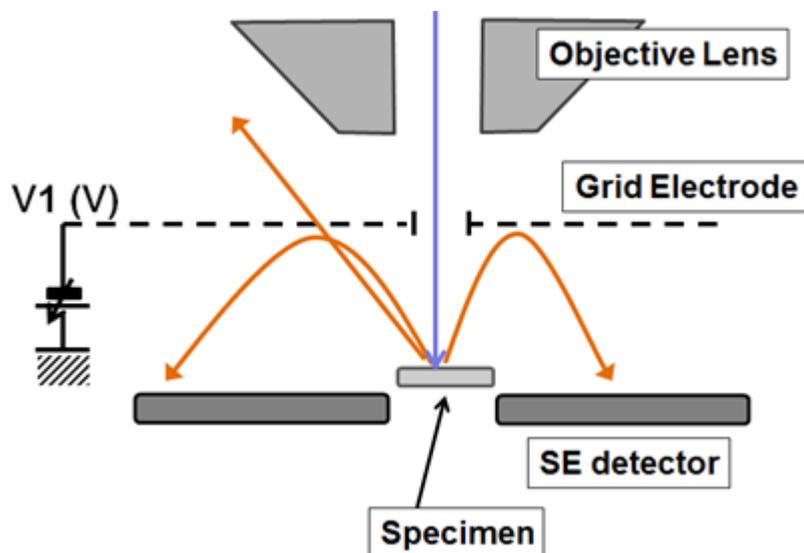


Fig. 1. Schematic of a fountain detector.