

Application of inverted fountain detector for downward secondary electron emitted from nanosheets in SEM

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Observation of some nanosheet whose thickness is smaller than the escape depth of secondary electrons (SEs) looks interesting. The primary electrons may only be scattered at once through passing this nanosheet and some SEs may be generated in the nanosheet. Such SEs may be emitted upward or downward from the specimen surfaces. The relation between such SEs are worth while to investigate. As the first step of such a study, we have developed of "fountain detector (FD)" to detect the SEs emitted downward from the lower surface of nanosheet. Fig. 1 shows the schematic of this detector. A FD is set as upside-down in SEM to detect low energy SEs travel downward. The SEs emitted from the lower surface travel downward and may be reflected by the bias grid if their energies are lower than the bias voltage ($-V_1$). Such reflected electrons are come into micro-channel plate (MCP) and give the signal. Taking the SE images by changing the bias voltage, we can get the low pass SE images. Image subtraction may give the energy spectra of SE.

We observed multilayered graphene supported on the punched Si₃N₄ nanosheets. Fig. 2 shows the Inv FD signal variations against the bias voltage (V_1). The signals increase around $V_1 = 0$ and monotonically increases with V_1 . (Fig. 2(a)) Then, we differentiate these curves to deduce SE energy spectra. (Fig. 2(b)) Both graphene and Si₃N₄ give the maximum around 3 eV, but it is difficult to deduce their clear features.

Now, this experiment is going on to improve the signal qualities to obtain much reliable information.

[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; DOI: 10.1002/pssc.201700057

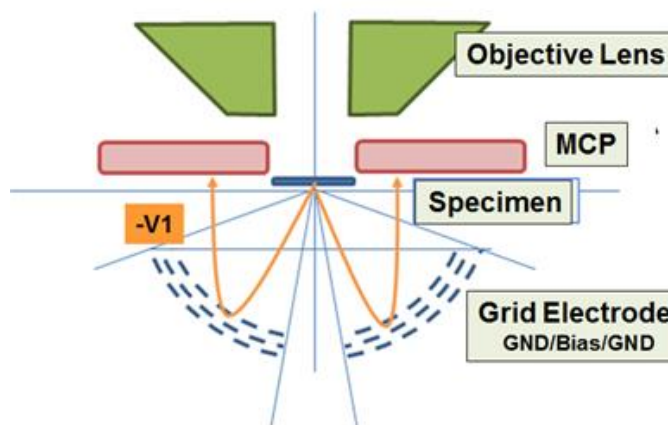


Fig. 1. Schematic of a inverted fountain detector.

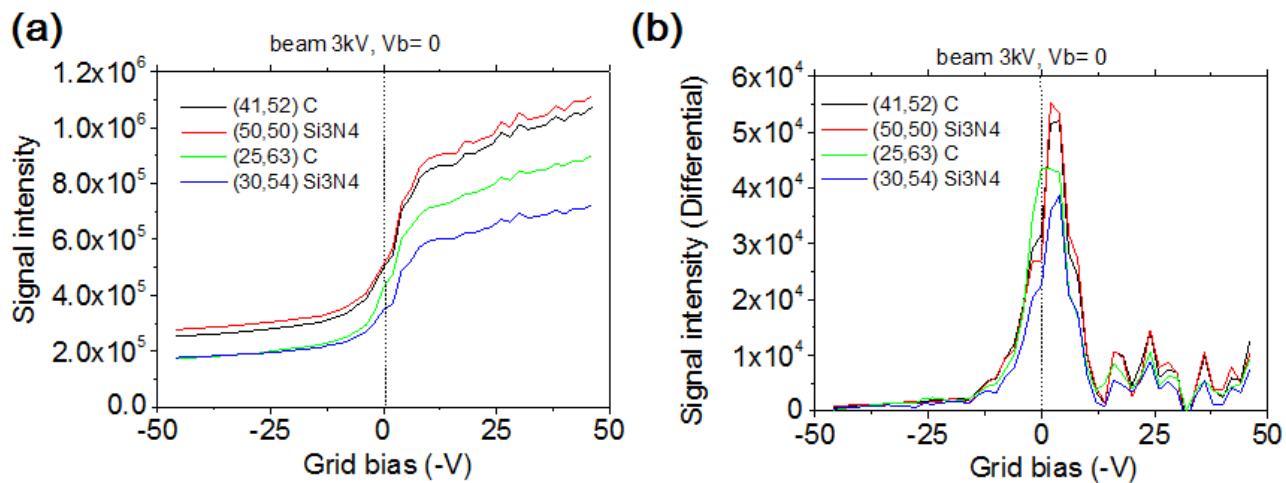


Fig. 2. (a) Inv FD signals vs bias voltage and (b) their differential <energy spectra>.