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Progress of aberration corrected microscopy in JEOL

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The performance of transmission electron microscopes has been improving dramatically through aberration correction and the development of new experimental techniques. Modern scanning transmission electron microscopy (STEM) with aberration correctors allows atomic resolution imaging and a variety of information depending on the detection angles of transmitted and scattered electrons. High angle annular dark field (HAADF) imaging, formed with electrons scattered to angles greater than about 50 mrad, is well known to show Z-dependent contrast of individual atomic columns. Annular bright field (ABF) imaging [1,2], obtained by detecting an annular-clipped disk of directly transmitted electrons, is effective to image light elements simultaneously with heavy elements. Recently, visualization of the atomic position of hydrogen in crystalline specimens was reported [3,4]. To determine elemental composition, an energy dispersive X-ray spectrometer (EDS) and/or an electron energy loss spectrometer (EELS) are usually used, both capable of achieving atomic resolution in modern STEM. Fig. 1 shows example result of atomic resolution EDS and EELS mapping. The difference in atomic number between Ga (Z=31) and As (Z=33) being only 2, identification of atomic species is difficult in HAADF, but readily apparent by measurement of elemental signal in EELS and EDS. Moreover, we have developed a large solid angle EDS detector for high performance analysis and high sensitivity by using a 100mm^2 x-ray sensor. Fig. 2 shows comparison results of fast (1 min acquisition) EDS mapping using conventional (30mm^2) and large solid angle (100mm^2) detectors. The oxide and nitride layers in the semiconductor device are clearly visible in the fast mapping condition. We will also report recent progress in imaging and analysis on the JEM-ARM200F with C-FEG, low-kV, and a monochromator.

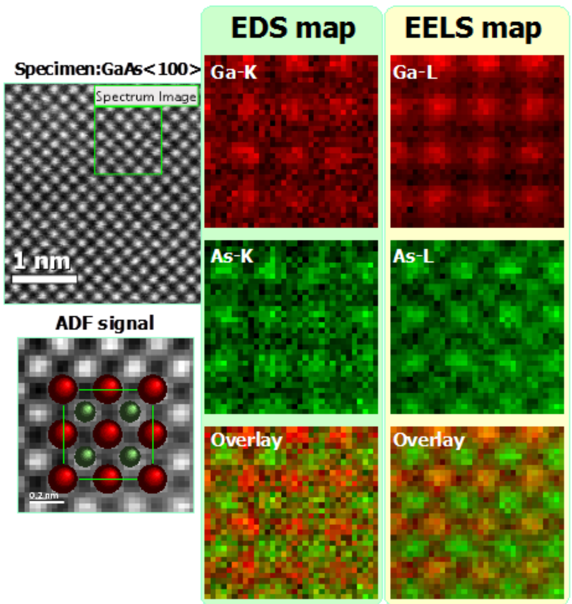

Fig .1. Atomic resolution EDS and EELS mapping.

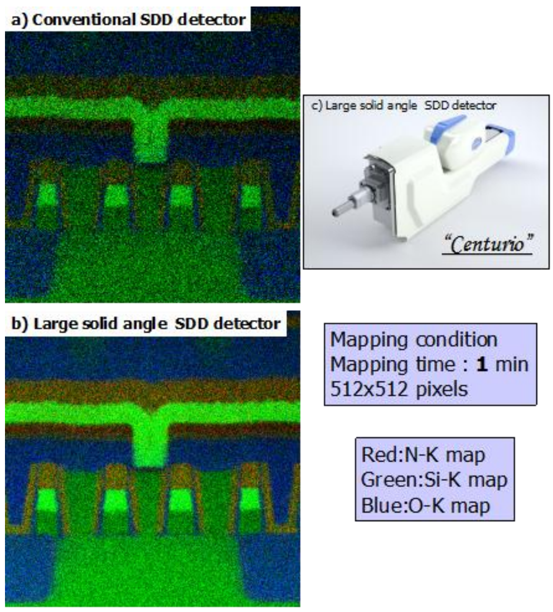

Fig .2. Result of fast EDS mapping by using large solid angle SDD detector.

References

1. E. Okunishi *et al.*, Proc. M&M 2009
2. S. Findlay *et al.*, Appl. Phys. Lett. 10 (2009) 997.
3. R. Ishikawa *et al.*, Nature Mater. 10 (2011) 278.
4. S.D. Findlay *et al.*, Appl. Phys. Express 3 (2010) 116603.

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