

New Developments and Applications of Electron Holography

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Even though electron holography was invented to correct spherical aberration of electron lenses, it can also be used for observing electromagnetic micro-fields. [1] Since electromagnetic properties of materials or devices are strongly related to their electromagnetic micro-fields, observation of such micro-fields is an important experiment for materials science or device engineering. In this paper, we present an application of conventional electron holography, two-dimensional visualization of electrostatic potential distribution in semiconductors, and a new interferometry based on amplitude-division three-wave interference to directly display electromagnetic micro-fields.

Figures 1(a) and 1(b) show an electron micrograph and a phase map of a cross-sectioned silicon-metal oxide semiconductor field-effect transistor (MOSFET), respectively. This MOSFET was fabricated from a silicon wafer with a boron concentration of 10^{15} cm^{-3} , and the TEM specimen was carefully prepared by the focused ion beam (FIB) method. The two dimensional electric potential distribution is clearly discernible in this figure. [2]

Figure 2 shows an amplitude-division three-wave interference pattern of a latex particle. In this method, a thin crystal of silicon prepared by ion-milling is installed at the standard specimen position, and a thin carbon film to which latex particles are adhered is placed at the selected area aperture position. By decreasing the electric current of the objective lens, a lattice image of Si is formed below the selected area aperture position. This lattice image can be observed at the final imaging plane by overexciting the first intermediate lens. With this method, we obtained three defocused images of a latex particle as shown in Fig. 2. The electric field around the particle is represented by the intensity modulation of Si lattice fringes.

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References

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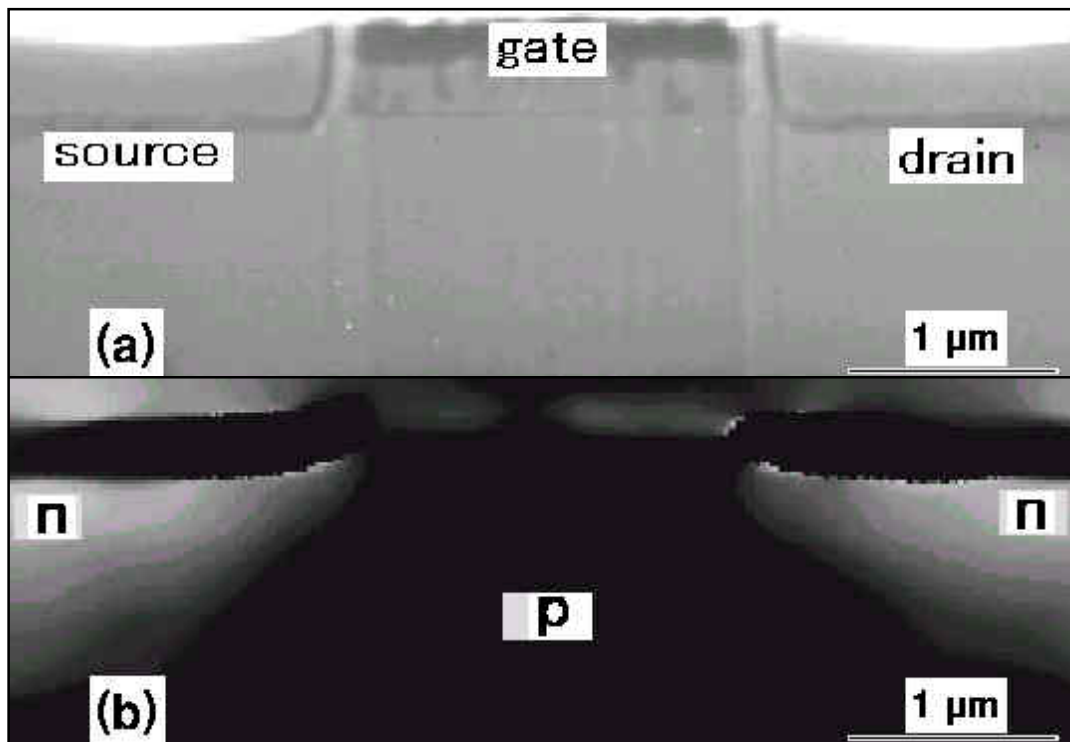


FIG. 1. Cross-sectional view of a MOSFET. (a) Electron micrograph. (b) Phase image obtained by electron holography.

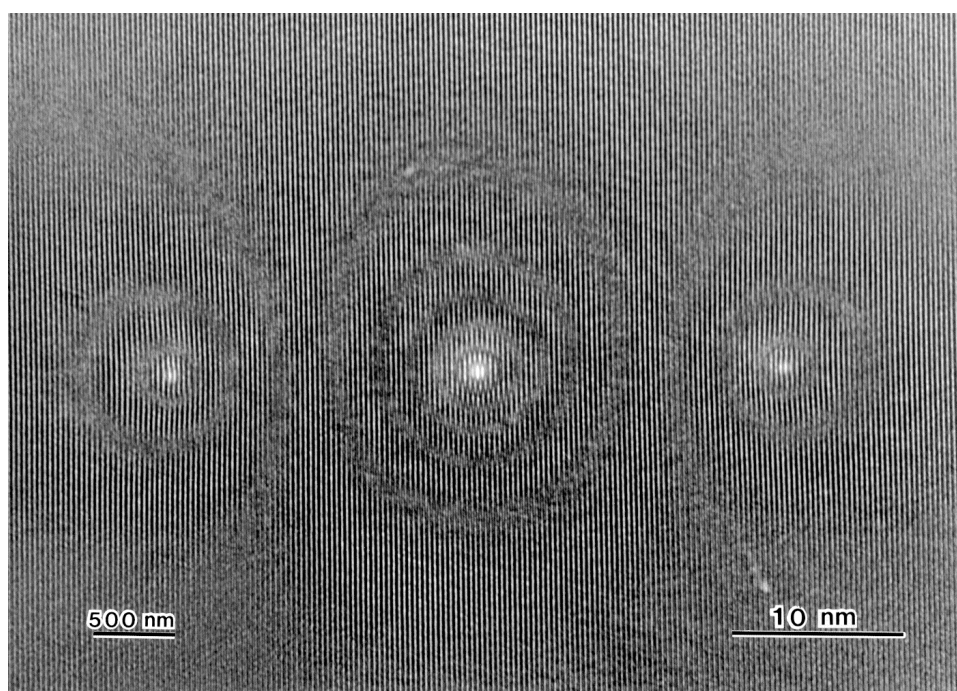


FIG. 2. Amplitude-division three-wave interference pattern of a latex particle.