

# Lateral Resolution Limit by Image Detector in LEEM/PEEM

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In a general knowledge of LEEM/PEEM, the resolution is limited by the spherical and chromatic aberrations of the objective lens and the diffraction limit. Although these are intrinsic, recent several attempts to improve the resolution of PEEM have been done [1-3] and we have proposed a new aberration correction method, the moving focus method [3]. However there are several essential problems which have to overcome, e.g., blurring by the very weak environmental AC magnetic field penetrating to the electron optics [3]. In the present study, we will discuss on the resolution limit by the image detection system including micro-channel plate s (MCPs) with phosphors screen and a CCD camera.

The lateral resolution was evaluated with line-profiling of 2D Cu/Si(111) "5×5" structure at different magnification. The resolution in pixel unit of the image is shown in FIG. 1. As clearly seen, the resolution is limited by some constant spread of about 3.8 pixels. This implies that the constant background is not due to electron optics but is caused by the image detection system. The image detection system consists of two MCPs with phosphor screen and CCD camera with transfer lens. We investigated the image spread by CCD camera with transfer lens using the direct image of a knife edge placed at the same focal distance as the screen. The image spread by CCD camera was estimated to be about 1.7 pixels. Then the contribution of the image spread due to the chevron MCPs with the phosphors screen is estimated to be about 3.4 pixels. The image spread on the screen was estimated to be about 140  $\mu\text{m}$ . As the results, the constant spread of about 3.8 pixels always limits the resolution. This value corresponds to 7.6nm on the image for 2 $\mu\text{m}$  frame size in our system.

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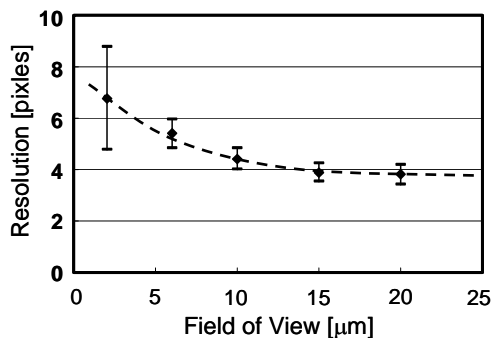


FIG. 1. The resolution represented in pixel unit. The constant background of about 3.8 pixels is included in the measured resolution.