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Comprehensive electron-optical characterization of an X-ray Photoemission Electron Microscope

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Typically the performance of Photoemission Electron Microscopes (PEEM) is reported as one number, representative of a microscope's ultimate performance under an ideal set of conditions. Often a simple Rayleigh criterion is used which defines the spatial resolution approximately as the minimum distance of two still distinguishable features. However, the ability of an instrument to provide meaningful spectroscopic and microscopic information depends on the contrast loss of a pattern over a much wider range of spatial frequencies. For example, the chemical signature of one area on the sample can be contaminated from an adjacent area although both areas are still easily distinguishable in a microscopic image. We report here on a more comprehensive measurement of the PEEM-II instrument at the Advanced Light Source that examines the response of the instrument to a wide range of experimental conditions and compares this response to both analytic and computer models of the expected performance. The absolute magnification, the transmission as a function of the four interchangeable energy and angular filtering apertures, and modulation transfer functions which describe the performance of the instrument over a range of spatial frequencies from unity to the performance limit were obtained at an experimentally relevant range of operating voltages. The results are both useful to current and future users of the instrument in determining what scientific questions can and cannot be answered with the apparatus, and after comparison with previously published analytic results and new computer raytracing simulations of the instrument highly valuable to the efforts in next generation PEEM realization.