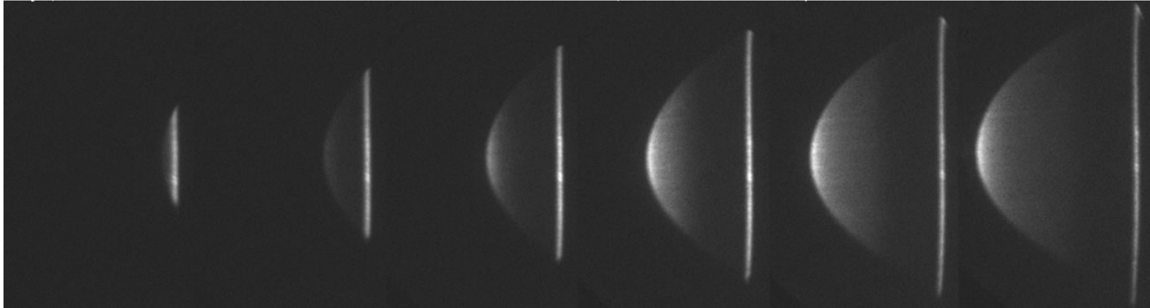
A New Design for an Energy-Filtered, Aberration-Corrected LEEM/PEEM Instrument

Rudolf M. Tromp
IBM Research Division
T.J. Watson Research Center
P.O. Box 218
Yorktown Heights, NY 10598, USA

Over the last two decades LEEM and PEEM have developed into more-or-less routine techniques for dynamic, high resolution surface and interface analysis. Nonetheless, there remains ample opportunity for further development of these techniques, both in terms of instrumentation and application. In this talk I will present recent work on the design of a simplified energy-filtered and aberration-corrected instrument. Energy filtering has been implemented in several microscopes, utilizing electron spectrometers such as a hemispherical analyzer, omega filter, or Wien filter incorporated in the projector lens system of the microscope. Such filters tend to be expensive, require multiple coupling lenses, and generally complicate microscope operation. We have recently implemented a drastically simplified energy filter in the IBM LEEM-II instrument which provides the possibility for the acquisition of energy filtered images and photo electron diffraction patterns, as well as area-selected energy spectra. An example of energy spectra obtained with ~5 - 30 eV electron beams illuminating an oxidized Si(111)sample is shown below.
In order to improve both spatial resolution and transmission, it is desirable to correct both the spherical and chromatic aberrations of the objective lens. Several projects, including the SMART project at BESSY and the PEEM-III project at ALS, have demonstrated the feasibility of using corrective mirror optics to achieve this goal. Here, I will describe a novel column configuration that incorporates mirror optics in a simplified geometry which will significantly ease design, construction, alignment, and operation of the corrected microscope.



Energy loss spectra of ~ 5, 10, 15, 20, 25, and 30 eV electrons (left to right) illuminating Si(111)