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Aberration corrected Low Energy Electron Microscopy for Surface and Interface Studies

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Correction of spherical and chromatic aberrations of the electron microscope objective lens constitutes one of the most significant and far-reaching breakthroughs in electron optics in the last 20 years. For instance, with the TEAM microscope it is now possible to image atoms with a spatial resolution of 50 picometers, providing a detailed real-space view of the carbon atoms in a single sheet of graphene. Similarly, the resolution on Low Energy Electron Microscopy (LEEM) has improved from a typical value of 5 nm, to less than 2 nm, at an electron energy of just a few eV. Photo Electron Emission Microscopy (PEEM) has recently achieved a resolution of 5 nm. In this talk I will discuss the successful implementation of electron-mirror based aberration correction in LEEM. Some of the details of the electron optical implementation will be discussed, in particular the unique optical properties of the electron mirror, and its mode of operation. Quantitative methods to verify proper control of the optical parameters and successful aberration correction have been developed and implemented in this new instrument. Spatial resolution has improved by more than a factor 2 as compared to the uncorrected instrument, and an ultimate spatial resolution below twice the wavelength of the electron at the sample appears to be achievable. In comparison, the highest resolution Tranmission Electron Microscopes have a spatial resolution of about 20 electron wavelengths.