

Semiconductor Physics with the SPELEEM at ELETTRA

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The present status of the SPELEEM project will be described. The SPELEEM (Spectroscopic Photo Emission and Low Energy Electron Microscope) of the Technical University of Clausthal is connected to a branch of beamline 6.2 at the Elettra storage ring. It is a multimethod electron microscope which combines Low Energy Electron Microscopy (LEEM) and Mirror Electron Microscopy with photoemission microscopy using synchrotron and UV light. This unique combination allows rapid micro structure, crystal structure, and orientation determination with LEEM/LEED before the more time-intensive photoemission studies, and thus saves valuable beam time. The microscope is equipped with an imaging electron energy analyser. The spatial resolution in photoemission mode is currently better than 25 nm, which is the highest so far reported for an instrument of this kind, while the energy resolution is better than 0.5 eV. The current photon energy range is 45 to 160 eV using light illuminating a 30 micron spot on the sample, which is incident at a grazing angle of 15 degrees. Since the microscope is a direct imaging rather than a scanning instrument, this is an acceptable area of illumination.

With this instrument, we measured the Schottky barrier height of engineered Al/Si/GaAs(001) heterostructures. All epilayers were grown by solid-source MBE at the TASC-INFM laboratory in Trieste. For the as-grown sample, no lateral inhomogeneities were observed in LEEM and PEEM. However, after the sample had been annealed at 500C for 10 min, we observed the initial stages of inhomogeneous As segregation to the surface, which is correlated with an As 3d core level shift of 0.3 eV. Therefore we conclude that the reported degradation of engineered Schottky Barriers upon annealing might be correlated with laterally inhomogeneous As segregation.