BEAMLINE FOR PHOTOEMISSION SPECTROMICROSCOPY AND SPIN POLARIZED MICROSCOPY WITH SLOW ELECTRONS AT CESLAB

Luděk Frank

Institute of Scientific Instruments AS CR, Královopolská 147, 61264 Brno, ludek@isibrno.cz

Examination of solid surfaces with very slow electrons in the energy range of tens and units of eV is a very powerful method of investigation of both crystalline and electronic structure of the surface as well as of processes connected with dynamic phenomena like lattice reconstruction, phase transitions, adsorption, desorption, precipitation or segregation of adatoms in crystals, sublimation or grow of surface layers and thin films, etc. Well established tool for these studies is the low energy electron microscope (LEEM) [1] illuminating the surface with coherent planar wave of very slow electrons. The key element here is the cathode lens retarding the primary electron beam to the desired very low energy and accelerating the emitted electrons, usually of a highly anisotropic angular distribution of diffracted beams. The same cathode lens is used in the photoemission electron microscope (PEEM) [2] for acceleration of slow photoelectrons. Combination of these two techniques, in particular in the spectromicroscopic version, belongs to most excellent tools for surface physics. Fig. 1 shows examples of both PEEM and LEEM images of heterogeneous surface structures.

The LEEM/PEEM beamline for the Central European Synchrotron Laboratory (CESLAB) is planned to combine two basic permanent experimental stations, namely a top level LEEM/PEEM instrument (Fig. 2) and a spectroscopic PEEM. The both lines will share the first mirror and monochromator. Detail analysis of the beamline optics will be performed upon technical data of the undulator, which is considered of the APPLE II principle (Fig. 3). Preliminarily considered configuration consists of a cylindrical mirror, plane mirror, plane grating and toroidal mirror with the overall length of 35 to 40 meters.

The photon beam parameters are considered as follows: energy range 20 to 1900 eV, resolution $E/\ E > 5000$, photon flux not less than 10^{14} photons/sec·1mrad·0.1%BW. In the LEEM/PEEM beamline the minimum spot size should be below 10 m while in the PEEM beamline it should reach up to 100 m.

The LEEM/PEEM apparatus will be equipped with imaging energy filter, spin polarized electron gun with field-emission electron source, corrector of basic optical aberrations, motorized sample stage and aperture manipulators, and specimen parking in the preparation chamber. The preparation chamber should contain ion beam bombardment, evaporation of layers, simple LEED system and sample heating and cooling features. The all-electrostatic PEEM device will also contain the imaging energy filter, namely the retarding field type, and Hg and He lamps as auxiliary light sources. The attached preparation chamber will offer ion beam bombardment, evaporation of adlayers and specimen heating and cooling.

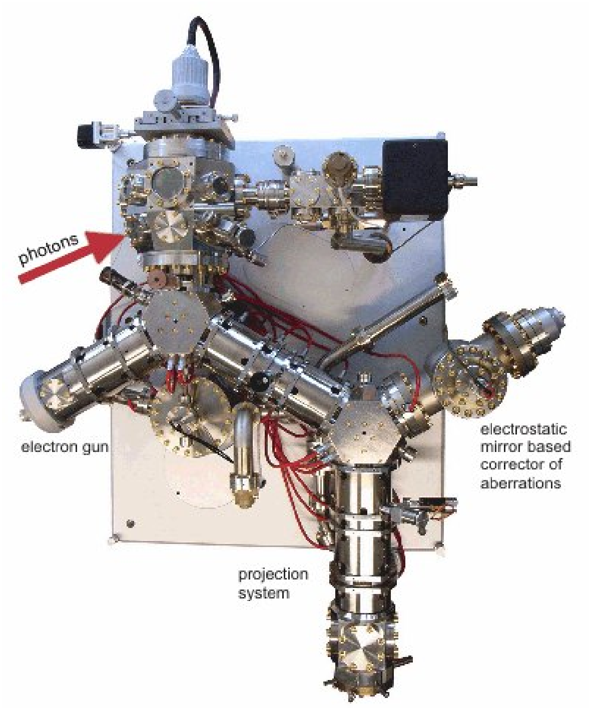

Figure 2. Aberration corrected LEEM/PEEM apparatus (energy analyzer not shown); reprinted from [3].

The beamline is planned for methodological development of the low energy electron imaging modes and for general surface physics as well as analysis and diagnostics of surface bound nanostructures including the magnetic ones in the spin polarized mode.

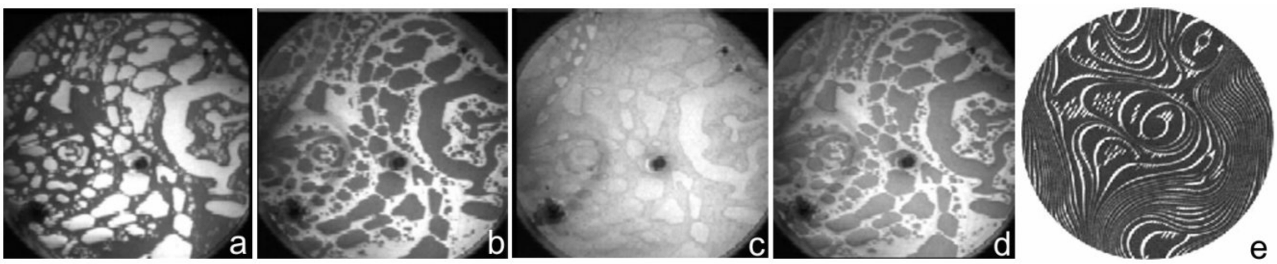

Figure 1. Grow of surface films: Pb layer on W (110) in the LEEM mode, electron energy 7 eV (a), 11 eV (b), 28 eV (c), and 42 eV (d); Cu layer on Mo (110), mercury lamp radiation excited PEEM image, field of view 20 m (reprinted from [3]).

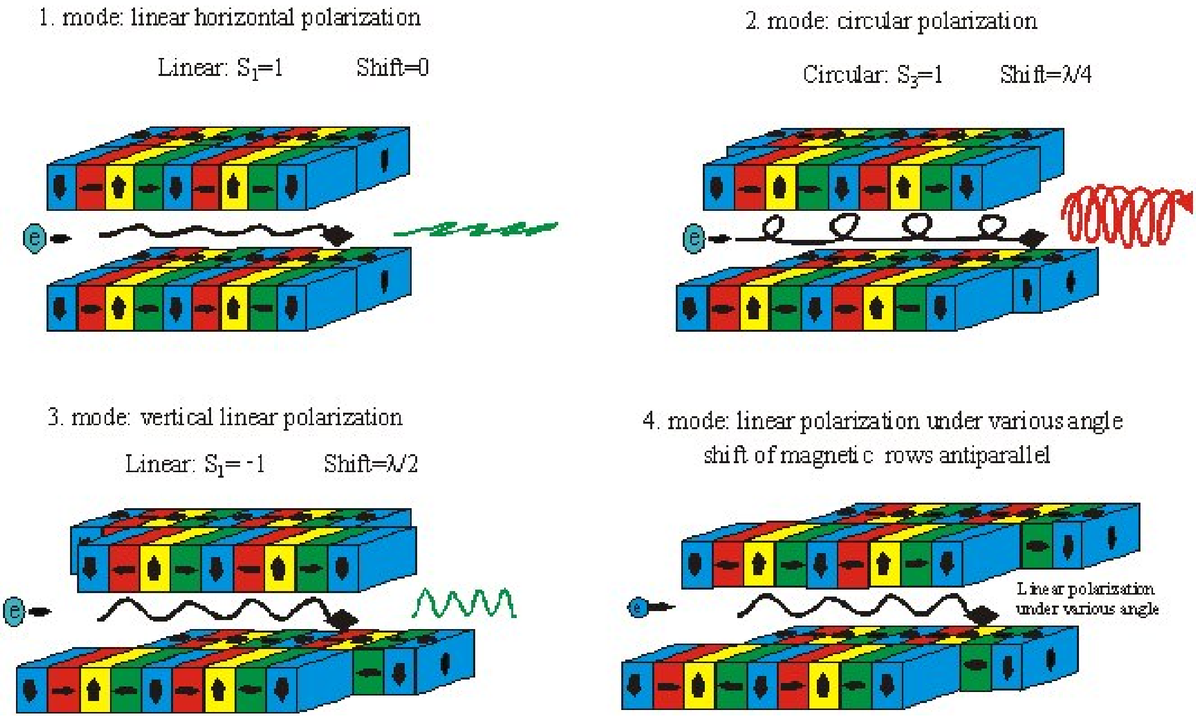

Figure 3. Schemes of the possible polarization modes of a helical undulator with four separately controllable rows of magnets (reprinted from [4]).

1. Bauer, E.: Low energy electron microscopy. *Rep. Progr. Phys.* **57** (1994) 895–938.
2. Bauer, E.: Photoelectron microscopy. *J. Phys.: Condens. Matter.* **13** (2001) 11391–11404.
3 http://www.elmitec.de.
4 http://www.bessy.de.