[총회초청 1]

Experimental Techniques for Surface Science with Synchrotron Radiation

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Synchrotron radiation is produced when charged particles moving with relativistic velocities are accelerated - for example, deflected by the bending magnets which guide the electron or positrons in circular accelerators or storage rings. By using special focusing magnetic lattices in the particle accelerators it is possible to make the dimensions of the particle beam very small with a high charge density which results in a light source with high brilliance. Synchrotron light has important properties which make it ideal for a wide range of investigations in surface science. The fact that the spectrum of electromagnetic radiation emitted in a bending magnet extends in a continuum from the far infra red region to hard x-rays means that it is ideal for a variety of spectroscopic studies. Since there are no convenient lasers, or other really bright light sources, in the vacuum ultraviolet and soft x-ray regions the development of synchrotron radiation has enabled enormous advances to be made in this difficult spectral region. Polarization-dependent measurements, for example ellipsometry or circular dichroism studies are possible because the radiation has a well-defined polarization - linear in the plane of orbit with additional right-circular, or left-circular, components for emission angles above, or below, the horizontal, respectively. Since the synchrotron light is emitted from a bunch of charge circulating in a ring the light is emitted with a well-defined time structure with a short flash of light every time a bunch passes an exit port. The time structure depends on the size of the ring and the number and sequence of filling of the bunches. A pulsed light source enables time-resolved studies to be performed which provide direct information on the lifetimes and decay modes of excited states and in addition opens up the possibility of using time of flight techniques for spectroscopic studies. The fact that synchrotron radiation is produced in a clean ultrahigh vacuum environment is of great importance for surface science studies. The current third generation synchrotron light sources provide exceptionally high brilliance and stability and open up possibilities for experiments which would have been inconceivable only a short time ago.

The experimental facilities available at the Hamburg Synchrotron Radiation Laboratory (HASYLAB at DESY) for performing surface science experiments will be outlined in this presentation. Particular emphasis will be placed on the combination of the techniques of photoelectron spectroscopy, scanning tunneling microscopy and surface x-ray diffraction which provide detailed information about the geometry and electronic structure of surfaces and interfaces. A case study will be presented with our latest results on the restructuring of germanium surfaces induced by an indium adsorbate layer and the parameters which lead to the formation of different reconstructions and self-organized nanostructures will be described.

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