ML.11–H 2 CRYSTALLOGRAPHY WITH SYNCHROTRON RADIATION. By M. Hart, Department of Physics, King's College, Strand, London WC2R 2LS, UK.

Synchrotron radiation sources are still only showing "great promise" for crystallography almost ten years after their virtues were proclaimed at the Tenth Congress in Amsterdam. Use of EXAFS has grown apace and its interpretation has matured to the extent that a routine service is now available. At long last the crystallographic communities in Europe, Japan, USSR and the USA either have or are about to have access to sources dedicated to their needs; the days of "great promise" are over, serious work begins!

Since the last congress in Ottawa there have been very significant changes in the nature of crystallographic work done at synchrotron radiation sources. Traditional work, for example precession photographs of proteins, x-ray diffraction topography and EXAFS has become routine. On the other hand, sufficient beamtime has become available for more speculative research to become feasible. Our x-ray interferometers now routinely measure f' and f'' with very high precision while others have been used to locate surface atomic sites using Borrmann wavefields. In the time domain, surface Rayleigh waves, magnetic domains in motion, muscles in action and crystal growth during laser annealing have all been studied. Our understanding and manufacturing capability in x-ray optics has been refined to the point that many new experiments are under construction; in powder diffraction, diffuse scattering, surface studies and scattering tomography.

I hope to present a comprehensive review of the state of the art.

ML.11–H 4 SURFACE STUDIES BY ELECTRON MICROSCOPY. By K.Yagi, Department of Physics, Tokyo Institute of Technology, Oh-okayama, Meguro, Tokyo 152 Japan.

Recently great progress has been made in surface science due to the deveopement of UHV techniques and related surface analyzing methods such as LEED, RHEED, AES, UPS, ISS. Information on structures and chemical compositions given by such methods, however, is an averaged one over the area covered by the electron, photon or ion beam. Microtopograpic information on surfaces is very important for the understanding of surfaces and surface phenomena. Various methods have been deveoped to get surface images as listed in the table. One general method is to reduce the probe size to get images in the scanning mode. However, their spacial resolution was not high enough to be compatible with needs in modern surface science except in the case where high resolution STEM was used.
In the present lecture direct observations of surfaces and surface processes with use of conventional transmission electron microscopes(CTEM) are reviewed(Yagi et al.Crystals,vol 7 Springer-Verlag 1982) and contrasted with the other methods in the table.
One of the characteristics of the CTEM method is that EM image contrast is determined by a electron diffraction(ED) process at surfaces and in crystals. Therefore, the images obtained have crystallographic information on the surfaces relative to the underlying bulk crystals. There are two modes of surface observations: transmission mode(TEM-TED) to observe surfaces of thin films through them and reflection mode(REM-RED=RHEED) to observe surfaces of bulk crystals with glancing angle. In both modes observations should be done under the UHV condition on specimens with clean and well-defined surfaces. Therefore, UHV EM and in-situ specimen treatment techniques must be developed. With these techniques, surface atomic steps, reconstructed surface structures and adsorbate structures and their domains and dynamic surface processes such as step motions due to sublimation and deposition, surface and adsorbate structure phase transitions and adsorption processes on silicon and metal surfaces were observed. High resolution imaging of surface and adsorbate structures on atom resolution level was also done.

TABLE: Surface Imaging Methods

(1) Scanning method for imaging.
  a) high resolution scanning transmission electron microscope (STEM).(in transmission and reflection modes(SREM))
  b) imaging by secondary electrons(SEM).(low energy electron incidence)
  c) imaging by singnals through analytical techniques (AES, EELS, X-ray)
  d) imaging by emitted ions (SIMS)
  e)...
(2) Conventional Electron Microscope(CTEM)
  a) indirect method(step decoration, replica)
  b) direct method(transmission mode:TEM-TED)
  (reflection mode :REM-RED)
(3) Photo Emission Electron Microscope(PEEM)
(4) Scanning Tunneling Microscope(STM)
(5) Field Ion(Emission) Microscope(FIM,FEM)

ML.12–H 2 POWDER'S PROGRESS. By R. A. Young, School of Physics, Georgia Institute of Technology, Atlanta, Georgia, 30332, USA

In its new status as a "beautiful swan" (Langford, 1981), the powder diffraction field continues to enjoy rapid progress, much of it driven by new developments in hardware (sources, detectors, diffractometers) and software, the declining cost of computing and the proliferation of microcomputers for control and analysis.

With spallation neutron sources, both intensity and resolution are maintained unusually far out in $(\sin\theta)/\lambda$, which leads to improved precision in the results. Synchrotron sources offer high intensity, high resolution, wavelength tunability, and a polarized beam. Linear position-sensitive detectors (PSD) decrease data collection times by a factor of 100. Curved PSD's are particularly good for maintaining resolution in focusing geometries. Transmission methods are receiving increasing attention and Guinier geometry with a curved PSD, either stationary or moving on a diffractometer arm, will clearly become more used.

Time-resolved x-ray studies have been reported in the manosecond range for a repetitive process and <10 sec for non-repetitive ones.

Structure solution from powder diffraction data has been systematically carried out for >20 structures. The powder pattern must first be decomposed into the Bragg intensities, which can then be used in MULTAN or other structure solution programs. Successful decomposition is materially aided by knowledge of the unit cell parameters (e.g. Werner; Pawley; Hewat), although success has also been reported with other methods (e.g. Parrish, Will & Huang; Rubia, Soria & Cano). Many hundreds of structures have now been refined with the Rietveld method. X-ray, neutron, fixed energy and fixed angle