20-Industrial Crystallography

20.01 - Aspects of Industrial Crystallography

MS-20.01.01 NEUTRON DIFFRACTION FOR NON-DESTRUCTIVE STRESS/STRAIN MEASUREMENTS IN INDUSTRIAL DEVICES by Hans Georg Priesnazer*, Institut für Reine und Angewandte Kernphysik der Universität Kiel, Otto-Hahn-Platz 1, 24118 Kiel, Germany

High resolution neutron diffraction is becoming diffraction is becoming widely used as a non-destructive tool to investigate three-dimensional stress fields in polycrystalline materials and ceramics. Lattice strains can be derived from Bragg peak positions measured with an accuracy better than 1%. Both crystal and time-of-flight diffractometry are used to perform the measurements, as will be demonstrated by examples. New instrumental developments like the European PREMIS project at ISIS/Rugiaid, the Fourier correlation spectrometer FSS at Geel (Belgium), and the energy-dispersive Neutron Transmission Stroboscope at LANSC/United States, will be introduced. Recent results on industrial devices will be presented and discussed.

MS-20.01.02 POWDER DIFFRACTION IN PETROLOGY by S.J.B. Stirling, British Gas plc, Gas Research Centre, Ashby Road, Longborough, LE11 4QU, UK

There is currently a worldwide trend towards performing more applied research in higher education establishments and central facilities. This talk will focus on some of the more successful applications of synchrotron radiation to the solution of some applied industrially relevant problems. Examples will include applications in lithography for the manufacture of miniature mechanical parts, the solution of organic crystal structures from powder diffraction which are relevant to the pharmaceutical industry, the study of ceramic processing, and coalification, and catalytic processes. Other applications of synchrotron radiation to petrology and crystallography will also be considered.

MS-20.01.03 INDUSTRIAL USES OF SYNCHROTRON RADIATION by J.J. Cernik*, Daresbury Laboratory, Warrington WA4 4AD, UK

There is currently a worldwide trend towards performing more applied research in higher education establishments and central facilities. This talk will focus on some of the more successful applications of synchrotron radiation to the solution of some applied industrially relevant problems. Examples will include applications in lithography for the manufacture of miniature mechanical parts, the solution of organic crystal structures from powder diffraction which are relevant to the pharmaceutical industry, the study of ceramic processing, and coalification, and catalytic processes. Other applications of synchrotron radiation to petrology and crystallography will also be considered.

MS-20.01.04 APPLICATIONS OF SMALL-ANGLE SCATTERING by G. Barta*, Inst. of Applied Physics, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland

Small-angle scattering is a versatile tool in the study of defect aggregation and phase separation in materials, resolving inhomogeneities of dimensions ranging from about 1 nm to more than 300 nm. Some characteristic results on vacancy agglomerations during fatigue and on the decomposition of Al and Ni alloys will be presented. The scattering from phase-separated systems will be discussed in the light of current theoretical concepts of nucleation and growth, spinodal decomposition, scaling laws and elastic interactions of precipitates.

MS-20.01.05 ROUTINE, RAPID, NON-DESTRUCTIVE ANALYSIS OF SEMICONDUCTOR WAFER SUBSTRATES BY REFLECTION ASYMMETRIC CRYSTAL X-RAY TOPOGRAPHY. By I. C. Bassignana* and D. A. Macquistan, Advanced Technology Laboratory, Bell-Northern Research Ltd, P.O. Box 3511 Station C, Ottawa, Ontario K1Y 4H7, Canada

Crystal defects, such as low angle grain boundaries and included mosaic crystals, present in single crystal semiconductor substrate wafers are known to adversely affect the yield and performance of devices fabricated directly on the substrates. Asymmetric crystal topography (ACT), a high-resolution, double crystal x-ray technique which requires no special sample preparation, has been adapted to topograph large single crystal wafers (75mm diam.) by using a very large area (100mm diam.) Si(111) first crystal, with a high magnification ratio (40X). This extensive study shows that reflection topographs of entire wafers can be routinely acquired by this non-scanning method in less than 30 min. using a conventional x-ray source (12kW). The device-quality substrates studied include: Si, used in all types of electronic devices; GaAs and InP, used in opto-electronic and high-speed devices; and synthetic single crystal quartz, used for surface acoustic wave devices.

A serious environmental contaminant in semiconductor manufacturing is dust. In order to avoid the ACT technique totally non-destructive a container has been developed which is transparent to x-rays but is entirely compatible with semiconductor processing. The container ensures that wafers can be removed from the production line for x-ray testing and returned to it without compromising cleanliness.

MS-20.01.06 CRYSTALLOGRAPHY IN THE PHARMACEUTICAL INDUSTRY by T. Skrzynski*, Glaxo Group Research Ltd, Greenford Road, Greenford, Middlesex UB6 9HE, UK

Rational, structure-based design of novel compounds as potential drugs has become a reality. Crystallography plays an increasing role in the process providing structural information on the biological receptors and the drug-receptor complexes. New techniques of X-ray data collection, accessibility of powerful computers and improved software packages contribute to the rapid increase of structural data available researchers. An overview of the current crystallographic techniques relevant to the drug discovery process will be given.

HIV protease provides a good example of the use of structural information in the design of potent, highly specific inhibitors that are of potential value as drugs against AIDS. Results of our studies that allowed optimization of lead compounds through an iterative cycle of protein crystallography and medicinal chemistry will be presented.