

16.2-2 A SPECIAL X-RAY DEVICE FOR STRUCTURAL INVESTIGATIONS UNDER EXTREME CONDITIONS. By V.V. Pet'kov, Institute of Metal Physics, Academy of Sciences of the UkrSSR, Kiev, USSR.

A review of a device for X-ray structural investigations of materials under extreme conditions by the use of different diffraction methods is given. Distinctive features of the construction, specifications, operational characteristics and physical performance of various chambers for photographic, powder-diffractometer attachments, diffractometers for the investigation of liquid and solid samples and for small-angle investigations, devices and equipment for the investigation of textures, of single crystals as well as of the fine structure of materials are considered. By use of both special diffractometers and apparatus, developed in the Institute of Metal Physics, Academy of Sciences of the UkrSSR, the potential of standard and new diffraction methods for the investigation of materials operating under special conditions (temperature, pressure, vacuum, etc). is shown.

16.2-3 A MULTI-PURPOSE γ -RAY DIFFRACTOMETER. By J-E Jørgensen, Uppsala University, The Studsvik Neutron Research Laboratory, S-611 82 Nyköping, Sweden.

The design as well as the scientific areas of application of a newly constructed γ -diffractometer will be presented. The diffractometer is designed as a multi-purpose instrument and it is equipped with an Ir-192 source with a half-life of 74 days. The maximum activity of the source is 450 Curie. γ -beams with energies 316.5, 468.1 and 604.4 keV are available for diffraction experiments. The diffractometer will first of all be used for the development of monochromator crystals for the neutron spectrometers at the Studsvik Reactor. A hydrolic press for plastic deformation of large single crystal can be mounted on the diffractometer. It is in this way possible to perform on-line studies of mosaic distribution functions during plastic deformation. The press is able to supply a force of $2 \cdot 10^5$ Newtons at temperatures up to 800°C and it is therefore suited for plastic deformation of e.g. Cu and Ge crystals. γ -rays interact only weakly with condensed matter, diffraction experiments are therefore easily performed in pressure cells, furnaces and cryostats. γ -diffraction is therefore a convenient technique for studies of phase transitions in which strain is an order parameter. Furthermore γ -diffraction can also be used for accurated charge density studies because structure factors are measured on an absolute scale and extinction is low compared to X-ray diffraction. Preliminary results showing the diffractometer performance will be presented.

16.2-4 HIGH SPEED HIGH ACCURACY BRAGG-SPACING MEASUREMENTS. By M. Hart, Department of Physics, University of Manchester, UK and D. Häusermann, Wheatstone Laboratory, King's College, London, UK.

A method of measuring differences in the lattice parameter of silicon to an accuracy of 1 part in 10^8 in two minutes has been developed. The technique uses three symmetric Bragg reflections from two parallel crystals but requires only one standard diffractometer axis, two detectors and one X-ray source. Mechanical stability is achieved by combining monolithic design and elastic axes. These axes are double leaf springs machined out of silicon which are made to flex using a combination of permanent magnets and small dc coils. They are used to control the fine rotation of the sample and third reflecting surface with a reproducible accuracy of one millisecond of arc. Short term thermal stability is ensured by the speed of the measurements and a very simple temperature control. The technique does not require a specialised operator as the measurements are entirely under microcomputer control. Changing the sample is straight forward and only takes a few seconds as the latter is simply held by gravity on a silicon spring. A single key stroke initiates a 30 minutes measuring cycle during which the sample tilt is optimised, measurements are repeated six times and all the data is analysed.

The technique consists of measuring the differences between the angles at which the third reflection occurs for various samples. Three beams of copper $K\alpha$ radiation are produced from a single source using pinholes and reflected from the 333 planes of the first crystal at the appropriate Bragg angle. When the angular position of the sample is such that its 333 planes satisfy their own Bragg condition, all three beams are reflected a second time towards the third surface, which is cut out of the first crystal. The central beam (T) undergoes a third reflection towards a detector when the angular position of this part of the crystal again satisfies the Bragg condition of the first crystal, whilst the outer beams (D) travel through the windows towards a second detector. The D-beams are used to optimise the sample tilt (Ando, Bailey and Hart, Acta Cryst. A34, 1978, 484-489) and provide a reproducible angular reference during all measurements. When the sample is changed the second axis is reset to the mean centroid of the two narrow non-dispersive double reflection rocking curves and a new angular position of the triple reflection rocking curve is obtained on the third axis. The difference between the Bragg spacings of the two samples is thus uniquely determined by the change in the latter.

