

**PS10.03.11 MEASUREMENTS OF STRAIN AROUND DEFECTS IN SYNTHETIC DIAMONDS.** Moreton Moore and Grzegorz Kowalski, Department of Physics, Royal Holloway University of London, Egham, TW20 0EX, England

Large synthetic single-crystal diamonds can be grown under conditions of high pressure and high temperature by the reconstitution technique [1], which are used in a variety of industrial applications; but they often contain defects. Crystals up to  $4 \times 4 \times 2$  mm<sup>3</sup> in size, which had been grown in either the [001] or the [111] direction, were studied by a combination of rocking-curve analysis and x-ray topography in symmetric (+,-) Bragg-Bragg diffraction geometries, using synchrotron radiation ( $\lambda = 0.1$  nm). By recording series of topographs in all four principal azimuths ( $\chi = 0, 90, 180, 270$ ), variations in relative lattice parameter ( $\Delta a/a_0$ ) were distinguished from misorientations. The strains associated with various types of defect were measured: (a) in populations of small inclusions (of diameter 1-5 micron) dispersed in diamond matrix; (b) across growth-sector boundaries separating sectors containing different concentrations of impurities; and (c) close to relatively large (100 $\mu$ m diameter, 1 mm long) cylindrical metal inclusions with axes along  $\langle 110 \rangle$  directions. Rocking curves were recorded from small specimen areas selected by a translatable pin-hole in order to determine the extent of the strains and to calculate strain gradients. The various types of defect gave characteristic measurements for  $\Delta a/a_0$  falling in the range 6-36 parts per million and for misorientations in the range 4-40 arc seconds [2,3].

[1] R.C.Burns & G.J.Davies, in *The Properties of Natural & Synthetic Diamond*, edited J.E.Field (London: Academic Press), p.409, 1990.

[2,3] G.Kowalski, M.Moore, G.Gledhill & Z.Maricic, *J.Phys.D:Appl. Phys.* 29 (1996)1; and *Diamond & Related Materials*, (1996).

**PS10.03.12 EVOLUTION OF STRESS DISTRIBUTIONS AND MORPHOLOGY OF CVD DIAMOND FILMS.** J. W Steeds, N. C. Burton, A. R. Lang, D. Pickard, and Yu Shreter, University of Bristol, Bristol U.K. and J. E. Butler, Naval Research Laboratory, Washington DC, USA

Three dimensional stress distributions have been determined in CVD diamond films by monochromatic cathodoluminescence imaging and confocal micro Raman spectroscopy. Particular emission lines were chosen in cathodoluminescence that were split by stress into components that were then selected for monochromatic imaging. Depth resolved information was obtained by changing the electron accelerating voltage in a scanning electron microscope. The data thus obtained has been analysed to give the stress tensor at the centre of square facets. Confocal Raman microscopy was performed at different focal depths to obtain independent three dimensional information about the stress distribution. The results were related to the growth processes involved by plan view transmission electron microscopy at different depths in the diamond films and by interference optical microscopy of the growth surfaces. Misorientations were explored by back scattered electron diffraction. Finite element modelling of the experimental situation is now in progress.

**PS10.03.13 HIGH TEMPERATURE DEFORMATION BEHAVIOR OF CdTe.** T. E. Stevens, J. C. Moosbrugger, F. M. Carlson, Department of Mechanical and Aeronautical Engineering, Clarkson University, Potsdam, NY 13699

The goal of this work is to investigate the role of inelasticity in the generation, multiplication and propagation of dislocations in directionally solidified CdTe.

High temperature deformation of CdTe is simulated using the MARC finite element code. A continuum slip viscoplastic model is incorporated, which allows prediction of three dimensional states of stress. Slip system interaction, dislocation arrangement variables and time-dependent recovery are extensions of the model proposed by Haasen and coworkers.

Creep experiments are modelled at high homologous temperatures, using 'dog-bone' shaped tensile specimens. Material response to various loading conditions, over time, is examined. Macroscopic plastic strain rate and dislocation density are calculated from values computed on the individual slip systems.

Experimentally, zinc-doped CdTe single crystals are subjected to creep loading. These small strain tests are conducted to characterize the mechanical behavior at elevated temperatures. A laser interferometric system was constructed to measure the small specimen displacements. Pre- and post-deformation dislocation densities are compared. Transmission Electron Microscopy is used to discern microstructural dislocation dynamics.

**PS10.03.14 THE MICROHARDNESS OF  $\sigma$ -Al<sub>2</sub>O<sub>3</sub> GROWN BY THE SKULL-MELTING TECHNIQUE.** By W. Guse, C. Lathe, M. Kriens, H. Saalfeld, Mineralogisch-Petrographisches Institut der Universität Hamburg, 20146 Hamburg, Germany

Single crystals of  $\sigma$ -Al<sub>2</sub>O<sub>3</sub> with spinel-type structure were grown by a modified skull-melting technique and investigated for microhardness. Due to their different hardness they have to be divided into two groups: 1.  $H_K \sim 21$  GPa, 2.  $H_K \sim 30$  GPa. SAALFELD, H. & GUSE, W. (1991: "The mysterious  $\sigma$ -Al<sub>2</sub>O<sub>3</sub>". *N.Jb., Miner. Abh.* 163; 159-167) reported that  $\sigma$ -Al<sub>2</sub>O<sub>3</sub> single crystals are strongly disordered. Weissenberg photographs of the plane hkl revealed that there are at least two types of disorder. The first is represented by photographs showing strong spinel reflections (111, 311, 511) surrounded by weak satellites, the other by having no spinel reflections any more, and the whole intensity is distributed into the satellites. The X-ray analysis of crystals type I revealed that they all belong to the less disordered spinel-structure type; i.e. all spinel reflections clearly exist. The crystals of type II all produce X-ray-photographs having no spinel reflection hkl odd. These crystals are more disordered and therefore more strained than those of type I and exhibit the greater hardness with maximum values up to  $H_K = 30,9 \pm 1,5$  GPa. The new alumina phase  $\sigma$ -Al<sub>2</sub>O<sub>3</sub> is not showing any hardness anisotropy and exhibits an extremely high microhardness (type II). Compared to  $\sigma$ -Al<sub>2</sub>O<sub>3</sub>, the hardness properties of  $\sigma$ -Al<sub>2</sub>O<sub>3</sub> are dominant and therefore  $\sigma$ -Al<sub>2</sub>O<sub>3</sub> might be an interesting material for the industrial application.