13-Defects, Microstructures and Textures

PS-13.01.08 FROM SHEAR LAG TO ATOMIC FIT. By P.M. Bronsveld* and J.Th.M. De Hosson, Department of Applied Physics, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands.

Already for some time it has been common practice to try improving the AlN or AlO powders to make so-called DRA- or continuously reinforced aluminum. This method has been used extensively, e.g., the shear lag model in which the load transfer takes place via a kind of press-fit between both phases. Residual stress measurements on the Al/SiC system using neutron diffraction [T. Lorenzen, J. M. Neutron Res. 11 (1995) 1] clearly show an initial strain in the aluminum base, subsequently taken over by the strain in the ceramic particles. In order to understand what happens on the atomic scale, a study has been undertaken applying high resolution electron microscopy. In this analysis one observes the atomic fit between the metal and ceramic structures and tries to interpret it starting from the distinctive space groups, unit cells, lattice parameters and orientation relationships. Subsequently one tries to measure the displacement between both phases and the formation of MgO as a reaction layer having a lower fracture toughness. We have studied the Al/SiC and Al/SiAlO systems and found that when the preparation method is one in which the fine powder is cold-pressed and subsequently heat-extracted, one finds indeed an interface being a more or less abrupt transition from metal to ceramic.

The so-called liquid route of manufacturing gives a reaction layer which for both systems turns out to be the spalled MgAl2O4, as confirmed by comparison of the experimental results with the EMS and MacTempas HREM simulation programs.


The report of straightforward procedure for synthesizing macroscopic quantities of C60 and its superconductivity in alkaldoped solids has triggered intense excitement in physicists, chemists, etc. As the thin films of C60 prepared by vacuum deposition are free from solvents and also have a potential application toward new electronic devices, it is very important to know the crystallization and structure of the thin film. Different thicknesses of C60 films on NaCl(001) substrates have been produced by us. The thin films were grown by sublimating the pure C60 powder to NaCl(001) cleavage surface with pretreatment of eliminating residual solvent at 70°C. Transmission electron microscopy study showed that at the initial stage the C60 thin film tended to crystalize randomly with few hexagonal phases and as it grew thicker, it formed [110] textured thin films, with multiply twin particles and fewer hexagonal phases. Twins, microtwins, stacking faults and five fold twin particles were studied by high resolution electron microscopy (HREM). As the C60 is grown by vacuum deposition, the lattice bending structure and disorder due to the strain releasing in five fold twin particles were expected by HREM. (Chen C. S., Shen T., and Ma C. S. J. of Alloys and Compounds, 244, 1997) (Chen C. S. and Ma C. S. J. of Alloys and Compounds, 244, 1997). The large vases of C60 experienced to the strong electron beam were also observed by HREM.

PS-13.01.10 REASONABLY GOOD DISLOCATION IMAGES IN LACBED PATTERNS AND EFFECTS OF ITS STRAIN FIELD ON THE REFLECTION CONTOURS. By Y. Xia and X.P. Duas, Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, P.O. Box 2724, Beijing, 100080, China.

Large-angle convergent beam electron diffraction (LACBED) comprises real space information and therefore is useful to the study of defects in crystals. Dislocations parallel to the reflection rocking curve contours have been studied by an improved LACBED technique. Shadow images of dislocations of reasonably good spatial resolution superimposed on LACBED patterns have been obtained at the diffraction plane. It has been found that only when the shadow image of the dislocation is parallel and close to a low-order reflection contour with the Bragg reflection can it be formed with reasonably good contrast in the LACBED patterns. Both the image and the change of the reflection contours clear in LACBED pattern make it convenient to study the strain field of a dislocation. The strain fields of dislocations in Si and Ge crystals have been investigated. Different effects are observed.

PS-13.01.11 SUPERLATTICE VARIANTS IN Sr5Cu3O4(CO3) - AN ELECTRON MICROSCOPY STUDY. By O. Milat*, G. Van Tendeloo, J. Van Landuyt and S. Amelinckx, EMAT University of Antwerp (RUCA), Belgium; *also at: Institute of Physics, University of Zagreb, Croatia.

The compound Sr5Cu3O4(CO3) has a layered structure based on that of the NaCl type lattice (a0 = 3.9 Å). It consists of lamellae with the interlamellar stacking sequence: ... (CO3-Sr-CO3-Sr)- (CuO2) ... The lamellae thickness is t = 2a p, the basic lattice is double perovskite, primitive tetragonal (a0 = 4.0 Å, c = 10.5 Å).

Electron microscopy and diffraction investigations revealed three intensity levels of the diffraction spots (associated with three sublattices in reciprocal space); they can be related to the levels in the crystal structure: the basic structure, the modulated Sr-Cu2O2-Sr block-layer structure, and the substructure due to the CO3 planar arrangement. (O. Milat, G. Van Tendeloo, S. Amelinckx, I. G. N. Bahu, C. Greaves, submitted to J. Solid State Chem.) The unit cell of the modulated block-layer structure is body-centered, while the superlattice cell of the CO3 planar arrangement is found to be either body-centered or primitive, with the same cell parameters 2a0, 2a0, 2c0. The appearance of two types of superlattice cells can be accounted for by a model of the layered arrangement of CO3 triangles between two enclosing block-layers (fig. 1). A sense can be attributed to the arrangement of the CO3 triangles and the two opposite sets may exist in the successive CO3-bilayers within block-layers of the same underlying structure. The Sr-displacement modulation of the block layer structure is a consequence of the mutual interaction between the basic perovskite and CO3 planar substructures. Of the different superlattice variants, two special cases were frequently observed: the body-centered superlattice variant, where the CO3-arrangement in all layers are of the same sense and the primitive superlattice variant, where the CO3-arrangements of opposite senses alternate in successive layers. More complicated regular stacking with a long period superlattice: c0 = 2c0 were also observed, and result in closely spaced satellites around the primitive superlattice peaks (fig. 2). An irregular stacking of the CO3 layers induces streaking of the corresponding superlattice spots in the diffraction pattern.

References