12-Amorphous, Imperfectly Ordered and Quasi-periodic Materials

small particles of size about 40 Å prepared chemically using zinc sulphate and sodium sulphide at room temperature. The size of the particles has been determined using TEM and from X-ray diffraction pattern using the Scherrer formula. X-ray diffraction and electron diffraction results have been used for the study of the structure of the particles. As expected, the X-ray diffraction lines are broadened. The electron diffraction rings show a strong broadening and are diffused indicating a high degree of disorder in the particle lattice. The d values calculated from the electron diffraction pattern are found to be close to (but slightly less than) those of the ICSD data corresponding to a nitride structure (84). The diffraction ring also points to the presence of the 101 polytype. The slightly less d values indicate that the lattice has undergone a small contraction. The electron diffraction pattern does not contain enough rings for an unequivocal determination of the lattice parameter c. The lattice parameter c calculated using the ICSD value for the parameter c is found to be slightly less than the standard value. The decrease in the interplanar spacing and the lattice parameter points to a lattice contraction of about 2%.

PS-12.01.23 A CLIFFORD ALGEBRA APPROACH TO N-DIMENSIONAL CRYSTALLOGRAPHY. By A. Gómez, J. L. Aragón, F. Dávila, and H. Terrones, Instituto de Física, UNAM, Apartado Postal 20-364, 01000 México, D.F. Departamento de Matemáticas, ESMIP-IPN, U.P. Adolfo López Mateos, Edif. 9, 07300 México, D.F.

The discovery of materials such as incommensurate structures and quasicrystals makes necessary to extend crystallography to more than three dimensions. Problems arise since some identities (such as cross products and normals to planes) and concepts are no longer valid in higher dimensions. In this work n-dimensional lattices are described with the language of Clifford algebra. This point of view allows to reformulate the crystallography in a concise language valid in any dimension. A system of definitions and algebraic identities has been developed to be used as an efficient and versatile computational tool.

PS-12.01.24 STUDY OF EDGE DISLOCATIONS IN Al₄(C₄H₉)₀₆Si₆, DECAGONAL QUASICRYSTALS BY MEANS OF HIGH-RESOLUTION ELECTRON MICROSCOPY. By H. Zhang and Z. Zheng, Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, P.O. Box 2724, Beijing, 100080, China.

High resolution electron microscopy (HRTEM) studies indicate that the edge-type dislocations in small angle boundaries in Al₄(C₄H₉)₀₆Si₆ decagonal quasicrystals dissociate into two partial dislocations. By performing Burgers circuit around these partial dislocations, the projected Burgers vectors of the partial dislocations on the plane normal to the twofold AB2 axis can be determined as b₁ₙ[1/2, 0, 0, 0, 0] and b₂ₙ[1/2, 1/2, 0, 0, 0] respectively. The total Burgers vector is bₙ = b₁ₙ + b₂ₙ = [1/2, 0, 0, 0, 0] which has a modulus of about 0.4 nm equal to the periodicity along the twofold axis of the decagonal quasicrystal. As reported previously, the dislocations at a small-angle boundary in decagonal quasicrystals are out of contrast when any reflection parallel to twofold axis is used to form electron diffraction contrast images under two-beam conditions. This implies that the Burgers vector of these dislocations is parallel to the twofold axis. However, the HRTEM images show that the dislocations observed in conventional contrast images actually consist of two close partial dislocations separated by about 3 nm from each other. The Burgers vector of each partial is not parallel to the AB2 axis but makes an angle of 30° with it. Since these two partials are very close to each other and the Burgers vector components along the twofold axis are equal but of opposite sign, the dislocations of the quasicrystal between the two partial compensates. Therefore, the twofold dislocation determining the diffusion contrast is along the tenfold direction. Consequently, only the effect of the total Burgers vector is usually observed in conventional electron diffraction contrast images.

PS-12.01.25 TRANSMISSION ELECTRON MICROSCOPE STUDIES OF DEFECTS IN DECAGONAL QUASICRYSTALS. By Y.F. Yan* and R. Wang, Department of Physics, Wunan University, 430072 Wunan, China, and Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, P.O. Box 2724, 100800 Beijing, China.

Studies of defects in quasicrystals have attracted extensive attention because of their importance not only for structure studies, but also for understanding of many of these physical and mechanical properties. Defects such as dislocations, dislocation pairs, dislocation multipoles, dislocation dipoles, rectangular dislocation networks and stacking faults in Al₄(C₄H₉)₀₆Si₆ decagonal quasicrystalline were studied by means of transmission electron microscopy. The Burgers vector of which the dislocation pairs and multipoles and dislocation dipoles consist are parallel to the tenfold axis. The rectangular dislocation networks consist of two dislocation sets whose Burgers vectors are parallel to the ten-fold axis and a two-fold axis AB2 or AD2. The fault planes of the stacking faults are perpendicular to the ten-fold axis and the displacement vectors are lying in the fault plane and parallel to a two-fold axis AD2.

PS-12.01.26 TRANSMISSION ELECTRON MICROSCOPIC OBSERVATION OF PHONONS COUPLED WITH PHASONS IN IMPERFECT DECAGONAL QUASICRYSTALS. By W. Geng and Z. Zheng, Beijing Laboratory of Electron Microscopy, P. O. Box 2724, 100800 Beijing, P. R. China.

We report, for the first time, an transmission electron microscopic (TEM) observation of phonons coupled with phasons in imperfect decagonal quasicrystals of Al₄(C₄H₉)₀₆Si₆. Phasons and phonons are topological defects which dominate the elastic properties of quasicrystals, therefore are of general interest. Phonons exist both in ordinary crystals and quasicrystals but for the phonon there is no analogue in normal crystals. Since the phonon distortion will relax with speed of sound while the phason distortion relaxes with diffusion, only phonons can be observed by the high resolution electron microscopic (HREM) images. In study of imperfect decagonal quasicrystals of Al₄(C₄H₉)₀₆Si₆, we observed a series of lines with dark contrast in the electron diffraction contrast images under two-beam conditions. The contrast of these lines is not produced by Moiré fringes, precipitates, and relief dislocations between the decagonal phase and its crystalline surface structures. HREM images and Fourier-filtered HREM images reveal that these short lines with dark contrast result from the obvious bending or distortion of quasiphases. There are lattice "jags" corresponding phasons densely distributed at the area centered by the short lines, implying that the quasiphase represented by the lattice distortion are coupled with phasons. Above TEM results show that phonons coupled with phasons do exist in imperfect decagonal quasicrystals.