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small particles of ZnS of size about 40 A prepared chemically using zinc sulphate and sodium sulphide at room temperature. The size of the particels has been determined using TEM and from Xray diffraction pattern using the Scherrer formula. Xray diffraction and electron diffraction results have been used for the study of the structure of the particles. As expected, the xray 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 JCPDS data corresponding to wurtzite structure (8H). The diffraction ring also points to the presence of the 10H polytype. The slightly lesser d values indicate that the lattice has undergone a small contraction. The electron diffraction pattern does not contrain enough rings for an unequivocal determination of the lattice parameters `a' and `c'. The lattice parameter `a' calculated using the JCPDS 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 Matematicas, ESFM-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 Problems arise since some identities (such as cross products and normals to planes) and concepts are no longer valid in higher dimensions.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 $Al_{62}Cu_{20}Co_{15}Si_3$ DECAGONAL QUASICRYSTALS BY MEANS OF HIGH RESOLUTION-ELECTRON MICROSCOPY. By H. Zhang and Z. Zhang, Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, P.O. Box 2724, Beijing 100080, China.

High resolution electron microscopy (HREM) studies indicate that the edge-type dislocations in small angle boundaries in $Al_{62}Cu_{20}Co_{15}Si_3$ decagonal quasicrystals dissociate into two partial dislocations. By performing Burgers circuit around these partial dislocations, the projected Burgers vectors of these partial dislocations on the plane normal to the twofold A2D axis can be determined as $b_1=[a_1/2, a_2, 0, 0, 0, 0]$ and $b_2=[a_1/2, -a_2, 0, 0, 0, 0]$, respectively. The total Burgers vector is $b=b_1+b_2=[a_1, 0, 0, 0, 0, 0]$ which has a modula of about 0.4 nm equal to the periodicity along the tenfold 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 tenfold axis. However the HREM 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 A10 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 distortions of the quasilattice between the two partials compensate. Therefore, the net lattice distortion determining the diffraction 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 QUASICRYSTAL. BY Y.F.Yan* and R.Wang, Department of Physics, Wuhan University, 430072 Wuhan, China and Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, P.O. Box 2724, 100080 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 their physical and mechanical properties. Defects such as dislocations, dislocation pairs, dislocation multipairs, dislocation dipoles, rectangular dislocation networks and stacking faults in $Al_{70}Co_{15}Ni_{15}$ decagonal quasicrystalline were studied by means of transmission eletron microscope. The Burgers vector of which the dislocation pairs and multipairs and dislocation dipoles consist are parallel to the ten-fold 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 A2P or A2D. The fault planes of the stacking faults are perpendicular to the ten-fold axis and the displacement vectors are lying in the fault planes and parallel to a two-fold axis A2D.

PS-12.01.26 TRANSMISSION ELECTRON MICROSCOPIC OBSERVATION OF PHONONS COUPLED WITH PHASONS IN IMFERFECT DECAGONAL QUASICRYSTALS, By W. Geng and Z. Zhang, Bejing Laboratory of Electron Microscopy, P. O. Box 2724, 100080 Beijing, P. R. China.

We report, for the first time, on transmission electron microscopic (TEM) observation of phonons coupled with phasons in imperfect decagonal quasicrystals of $Al_{63}Cu_{17.5}Co_{17.5}Si_2$.
Phasons and phonons are topological defects which dominate the elastic property of quasicrystals, therefore are of general interest. Phonons exist both in ordinary crystals and quasicrystals but for the phason 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 phasons can frequently be observed by high resolution electron microscopic (HREM) images.
In study of imperfect decagonal quasicrystals of $Al_{63}Cu_{17.5}Co_{17.5}Si_2$, we observed a serie short lines with dark contrast in the electron diffraction contrast-images under two-beam conditions. The contrast of these lines is not produced by Moire fringes, precipitates, and misfit 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 quasilattices. There are lattice "jags" corresponding phasons densely distributed at the area centered by the short lines, implying that the phonons represented by the lattice distortion are coupled with phasons. Above TEM results show that phonons coupled with phasons do exist in imperfect decagonal quasicrystals.

