12-Amorphous, Imperfectly Ordered and Quasi-periodic Materials

PS-12.01.27 NEW CRYSTALLINE APPROXIMANTS OF DECAGONAL QUASICRYSTALS IN Al-Co-Ni-Tb. ALLOY. By R.C. Yu, X. Z. Li, D. P. Xu, Z. Zhang, W.H. Su* and K.H. Kuo, Beijing Laboratory of Microscopy, Chinese Academy of Sciences, P. O. Box 2724, Beijing 10080, P.R.China: *Department of Physics, Jilin University, Changchun 130023, P.R.China.

Four new orthorhombic approximants, Cα, Cβ, Cλ and Cω, have been found in the AlxCoyNi1-2Tbx decagonal quasicrystals, which were prepared by the method of quenching from the fusion state under high static pressure 4.0 GPa. The lattice parameters of these orthorhombic phases are: Cα, a=2.28 nm, b=1.00 nm, c=5.66 nm (B-type); Cβ, a=6.1 nm, b=0.44 nm, c=8.4 nm (P-type); Cλ, a=6.1 nm, b=9.4 nm, c=8.4 nm (P-type); Cω, a=3.68 nm, b=0.4 nm, c=3.2 nm, respectively. The strong diffraction spots in the electron diffraction patterns of these phases show the same intense modulation as those of the decagonal quasicrystals, implying a close structural relationship. The formation of these new crystalline approximants of the decagonal quasicrystals can be understood by substituting a rational ratio of two consecutive Fibonacci integers, Fα/Fβ (α=1, 2, 3, 5, 8, 13, 21,...) for the irrational c/λ (c/λ=1.72) in the two quasi-periodic directions in the decagonal quasicrystals. The larger the Fibonacci integer, the larger the lattice parameter and the closer the structure of the crystalline approximants to that of the decagonal quasicrystal. As α → ∞, Fα/Fβ → γ, the approximants γ → the decagonal quasicrystal. In this context, the decagonal quasicrystal can be considered as the limiting case of this series of approximants with infinitely large lattice parameters.

PS-12.01.28 QUANTITATIVE EVALUATION OF PRIMAR Y AND SECONDARY AMMANS JAGS IN AN EIGHTFOLD QUASICLATTICE. By J.C. Jiang*, H.L. Li and K.H. Kuo, Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, 100080 Beijing, China: Department of Materials Physics, University of Science and Technology, Beijing, 100083 Beijing, China.

The structure of Mn8Si13Al octagonal quasicrystal on atomic scale was studied by high resolution electron microscopy (HREM) and image processing. A HREM image taken along the eight-fold axis shows numerous octagons consisting of eight bright image dots. As in electron diffraction patterns of this octagonal phase, the Fourier transform of the HREM image comprises both basic and satellite reflexes. The inverse Fourier transform of only basic reflexes gives a clearer image of octagons from which the basic quasitessellation of the Mn-Si-Al octagonal quasicrystal can be obtained. By connecting all the bright dots in the Fourier filtered image, a tiling configuration of squares and 45° rhombi with an edge length of 2.5 Å results. Both primary and secondary Ammann lines are drawn on this quasitile and Jags are clearly shown. They correspond to the tiling mistakes at the edge and vertex, respectively, of this eight-fold quasitessellation. Consequently, plasmons in this quasitessellation can be quantitatively evaluated. Within an area of 8.56 K, there are 254 squares and 349 rhombi. Of the 1296 edges and 572 vertices, altogether 66 primary and 52 secondary tiling mistakes have been found. Broadly speaking, this is a phonon-terminated Penrose or Ammann tiling with eightfold symmetry, but not a random tiling of squares and 45° rhombi.

PS-12.01.29 DYNAMICAL SIMULATIONS OF DIFFRACTION CONTRAST IMAGE OF DISLOCATIONS IN ICOSAHEDRAL QUASICRYSTALS. By Z.G. Wang*, Z. Zhang, M.X. Dai† and R. Wang+, Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, Beijing 100080, China: Department of Materials Physics, University of Science and Technology Beijing, Beijing 100083, China: *Department of Physics, Wuhan University, Wuhan 430072, China.

In studies of defects in normal crystals, simulations of diffraction contrast images have been extensively used to characterize these defects quantitatively. Recently, the defects in quasicrystals (QCs) have also been observed by using electron diffraction contrast images. Due to the unusual contrast behaviors of these dislocations caused by the incommensurate nature of the quasicrystal, further simulations of these dislocations are necessary. In present paper, the contrast of dislocations in icosahedral QC's have been simulated by using a computer program based on the dynamical diffraction theory extended to QCs. For the simulation, we use a first order approximation of a strain field of a dislocation in icosahedral QC's. By variation of crystallographic parameters and imaging conditions, the diffraction contrast images of edge, screw and mixing types of dislocations in icosahedral QC's were simulated systematically. The simulated results agree well with the experimental images.