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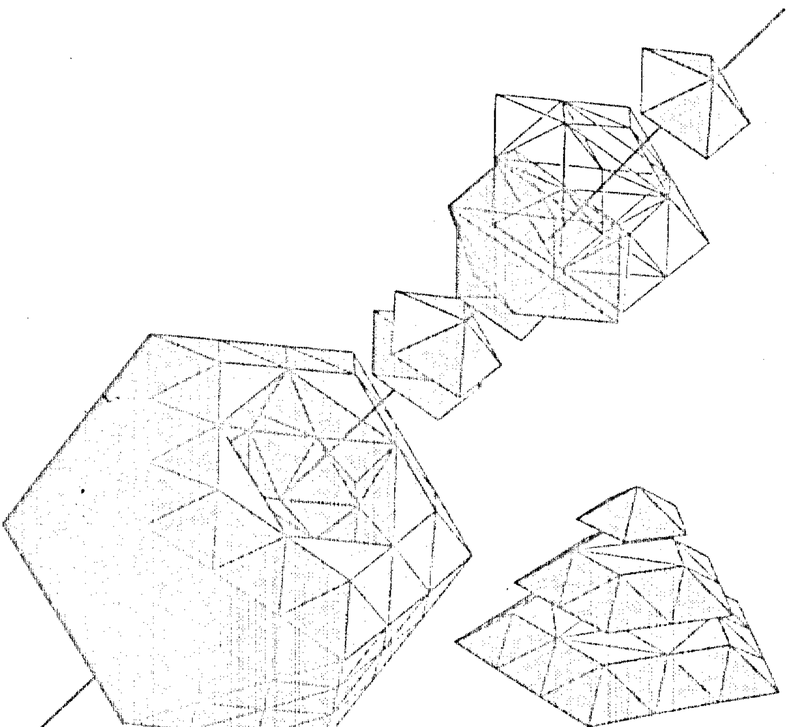

GROWTH AND SHAPES IN QUASICRYSTALS

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The discovery of a quasicrystal[1] with icosahedral symmetry has attracted great interest not only for physicist or mathematician but also for architect and artist. Study on equilibrium morphology of non-periodic system is possible since the discoveries of a series of stable quasicrystals. A material revealing a atomic structure with icosahedral symmetry is expected to see a morphological shape reflecting its atomic structure. To date, three kinds of morphology with icosahedral symmetry have been observed in quasicrystalline alloys; a rhombic triacontahedron for an $Al_6Cu_1Li_3$[2], a pentagonal dodecahedron for an $Al_{65}Cu_{20}Fe_{15}$[3] and global shape for an $Al_{75}Cu_{15}V_{10}$[4]. The triacontahedron with 30 diamond faces, 32 vertices and 60 edges in a solidified Al-Cu-Li alloy, can be constructed by two kinds of rhombohedron; a prolate and an oblate, corresponding to the atomic cluster of quasicrystalline Al-Cu-Li structure. The triacontahedral atomic cluster with a size of few nm can be grown to the size as large as a mm order by an inflation operation of the rhombohedral units. There is a very reasonable relation between the atomic structure and morphology for this quasicrystalline alloy. On the other hand, although the Al-Cu-Fe alloy reveal a beautiful pentagonal dodecahedron, it is still unclear that how to grow a mm sized pentagonal dodecahedron from its atomic cluster. The atomic structures of the Al-Cu-Li and the Al-Cu-Fe quasicrystalline alloy are described by three dimensional Penrose tiling constructed by two kinds of rhombohedral unit with different atomic decoration which build up different fundamental atomic cluster; a triacontahedron for the former and a Mackay icosahedron for the latter. The quasicrystalline Al-Cu-V alloy seems to be described by the icosahedral glass model. The icosahedral glass model relies on local interaction to join clusters of atoms in a somewhat random way. In this model, all the clusters have the same orientation, but because of random growth the structure contains many defects. The icosahedral glass model is suitable for quasicrystalline Al-Cu-V in two ways. First, it removes the necessity of arcane matching rules and gives a plausible explanation the growth of quasicrystal from the amorphous phase. Second, the disorder introduced through randomness closely mimics that evidenced by peak boardening of the diffraction peaks in Al-Cu-V quasicrystals. In growth process, it reveals a global shape without significant facet.

In view of the growth condition we note that quasicrystal could be formed from melt, amorphous and crystalline, respectively reveal outlooks of pentagonal dodecahedron, star polyhedron and global shape. The shape is very sensitive to the environmental factors such as temperature and composition fluctuation of the parent phase. We shall discuss the facets of quasicrystal by taking the structural model and the growth conditions into account.

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