category and the present paper reports the results of single crystal structural analysis for theses approximants. The present study reveals the fundamental atomic arrangement of the pentagonal columnar structure with 0.8nm periodicity and clarifies its linkage so as to form crystalline structures. Such structural information allows us to discuss the atomic structure of decagonal quasicrystals by reproducing the images of HREM and HAADF-STEM.

Keywords: alloy structurte, single-crystal diffraction, quasicrystals

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New phenomena in epitaxial growth: Solid films on quasicrystalline substrates

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A quasiperiodic arrangement of atoms has only been realized in binary or ternary alloys, known as quasicrystals. These are complex intermetallics with long-range aperiodic order and non-crystallographic rotational symmetry (usually five-fold or ten-fold symmetry). The physical properties arising from the quasiperiodic arrangement of the metal atoms significantly depart from that of periodic alloys and have attracted a broad interest. A long standing issue has been to understand the relative influence of the quasiperiodic order on the physical properties of quasicrystals, independently from the complex chemistry associated with such alloys. This has been the starting point of recent attempts to grow new quasiperiodic systems by using quasicrystalline surfaces as templates to force a quasiperiodic structure in metal thin films deposited on such substrates. Here I will give an overview of the research conducted in the field of solid film growth on quasiperiodic surfaces. An atomistic description of quasicrystalline surfaces will be presented and discussed in relation to bulk structural models. Then the various phenomena occurring during thin film growth on quasiperiodic surfaces will be outlined. Emphasis will be placed on the nucleation mechanisms of the solid films, on their growth modes in relation to the nature of the deposited metals, on the possibility of alloying at the interface, and on the epitaxial relationships at the crystal-quasicrystal interfaces. We will also describe situations where the deposited elements adopt a quasiperiodic structure, which opens up the possibility of extending our understanding of the relation between quasiperiodicity and the physical properties of such structurally and chemically complex solids.

Keywords: surface science, quasicrystals, thin films

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Mesoscopic quasicrystalline and Archimedean tilings in polymer alloys

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Tilings and patterns are known not only to mathematicians and crystallographers, but also to designers and visual artists as the basis of decorative art appearing on furniture, curtains, wall papers, kilts, ceramics, ties, etc. In this talk, we show that star-polymers can produce elegant self-assembled periodic and quasiperiodic patterns without fabrication technique. We have been creating several complex but periodic patterns known as antique Archimedean tiling patterns, and finally, we have found evidence of a “polymeric quasicrystal” tiling for the first time [1]. Quasicrystals are the avant-garde structures that have noncrystallographic symmetry, and initiated a revolution of crystallography and solid-state physics in 1980’s. Remarkably, our polymeric dodecagonal quasicrystal has a hundred times length-scale compared to metallic systems, and thus it approaches the scale of visible light, where a promising photonic application has been considered [2]. The present result indicates the universality of quasicrystalline order from atoms to polymers.
Reference:
[1] Kenichi Hayashida, Tomonari Dotera, Atsushi Takano, and Yushu Matsushita, Phys. Rev. Lett. 98, (2007) 195502.
[2] Kazunari Ueda, Tomonari Dotera, and Tohru Gemma, Phys. Rev. B 75 (2007) 195122.

Keywords: quasicrystals, multicomponent polymer systems, molecular architecture self-assembly

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Atomic simulation and lattice dynamics of the ZnMgSc icosahedral quasicrystal

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The structure of the binary CdYb icosahedral quasicrystal was recently solved using a 6D modeling approach and synchrotron radiation data. The structure of the quasicrystal is described as a quasiperiodic packing of a large triacontahedron connected along 2- and 3-fold axis [1]. Going from the atomic structure to physical properties remains a challenging problem. Indeed, an accurate derivation of the physical properties requires to, (i) have a tractable Hamiltonian and (ii) specify a realistic and unique position and chemical spicy for each atom in the quasicrystal structural model. The whole procedure is illustrated on the example of icosahedral Sc-Mg-Zn alloy, starting from the derivation of effective pair potentials from first principle database, through “energetic” refinement of uncertain structural details, and finally comparative study of lattice dynamics for 1/1 and 3/2 approximants. The simulated dynamical response function reproduces perfectly the experimental one, measured by inelastic neutron and x-ray scattering [2]. In particular the differences observed between the quasicrystal and the 1/1 approximant are well accounted for. An analysis of eigen modes and their localization on clusters will be presented. It is also found that, except for the Sc icosahedrons, all cluster shells present a significant deviation from icosahedral symmetry, related to the relative orientation of the inner