MM 21: Quasicrystals

Time: Tuesday 11:45–13:00 Location: H 0111

MM 21.1 Tue 11:45 H 0111

The (010) Surface of the T-Al3(Mn,Pd) Complex Metallic Alloy — •Thalia Deniozou[1], Rafik Addou[1], Marc Heggen[2], Michael Feuerbacher[2], Oliver Gröning[3], Vincent Fournée[1], Julian Ledieu[1], and Jean-Marie Dubois[1] — [1]1LSG2M, UMR 7584 CNRS-INPL Ecole des Mines, F-54042 Nancy, France — [2]Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich, Germany — [3]3EMPA, Materials Science and Technology, Nanotech at Surfaces, Feuerwerkerstraße 39, CH-3602 Thun, Schweiz

The discovery of quasicrystals modified the basic concept of solid state physics, as they lack periodicity but still have long-range order and forbidden rotational symmetries. There is currently a broad interest in related systems, called complex metallic alloys, presenting a similar local order but recovering periodicity, though on a large scale compared to regular crystals. The orthorhombic phase T-Al3(Mn,Pd) is an example of such large unit cell crystal, approximant of the decagonal Al-Mn-Pd quasicrystal. Here we report the first study of the (010) surface of the T-Al3(Mn,Pd) phase, using scanning tunnelling microscopy (STM) and low energy electron diffraction (LEED). The surface is prepared by sputtering and annealing to 900 K. The characteristic pseudo-decagonal symmetry and the orthorhombic unit mesh of the (010) T-Al3(Mn,Pd) surface could be observed with LEED. STM images reveal flat terraces separated by a unique step height (6.3 +0.3 Å). High-resolution images show a pattern of pentagonal chains characteristic of the bulk structure. We found that the contrast in STM images strongly depends on the bias voltage.

MM 21.2 Tue 12:00 H 0111

Are the Al atoms correctly placed in the models of i-AlPdMn and i-AlCuFe? — •Zorka Papadopolos[1], Oliver Gröning[2], and Roland Widmer[2] — [1]Institut für Theoretische Physik, Univ. Tübingen, Germany — [2]Material Science and Technology, EMPA, Thun, Switzerland

The model $\mathcal{M}(\mathcal{T}^{*(2F)})$ [1], as a model of atomic positions describes $Al_{70}Pd_{21}Mn_9$ and $Al_{62}Cu_{25.5}Fe_{12.5}$ [2]. The model is based on the diffraction results [3,4]. In the model we study the bulk terminations as defined in [5], through a generalisation of the Bravais' rule to the quasicrystals. Assuming the model independent results of LEIS (low energy ion scattering) [6], from the STM (scanning tunnelling microscopy) simulations [7] on the 5fold surface, compared to the real images of i-AlPdMn, we conclude that either the Al atoms are not correctly placed in the model, or the shape of atomic surfaces, i.e. the model of atomic positions itself must be changed.

[1] http://www.quasi.iastate.edu/Structure%20Dbase%20Info.html
[2] V. Elser, *Philos. Mag. B* **73**, (1996) 641.
[3] M.de Boissieu et al., *J. Phys.: Condens. Matter* **6**, (1994) 10725.
[4] A. Katz et al., in *Proc. of the 5th Int. Conf. on Quasicrystals*, ed. C. Janot et al., (World Scientific, Singapore, 1995) p. 164.
[5] Z. Papadopolos and G. Kasner, *Phys. Rev. B* **72** (2005) 094206.
[6] R. Bastasz et al., *Philos. Mag.* **86**, (2006) 855.
[7] J. Tersoff and D.R. Haman, *Phys. Rev. B* **31**, (1985) 805.

MM 21.3 Tue 12:15 H 0111

Observation of Archimedean-Like Tiling Structures on Decagonal Quasicrystalline Structures — •Jules Mikhael, Laurent Helden, and Clemens Bechinger — 2. Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart, Germany.

Spontaneous formation of quasicrystals is typically only observed in rather complex metal alloys, for instance i-AlPdMn or d-AlNiCo, and strongly depends on the specific chemical composition. One way for forming monoatomic quasicrystalline structures is to use the surface of the quasicrystals as templates for adsorbed monolayers. Here we report a real space investigation of the phase behavior of micron-sized colloidal particles adsorbed onto a quasicrystalline decagonal substrate created by interfering five laser beams. An intermediate remarkably stable phase is found revealing likewise crystalline and quasicrystalline characteristics. It can be described as a Fibonacci sequence of periodic (3.3.3.4.4) Archimedean tiling segments. This result opens a route to identify the primordial parameters for the formation of pseudomorphic monoatomic quasicrystals.

MM 21.4 Tue 12:30 H 0111

Dominant motion vs. localization in quasiperiodic chains — •Klaus Morawetz[1,2] and Michael Schreiber[1] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Noethnitzer Str. 38, 01187 Dresden, Germany

Chains of coupled clusters arranged in a quasiperiodic sequence are analyzed with respect to the dynamics of wave packets. The recurrence probability is shown to show characteristic plateaus described by an interplay of localization and dominant motion. A three-mode model is developed which allows to understand the features of the recurrence probability as well as of the time-dependent width of the wave packets. The relation to waiting probabilities and anomalous diffusion is worked out. The consequences for the transmission coefficient realizable in experiments by sequences of quasiperiodic chains are discussed and the generalizations towards two-dimensional tilings are presented.

MM 21.5 Tue 12:45 H 0111

Phase behavior of colloidal particles on a 2D quasicrystalline substrate — •Michael Schmiedeberg and Holger Stark — Institut für Theoretische Physik, Technische Universität Berlin, D-10623 Berlin, Germany

By using Monte-Carlo simulations, we study charged-stabilized colloidal particles in a two-dimensional decagonal potential and calculate their phase diagram as a function of the particle density and the strength of the substrate potential, which in experiments is realized by interfering laser beams.

As one expects, we find a triangular to liquid phase transition for small laser intensities and a ten-fold symmetric quasicrystalline phase for high potential strengths. For intermediate intensities, however, where the colloidal ordering is influenced by both the colloidal interaction and the substrate potential, we identify a series of interesting phases: For systems with low densities, where the number of colloidal particles is less than the number of potential minima, there is a quasicrystalline phase which exhibits bond orientations in 20 different directions. When the number of colloids exceeds the occurence of minima, we usually find a solid phase without any bond-orientational order. However, for certain densities the system locks into a highly ordered phase that is close to an Archimedean tiling.