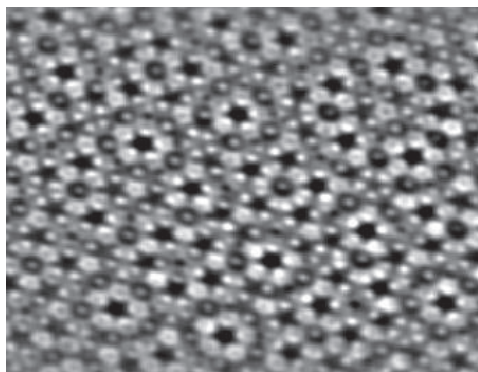


layer is formed first, followed by the growth of Bi islands for larger coverage. An astonishing feature of this system is that, for multi-layer coverage, Bi deposition yields islands with specific heights (magic height) corresponding to the stacking of a specific number of atomic layers. This unusual growth morphology is interpreted as quantum size effects and explained by confinement of electrons within the film.



Keywords: quasicrystal, surface, STM

### P23.04.06

*Acta Cryst.* (2008). A64, C625

#### Influence of the additional ligands dimensionality on the topology of Zn MOFs

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The use of flexible ligands in the synthesis of MOFs makes possible the obtaining of compounds with not very habitual topologies. Hexafluoroisopropilidenebisbenzoic (hfipbb) acid has a central atom with  $sp^3$  hybridization, conferring it the possibility of coordinate in a flexible way. On the other hand, the use of auxiliary ligands is relatively usual in the construction of this type of materials, being more or less determinant in the conformation of the final network, either for their geometry, or because they contribute with new interactions. Here is presented the topological study of Zn compounds, synthesized under hydrothermal conditions in presence of the hfipbb dianion, alone or with different auxiliary ligands, all them pyridine derivatives. With hfipbb, a 3D structure has been obtained without any additional ligand; when these are incorporated into the network, the dimensionality of the final structures depends on their coordination mode. If chelating ligands are used, one-dimensional structures are obtained; however, thanks to  $\pi$ - $\pi$  stacking or H-bonds interactions, 2D nets can be considered. Lineal bitopic, rigid or flexible, ligands give rise to biperiodic nets. In one of these cases, the biperiodic interpenetrated network formed by covalent bonds can be viewed as 3D self-catenated 6-connected net when the  $\pi$ - $\pi$  stacking interactions are considered.

Keywords: supramolecular interactions, metal-organic frameworks, main-group compounds

### P23.02.07

*Acta Cryst.* (2008). A64, C625

#### The periodic average structure of 7-, 8-, 10-, and 12-fold quasiperiodic tilings

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The motivation for the present work stems from the study of geometrical aspects of quasicrystal-to-crystal phase transformations, growth of quasicrystal-crystal interfaces, as well as the intrinsic band-gap behavior of phononic quasicrystals [1]. Average structures provide furthermore a tool for the classification of quasiperiodic tilings regarding their degree of quasiperiodicity. In the higher-dimensional approach, a  $d$ -fold 2-dimensional (2D) quasiperiodic structure can be described as an irrational cut of a  $nD$  hyperlattice decorated with hypersurfaces, with the 2D physical space. If a proper oblique projection of the hyperlattice upon physical space is performed, the vertices project onto the lattice nodes of a periodic average structure (PAS) [2], and the related 2D reciprocal space section contains a subset of reflections of the quasiperiodic tiling. The deviation of the tiling vertices from the PAS nodes is always within the boundaries of the projected hypersurfaces, and the overall intensity represented in the 2D reciprocal space section is a direct measure for the interconnection between PAS and quasiperiodic lattice. By using only strong Bragg reflections as reciprocal basis of the PAS, we can obtain the most representative PASs and compare them for each tiling, comparing thus their degree of quasiperiodicity. The diffraction pattern for each tiling is calculated analytically, by Fourier transformation of the hypersurfaces (which are 2-dimensional for the 8-, 10- and 12-fold tilings, and 4-dimensional for the 7-fold tiling).

[1] D. Sutter-Widmer, S. Deloudi and W. Steurer, *Phys. Rev. B* 75, 94304 (2007).

[2] W. Steurer and T. Haibach, *Acta Cryst. A* 55, 48 (1999).

Keywords: quasiperiodic tiling, periodic average structure, higher dimensional crystallography

### P23.05.08

*Acta Cryst.* (2008). A64, C625

#### The breaking of duality symmetry, melting, and glass transition

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Extending the Sethna-Sachdev-Nelson formula, we will introduce a theoretical formula based on the gauge-invariant Lagrangian density with spontaneous breaking for three-dimensional metallic glasses. We discuss a generalized view of the physical origin of the Boson peak in the gauge-invariant formula. The localized modes (massive gauge modes), which correspond to the Boson peak, are required naturally through the Higgs mechanism in the present theory. It is proposed that the duality symmetry between the new order parameter and the new disorder parameter might be related to the melting. In addition, we will discuss the relation between the glass transition and the breaking of duality symmetry.

Keywords: duality symmetry, melting, glass transition