**Poster Sessions**

**MS63.P06**

Structure of quasicrystals – scaling in real and reciprocal space

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Quasicrystals are aperiodic structures and there are no unit cells for them in physical space. Recently it was shown that structure of quasicrystals can be successfully described in physical space by statistical approach. The normal unit cell is replaced by an Average Unit Cell (AUC) [1,2], where atoms occupy the positions with some probabilities. Knowing the probability distribution one can calculate the structure factor and use it for the structure refining procedure [2-4].

In the presentation the concept of AUC is discussed. It is also shown that:
1. Structure refinement of quasicrystals can be done in physical space only by using the AUC approach.
2. AUC can be easily supported by higher dimension analysis by an oblique projection method.
3. With the AUC approach one can go beyond quasicrystals, even to more complicated structures with singular continuous diffraction pattern.

For all crystalline structures (including quasicrystals) one can define an appropriate scaling factor. After scaling of all the distances by such factor the self-similar structure is obtained. The same holds in reciprocal space. When scattering vector of any diffraction peak is multiplied by an appropriate scaling factor the self-similar structure is obtained. The same holds in reciprocal space. When scattering vector of any diffraction peak is multiplied by a scaling factor the self-similar structure is obtained.

Keywords: quasicrystal, structure, modeling

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To the Model of a Decagonal Al-Cu-Co

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It is attempted to produce a model of atomic positions of decagonal Al-Cu-Co using only the images of the phase in the direct space. Up till now, there is a large HREM (high-resolution electron microscopy) image of Al65-Cu15-Co20 [1] and a STEM (scanning transmission electron microscope) image of Al64-Cu22-Co14 [2], both taken along the c-axis, perpendicular to the quasiperiodic structure. The atomic positions, seen on the images taken along the c-axis should be related to an ideal 2-dimensional pentagonal tiling T*(A4), obtained by the projection from the 4-dimensional A4 root-lattice [3]. In Ref [4] was shown that the Burkov model [5], based on the same tiling T*(A4) overestimates the density of certain pentagonal local atomic configurations. The tiling is now placed over different local pentagonal atomic configurations and improves the model with respect to both above mentioned images of quasicrystals [1,2]. The atomic positions are related to the prototiles of the tiling T*(A4) and sorted into five classes with respect to the pentagonal module. The use will be made of the single 2-dimensional pentagonal cluster of atomic positions suggested in Ref [2]. For the 2-dimensional cluster a possible splitting along the c-axis into 5fold planes is proposed.


Keywords: quasicrystal, decagonal, structure

**MS63.P08**

Physical properties of the Cd₇R 1/1 approximants

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Quasicrystalline 1/1 approximants Cd₇R (R=Ca, Y, rare earth elements) are known as cubic systems made up of Tsai-type clusters located at the bcc lattice points [1]. A Tsai-type cluster is composed of four successive shells, i.e., from the cluster center, a Cd₄ tetrahedron, a Cd₁₂ dodecahedron, a R₁icosahedron and a Cd₁₄icosiddodecahedron. These compounds are reported to exhibit an order-disorder type phase transition, which is interpreted as ordering of the Cd₄ tetrahedron at the center of cluster below T₁ [2]. Besides the structural phase transition phenomena, also interesting are their physical properties, especially the magnetic property of the magnetic moments sitting on the vertices of the R₁icosahedron. Recently, we have found an occurrence of three successive anti-ferro magnetic phase transitions in Cd₇Tb approximant [3], which is in a contrast with the cases of the isostructural Ag-In-R where spin glass-like behaviors, not long-range orders, are observed at

Keywords: quasicrystal, structure, modeling
low temperatures [4].

In the present work, we have prepared Cd₃R single grains by a self-flux method and have measured their physical properties such as electrical, thermal and magnetic properties. We have also performed high-magnetic field measurements up to ~50 Tesla at low temperatures down to 1.3 K.

For most of Cd₃R compounds, the magnetic susceptibility is found to obey the Curie-Weiss law, say, above 50 K, indicating that R atoms at the vertices of the R₃Cd₂icosahedron are well localized in a trivalent state. At low temperatures, heat capacity exhibits peaks attributed to occurrences of long-range magnetic orders. In Cd₃Tb, measurements under high-magnetic field show two clearly meta-magnetic transitions below 10 Tesla. This result suggests that several magnetic states are nearly degenerate at low temperatures. Detail of the physical properties of Cd₃R will be discussed in the presentation.


Keywords: quasicrystal, magnetism

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Synthesis of single-grained Zn₉Sc₁₂ quasicrystal and its electrical resistivity
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Zn₉Sc₁₂ icosahedral quasicrystal (iQC) has recently been discovered by Canfield et al. [1]. It is a stable binary iQC and is expected to contain no chemical disorder. An interesting feature about the iQC is that the initial compositions of Zn₉Sc₁₂ single grains having two different morphologies, i.e., morphologies, of single grains are obtained by sputtering of aluminum in a krypton atmosphere with addition of oxygen. The aluminum oxide layer was deposited to prevent selective escape of elements from the film upon vacuum annealing. The formation during annealing process of a layered structure is an important aspect for the iQC formation.


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Dislocation mobility in icosahedral quasicrystals
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A theoretical description of the dislocation motion in quasicrystals is developed. The hydrodynamic approximation is used in deriving the expression for dissipation losses of a moving dislocation. The continuum theory of dislocation mobility [1] and the dynamic equations of elastic and phason fields [2] are combined. Hence the dependence of dislocation mobility on vacancy concentration is found explicitly [3,4]. The numerical analysis of dislocation mobility shows that phason deformations make the major contribution to the drag of free dislocations in icosahedral quasicrystal Al-Pd-Mn. The influence of vacancies on dislocation mobility becomes noticeable only at very large vacancy concentration, Cₐ > 10², and at very low dislocation velocity, vₐ < 10⁻⁴ cm/s.

The study of existing experimental data reveals the considerable contribution of mutual pinning of dislocations to their mobility in icosahedral quasicrystal. The expressions obtained for dislocation mobility are valid for temperatures close to the melting temperature since the role of mutual pinning decreases with the increase of temperature. Dislocation drag on pinning centers has a dominant role at lower temperatures.

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Structural characterization of thin AlPdRe quasicrystalline film formation during annealing process
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One of the possible ways to form ultrafine Al₃Pd₉Re₇ quasicrystalline film is the annealing of 3-layer (Al/Pd/Re) structure. Layer-by-layer ion-plasma deposition allows forming thin quasicrystalline film with precisely controlled thickness and homogeneity. Deposition was performed in a vacuum system with a sputtering chamber in the form of a Penning cell by Kr assisted magnetron sputtering from separate pure materials targets. After deposition of a layered structure, the films were coated with a layer of aluminum oxide, which was formed by sputtering of aluminum in a krypton atmosphere with addition of oxygen. The aluminum oxide layer was deposited to prevent selective escape of elements from the film upon vacuum annealing. The concentration range for the films prepared coincided with the known range of quasicrystalline phase formation in bulk samples [1].

We have studied phase evolution of Al/Pd/Re layered structures in situ during heat treatment and layer intermixing on intermediate annealing steps ex-situ. In-situ phase evolution study was done with X-ray diffraction and ex-situ layers intermixing analysis was done with