QC1 Decagonal quasicrystals.

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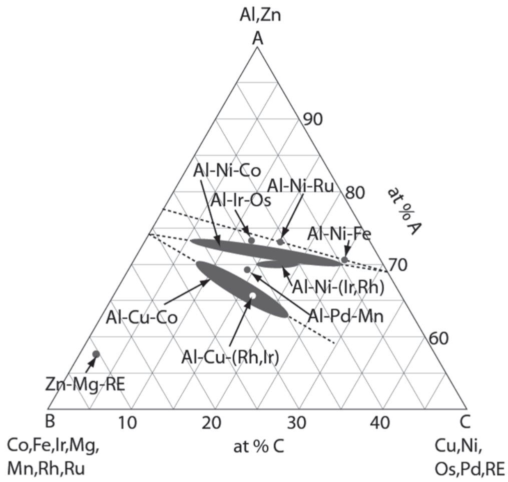
Decagonal phases are a special kind of quasicrystals combining quasiperiodicity in two dimensions (2D) with 1D periodicity along the tenfold axis (for an introduction see [1]). Decagonal quasicrystals (DQC) show Laue symmetries 10/mmm or 10/m. They are of particular interest for the study of the dependence of physical properties on the kind of long-range order, because with DQC this can be done on one and the same sample.While metastable DQC have been found in binary as well as ternary intermetallic phases, stable DQC have only been discovered so far in ternary intermetallic systems. Their compositional stability ranges vary from line compounds such as decagonal Zn-Mg-RE (RE...rare earth) to decagonal Al-Co-Ni with rather broad stability range (see figure below).



With more than 1300 papers published so far, structures and properties of decagonal phases are quite well understood now. While the structures can be geometrically seen as stackings of quasiperiodic layers with periods of 2, 4, 6 or 8 layers [2], crystal-chemically they are by no means layer-structures. The other commonly used picture of a quasiperiodic packing of partially overlapping columnar clusters is for the under-standing of the structure very useful. However, the cluster can only be seen as structural motifs because intra- and inter-cluster chemical bonding does not differ. It is remarkable that all structures of DQC studied so far can be described as cluster-decoration of tilings that are related to the Penrose tiling. In the talk, our knowledge on the structure of decagonal quasicrystals will be critically reviewed.

[1] Steurer, W.&Deloudi, S. (2008). *Acta Cryst.* A**64**, 1-11.
[2] Steurer, W. (2004) *Z. Kristallogr*. **219**, 391-446.

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QC2 Structures of Icosahedral Quasicrystals and Approximants.

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Structure determination of quasicrystals (QCs) has been one of the most challenging tasks since their discovery by Shechtman *et al*.[1] In this work we will assess the present state of the art concerning structure determination of icosahedral quasicrystals and approximants. In particular we will discuss the structure of the binary stable *i*-$YbCd_{5.7}$ quasicrystal,[2] and how our knowledge of this phase has affected our overall understanding of icosahedral quasicrystals.[3] The binary *i*-$YbCd_{5.7}$ phase could be characterized due to a fortuitous combination of circumstances: the quasicrystal is stable and high quality singlecrystals can be grown in equilibrium with a melt of the same composition. It is binary and chemically well-ordered, and furthermore two closely related approximant phases are known in close compositional vicinity to the quasicrystal. By carefully studying the structures of these related approximants and collecting singlecrystal data on the quasicrystal the structure of the *i*-$YbCd_{5.7}$ phase could be characterized. However, far from all quasicrystals benefit from stability, chemical order and the availability of closely related approximants, in fact the *i*-$YbCd_{5.7}$ QC is a rare exception. Fortunately, much of what we have learnt from this phase can be applied also to other quasicrystals. Primarily this applies to the related phases of the same family, since the *i*-$YbCd_{5.7}$ phase is the parent structure for the largest family of icosahedral quasicrystals and approximants. Most of these phases however, are ternary and suffer from chemical disorder which is yet to be well understood.

[1] Shechtman *et al*., *Phys. Rev. Lett.* **53**, 1951 (1984). [2] Tsai *et al*., *Nature* 408, **537** (2000).[3] Takakura *et al*., *Nature Materials*. **6**, 58 (2007).

Keywords: quasicrystal; approximant; disorder