s3.m12.o4 **Interplay of Periodicity and Aperiodicity for the Physical Properties of Aperiodic Crystals.**
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Keywords: Quasicrystals; Incommensurate Composites; Aperiodic

Incommensurate composites may have subsystems for which the basic structure even is aperiodic. Examples are composition flexible composites. The other subsystems may have periodic basic structures. One of the distinctions between the two is the character of vibrational excitations and of elctrons. In periodic subsystems they are in first approximation extended, whereas in the aperiodic subsystems they tend to be localised or critical. In a class of quasicrystals it is also possible to distinguish subsystems with a different character of the phonons and electrons.

The mutual interaction between the subsystems may be considered to be responsible for a number of peculiar properties of the systems mentioned before. This will be illustrated on a simple model, the double chain model, with electrons and phonons. Among the special properties is the occurrence of a pseudo-gap in the density of states (VDOD or EDOS).

s3.m12.o5 **Structural ordering of decagonal Al-Co-Ni.**
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Keywords: Quasicrystals; Decagonal; Order/Disorder

A huge amount of work has already been invested in the study of stability, structure and ordering of decagonal Al-Co-Ni (for a recent review see [1]). This phase has become *the* model system for decagonal quasicrystals for several reasons: it shows an exceptionally broad stability range with a wealth of different structural ordering states as a function of composi-tion and/or temperature; the full power of electron-microscopic and surface imaging methods can be applied due to the short translation period along the periodic axis (2-4 atomic layers); it can be easily grown in centimeter-sized sin-gle crystals of excellent quality, which makes it well-suitable for the study of all kinds of physical properties. In our ongoing project we study the evolution of structural order/disorder phenomena across the wide stability field of the decagonal phase in the system Al-Co-Ni as a function of temperature and/or pressure. Based on reciprocal space reconstructions of imaging-plate-scanner single-crystal X-ray diffraction data, the variation in Bragg as well as in diffuse scattering is inves-tigated in detail. We found, for instance, no indication of a phase transition of the d-phase with superstructure type I (S1+S2) at low temperatures ($T \geq 20$ K) or at high-pressure ($p \leq 10.7$ GPa). At high temperature, however, a phase transition and changes in the structural ordering of this particular d-phase have been observed. The variation of the diffracted intensity with composition at a given temperature (e.g. 900°C has also been studied. The (quasi)lattice parameters vary smoothly over the stability range of decagonal $Al_{71.5}Co_{28.5-x}Ni_x$ ($8 \leq x \leq 20$). A smooth variation is also observed for the diffuse scattering related to the ≈8 Å superstructure. These ob-servations indicate a continuous ordering process at 900°C from the basic Co-rich phase via the type II and type I super-structures to the basic Ni-rich phase. The stability of these two boundary d-phases differs considerably. The melting point of the basic Co-rich d-phase is more than 250°C higher than that of the basic Ni-rich d-phase. For comparison, the melting tem-peratures of CsCl-type AlCo and AlNi differ by 2°C only. Thus, substituting Co by Ni modifies structure and chemical bonding of the d-phase considerably. Indeed, Co- and Ni-rich d-phase structures differ in the period along the tenfold axis as well as in the intra- and inter-cluster short- and long-range ordering state. The present state of our knowledge on the or-dering of the d-phase in the system Al-Co-Ni will be discussed.

[1] Steurer, W.: Twenty years of structure research on quasicrystals. Part I. Pentagonal, octagonal, decagonal and dodecagonal quasi-crystals. *Z. Kristallogr*. **219** (2004) in press.