Magnetic and physical properties of giant-unit-cell intermetallics

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Large unit cells containing up to a few thousand atoms, well organized clusters forming shells (often of icosahedral symmetry), an disorder caused by mixed occupancy of atoms at the same positions in unit cells and long range order are characteristic for quasicrystals. Such structure brings about untypical hybridization effects responsible for the formation of a pseudo-gap at the Fermi energy level. In such systems, electrons cannot move freely (the electronic conductivity is small), the atoms cannot oscillate collectively and exchange energy in the usual way (the heat conductivity is small) and electrons inbetween atoms bind the atoms stiffer to each other (the elasticy constant is very high at room temperature). The magnetic and physical properties, the specific heat and the electronic and thermal transport manifest themselves in the surface energy, the solid-solid friction, the wetting and the extraordinary mechanical properties. Thus quasicrystals are highly applicable alloys used in surface engineering as thick coatings, functional top surfaces to promote selectively specific reactions in catalysis, small mechanical devices requiring extreme elastic properties and for thermoelectric generators and fuel cells. Various properties of quasicrystals and their aproximants belonging to the Al-Ni-Co, Al-Pd-(Mn,Re), Al-Cu-(Ni,Fe), Zr-Cu-Ni-Al, Al-Mn-Fe, Al-Fe-Ni and Yb-Cu families synthesized in numerous phases will be presented. The overview through the physical phenomena in of the giant-unit-cell solids will be given beginning from the NMR. As spin probes, the ^{27}Al, ^{59}Co, ^{63}Cu and ^{1}H were used. For quasicrystals, a slow, low-energy, diffusive atomic motions persist down to low temperatures. The hydrogen diffusion constant exhibits strong temperature dependence and obeys classical Arrhenius thermally activated over-barrier

hopping. The metallic Korringa relation shows in quasicrystaline lattices the cancellation of Kondo screening of the f-moments. The 1-D and 2-D NMR results will be supported by EPR, μ-SR, PPMS and SQUID measurements to show the investigated physical phenomenon from several points of view.