MM 27 Quasikristalle

Zeit: Montag 10:30–11:45 Raum: TU H111

MM 27.1 Mo 10:30 TU H111

Reversible Phase Transformation between amorphous and quasicrystalline state of ZrTiNiCu. — •S. Mechler, Ch. Abromeit, N. Wanderka, M.-P. Macht, G. Schumacher , B. Schattat, and S. Klaumuenzer — Hahn-Meitner Institut Berlin

During the crystallization process of several classes of metallic glasses quasicrystals are formed as the primary nucleating, intermediate phase. The alloy $Zr_{64.5}Ti_{11.4}Cu_{13.8}Ni_{10.3}$ can be produced by the splat quenching technique into amorphous sheets upto 50 μm thickness, whereas sheets of about 70-100 μm are fully quasicrystalline. Heating of the amorphous material leads at first to the transformation into the fully quasicrystalline state. The quasicrystals are metastable and vanish at higher temperatures in favor of crystalline phases. The phase transformations are investigated by means of DSC, XRD and TEM. To study the stability of quasicrystalline ZrTiCuNi under irradiation with swift heavy ions, we used Au, Xe and Kr ions in the energetic range of 300-600 MeV. Irradiation by 600 MeV Au, leads to full amorphization of the sample already for a fluence of 10^{13} /cm^2. At lower fluences, amorphous tracks inside the quasicrystals can be visualized by HRTEM. The amorphization of the quasicrystalline phase is ascribed to the high electronic energy loss of the Au ions (40 keV/nm). This state can be reversed again by heating.

MM 27.2 Mo 10:45 TU H111

Quasicrystal formation in mechanically alloyed Zr-Ti-Nb-Cu-Ni-Al glassy powders — •Sergio Scudino[1], Ludwig Schultz[1], Jürgen Eckert[2], Hergen Breitzke[3], and Klaus Lüders[3] — [1]IFW Dresden, Institut für Metallische Werkstoffe, Postfach 270016, D-01171 Dresden, Germany — [2]FB 11 Material- und Geowissenschaften, FG Physikalische Metallkunde, Technische Universität Darmstadt, Petersenstraße 23, D-64287 Darmstadt, Germany — [3]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, D-14195 Berlin, Germany

Differently from the glassy $Zr_{57}Ti_8Nb_{2.5}Cu_{13.9}Ni_{11.1}Al_{7.5}$ melt-spun ribbon that forms an icosahedral quasicrystalline phase upon devitrification, the corresponding alloy produced by mechanical alloying of elemental powder mixtures does not clearly show quasicrystal formation. However, the addition of an appropriate amount of elemental zirconium to the mechanically alloyed powder changes the crystallization behavior inducing the formation of the quasicrystalline phase. This indicates that for this multi-component metallic glass quasicrystal formation in the mechanically alloyed powder is crucially linked to the composition rather than to the question whether there is a special quenched-in short-range order. This work was supported by the German Science Foundation under grants Ec 111/10-1,2 and Lu 217/17-1.

MM 27.3 Mo 11:00 TU H111

Multiscaling, Ergodicity and Localization in Quasiperiodic Chains — •V. Z. Cerovski[1], M. Schreiber[1], and U. Grimm[2] — [1]Institute für Physik, Technische Universität Chemnitz, D-09107 Chemnitz — [2]The Open University, Applied Mathematics Dept., Milton Keynes, MK76AA, UK.

We report results of numerical simulations of wavepacket dynamics in a class of chains consisting of two types of weakly coupled clusters arranged in a quasiperiodic sequence and investigate properties of eigenstates using the perturbation theory of degenerate levels in the coupling strength v and numerical diagonalization. Results show that wave packets anomalously diffuse *via* a two-step process of rapid and slow expansions, that persist for any $v > 0$. An elementary analysis of the perturbation theory of degenerate levels reveal that non-localized states appear only in sufficiently high order of perturbation theory that is simply related to the combinatorial properties of the sequences, and numerical diagonalization furthermore shows that eigenstates ergodically spread across the whole chain for $v > 0$, while in the limit $v \to 0$ ergodicity is broken and eigenstates spread only across clusters with the same number of atoms, in contradistinction with trivial localization at $v = 0$. Effects of the single-site perturbation on wavepacket dynamics are furthermore investigated and shown that by changing the position or strength of the impurity it is possible to control long-time wavepacket dynamics. By adding a single impurity it is possible to induce wavepacket localization on individual subchains as well as on the whole chain.

MM 27.4 Mo 11:15 TU H111

Electronic transport and structural properties of amorphous and quasicrystalline Al-TM thin films — •Jose Barzola-Quiquia and Peter Häussler — Institut für Physik, Technische Universität Chemnitz, D-09107, Germany

In the present contribution we present a detailed study and comparison of electronic transport properties and the atomic structure of the amorphous and the quasicrystalline state of Al(CuFe, PdMn, PdFe). The samples are prepared in situ at low temperature (T≈10K) as amorphous thin films. After preparation the samples were annealed at different temperatures and both, transport and structural properties were measured up to the transition to the quasicrystalline state at T>700K. The electronic transport properties show pronounced non- metallic behaviour versus temperature. The atomic structure is characterized by the typical spherical-periodic order of disordered systems. But, additional, local icosahedral order is observed, which gets more pronounced by annealing. This behaviours can be explained in the frame of an electronic stabilization of amorphous systems, very similar to Hume-Rothery alloys. Contrary to Hume-Rothery alloys, in the systems under consideration hybridisation effects between Al_p with TM_d electrons play an important rule. Our view on the electronic stabilization gets supported by electronic transport measurements.

MM 27.5 Mo 11:30 TU H111

Nichtkollineare magnetische Ordnung in Quasikristallen — •Elena Y. Vedmedenko[1], Uwe Grimm[2] und Roland Wiesendanger[1] — [1]Institut für Angewandte Physik, Jungiusstr. 11, 20355 Hamburg, Germany — [2]Applied Mathematics Department, The Open University, Milton Keynes MK7 6AA, UK

Die Grundzustandskonfigurationen eines Antiferromagneten, in dem die magnetischen Momente nach einer planaren quasiperiodische Parkettierung angeordnet sind, werden mittels Monte-Carlo Simulationen untersucht. Im Gegensatz zu der Situation für ferromagnetische Wechselwirkung [1] stellt sich heraus, dass das Zusammenspiel geometrischer Frustration und quasiperiodischer Ordnung zu einer dreidimensionalen nichtkollinearen antiferromagnetischen Struktur führt [2]. Diese besteht aus geordneten magnetischen Überstrukturen mit verschiedenen Energien und charakteristischen Wellenvektoren, in Abhängigkeit von der quasiperiodischen Anordnung der magnetischen Momente. Derartige Strukturen liefern eine mögliche Erklärung für die experimentell beobachteten kurzreichweitige magnetische Ordnung in ikosaedrischen Ho-Mg-Zn Quasikristallen [3].

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