grazing incidence X-ray standing waves technique [2].

Samples under examination were studied stratified Al/Pd/Re structures with layer thicknesses 30/8/3 nm correspondently. Layer thicknesses were controlled by numerical modeling combined with ex-situ calibrations. As a substrate we used super polished sapphire. Order of layers were selected as substrate- Pd-Al-Re to inctear contrast of X-ray standing waves All samples were covered with 10 nm Al_2O_3 layer to prevent oxidation of top layer.

All experiments were done on KMC-2 station BESSY-II synchrotron radiation source. For in-situ phase ID analysis samples were annealed in the high vacuum oven with beryllium dome and tilted for 0.7 degree with respect to the x-ray beam. Diffracted radiation was measured using 2D CCD detector. Samples were heated up to 700 degrees C with the speed 5 degrees per minute then annealed during 1 hour and then cooled down with the speed 10 degrees per minute. Diffraction patterns were detected every 2 seconds. For intermediate layer intermixing study samples were similarly heated and annealed at 250˚C, 300˚C, 350˚C, 450˚C, 550˚C, 650˚C and 700˚C.

We have found that ultrathin quasicrystalline film is formed in 3 steps. At first step at 350˚C forms homogeneous polycrystalline Al_3Pd layer, while Re layer remains separate. Second, between 450 and 680˚C Al_3Pd phase transforms into AlPd phase. At this step Re starts to diffuse into Al-Pd layer. Finally homogeneous Al-Pd-Re intermixed layer forms at 700˚C and with major icosahedra *i*-$Al_{70}Pd_{20}Re_{10}$ quasicristalline phase. First indication of Quasicristalline phase formation was detected at 680˚C.

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Multiple diffraction in icosahedral and decagonal quasicrystal

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Multiple diffraction (MD) may be stimulated if more than one set of atomic planes of a crystal are simultaneously in reflection position. When a sample rotates around the diffraction vector of the main reflection and brings another reciprocal lattice point (the so called *simultaneous* or *operative* reflection) onto the surface of the Ewald sphere, the diffracted beam of the primary reflection may also serve as an incident beam for the operative reflection. As a consequence the total amount of intensity will be redistributed among both of them.

Because of the presence of a dense set of Bragg reflections MD is thought to be omnipresent in diffraction experiments with quasicrystal. Accurate measurement of weak Bragg intensities is expected to be heavily affected by MD. To reveal its influence on quasicrystal structure analysis, MD effects in an icosahedral Al-Cu-Fe quasicrystal [1] and in a basic Co-rich decagonal Al-Co-Ni quasicrystal [2] were studied with synchrotron radiation. The high flux available at the beam line SNBL at ESRF, Grenoble allows large-angle ψ-scans within a reasonable time: 10º and 40º ψ-scans (step size 0.01º) were performed for the reflections from *i*-$Al_{64}Cu_{23}Fe_{13}$ and for from *d*- $Al_{72.5}Co_{18.5}Ni_9$., respectively. To compensate for small misalignments a 0.5º ω-scan was performed at each ψ–position. From the ω-ψ-scan patterns, several *Umweganregung* peaks could clearly be observed. Figure 1 illustrates the intensity variation of the primary reflection during such wide ψ-scans at one selected peak from *d*-$Al_{72.5}Co_{18.5}Ni_9$.

Either the individual MD peak or the MD events in a full data set has been simulated by the kinematical approach. Preliminary results reveal that the amount of weak reflections affected by MD effects during the collection of a full data set is on the same level as those of outliers recognized in a standard data reduction, however, the data quality of the data sets is not seriously biased by the MD effects.

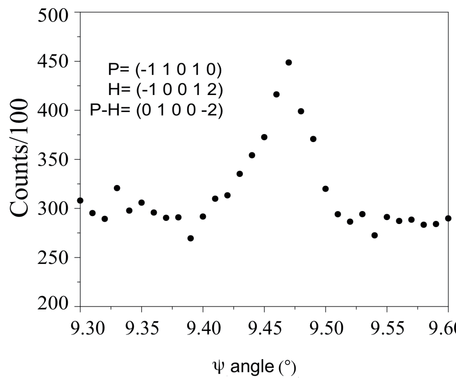

Fig.1 Intensity of a weak reflection $\bar{1}1010$ for *d*-$Al_{72.5}Co_{18.5}Ni_9$ as a function of the ψ angle

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Localization of current states in one-dimentional aperiodic structures

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In periodic one-dimentional atomic structures the current states are impossible. Even the small perturbation leads to localization of electrons [1]. We show that this is not so in some aperiodic structures. For this purose the sequences of quantum dots (QDs) were considered (the QDs can be considered as the artificial atoms, and it is easy to influence on their electronic specta by realistic external fields [2]). As an example the sequence of GaAs and isles of its solid solution $Al_xGa_{1-x}As$ and $In_xGa_{1-x}As$ where x=0.1–1 was considered as sequence of QDs. The energy spectra and transport of electronic excitations in one-dimensional aperiodic sequences of QDs of Thue-Morse and double-periodic type were studied. The influence of the external magnetic field and electric field on energy spectra and transport were studied. For aperiodic sequences of quantum dots the influence of relatively small magnetic and electrical fields is essential (about several Tesla or V/cm), but localization occurs at the finite values of perturbations. The transmission coefficient was determined in quasiclassical approximation taking into account the Coulomb blockade. The resonance tunneling was studied. It takes place when electronic energy levels in neighbor quantum dots are aligned by external fields .

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