X-ray study of the phason strains in Al-Pd-Mn and Al-Ni-Co decagonal quasicrystals

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The peak broadening and peak positions of Bragg reflections on the 2-fold axis in a single-phase decagonal $Al_{70}Ni_{10}Co_{20}$ quasicrystal have been studied. In order to achieve the high-resolution, 2θ-long arm and sharp slit system were used. Receiving slit with 0.25mm width was set on 900mm distance from ϕ-center. In this slit system, the angle resolution of 2θ is 0.016° and the corresponding momentum resolution along the L-direction is 0.048×10^{-2}Å^{-1}. Furthermore, the analyzer system was used for several reflections with small $Q_\perp$ values. A Si (220) analyzer crystal was set 700mm distance from ϕ-center and receiving slit with 0.5mm width was set 200mm distance from the analyzer crystal. The momentum resolution in this system along the L-direction is less than 0.01×10^{-2}Å^{-1}.

Full-widths at half-maximum (FWHM) of the Bragg reflections along the longitudinal direction (L) and transverse direction (T1) which is perpendicular to L-direction in an aperiodic plane have linear $Q_\perp$ dependence. This means that the $Al_{70}Ni_{10}Co_{20}$ decagonal phase has random phason strains. Notable peak shifts from ideal Bragg peak positions were not observed.

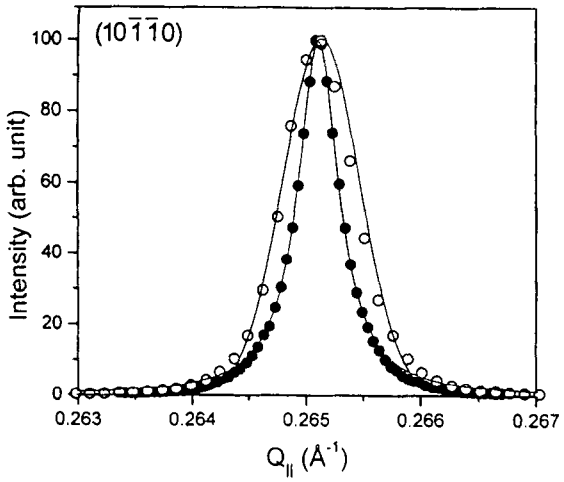

Fig.1 Peak profiles along the L-direction for the (10$\bar{1}\bar{1}$0) peak. Filled and open circles denote with and without analyzer, respectively.

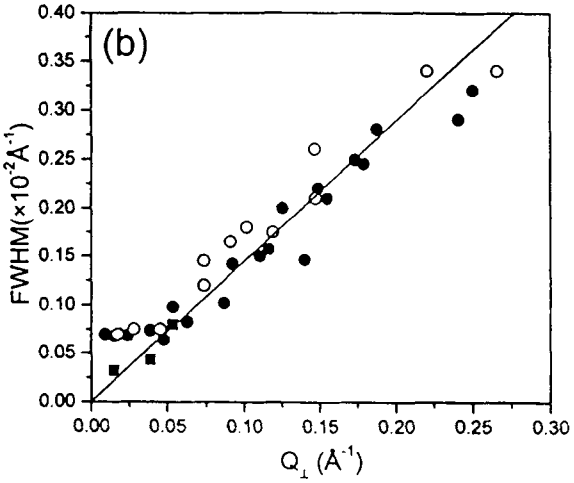

Fig.2 FWHM against $Q_\perp$ for L-direction. Filled and open circles denote the (10000) and (0100$\bar{1}$) direction, respectively. Filled squares denote the reflections in the (10000) direction obtained with the analyzer.