

Poster Presentation

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Single crystals of Al-rich complex metallic alloys grown by Czochralski method

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In quasicrystal-forming systems very often complex metallic phases exist which show similar structure motifs as the neighbouring quasicrystals but are periodic in all three directions. Therefore these phases are called approximants. They have similar chemical compositions as their parent quasicrystalline phases and can show the same periodicity of stacking of planes as for example found in decagonal quasicrystals. Using the Czochralski method cm³-size single-grain approximants of the Al₄TM type, as orthorhombic Al₄(Cr,Fe) and hexagonal Al₄Cr and of the Al₁₃TM₄ type, as monoclinic Al₁₃(Co,Ni)₄, orthorhombic Al₁₃Co₄, monoclinic Al₁₃Fe₄ and its ternary extensions Al₁₃(Fe,Cr)₄ and Al₁₃(Fe,Ni)₄ have been grown from Al-rich solutions [1,2]. The Czochralski method has proven to be a suitable technique for growing single crystals from off-stoichiometric melts due to easy seeding, good mixing of the melt and by allowing good observation of the growth process. To meet the special needs of Al-rich melts a fully metal-sealed growth chamber is used to prevent almost any contact to traces of oxygen. Simultaneously to pulling the change of the liquidus temperature during the growth process has to be compensated by slightly decreasing the temperature using ramps of -(0.1 - 0.8) K/h. For seeding native seeds in different orientations were used. Pulling rates as low as (0.05 - 0.15) mm/h were necessary for growing because of matter transport limits in solution growth and kinetic reasons. Growing the approximant phases the same slow growth kinetics as known from the decagonal quasicrystals was found. Therefore, it might be concluded that the growth of quasicrystalline phases is primarily not limited by the absence of periodicity but by the large clusters that are a common feature in the crystal structures of both, quasicrystals and their approximants.

[1] B. Bauer, P. Gille, *Z. Anorg. Allg. Chem.*, 2011, 637(13), 2052-2058, [2] P. Gille, B. Bauer, *Cryst. Res. Technol.*, 2008, 43(11), 1161 – 1167

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