Anisotropic transport properties of single-crystalline d-Al- Ni-Co decagonal quasicrystal

P. Popčević[a], J. Ivkov[a], D. Stanić[a,b], K. Velebit[a], D. Cmrk[a], J. Dolinšek[c], P. Gille[d], and A. Smontara[a,*]

[a] Institute of Physics, Laboratory for the Physics of Transport Phenomena, Bijenička 46, P.O.Box 304, HR-10000 Zagreb, Hrvatska (Croatia)
[b]Physics Department, Josip Juraj Strossmayer University in Osijek, Trg Ljudevita Gaja 6, HR-31000 Osijek, Hrvatska (Croatia)
[c]J. Stefan Institute, University of Ljubljana, Jamova 39, SI-1000 Ljubljana, Slovenia
[d]Department of Earth and Enviromental Sciences, Crystallography Section, Ludwig-Maximilians-Universität München, Theresienstrasse 41, D-80333 München, Germany

Keywords: d-Al-Ni-Co, electrical resistivity, thermopower, Hall coefficient, thermal conductivity, anisotropy

The crystallographic-direction-dependent transport measurements were performed on large single crystals [1] of d-Al-Ni-Co with the exact composition $Al_{69.7}Co_{10.0}Ni_{20.3}$. The measurements were performed along three orthogonal directions which are: [00001] direction (periodic one, and that of the 10-fold axis of d-phase), and [10-00] and [10000] directions which are the of two different 2-fold axes in the quasiperiodic plane. Anisotropic electrical resistivity, ρ, thermopower, S, and thermal conductivity, κ, were measured from 2 to 300 K and the Hall coefficient, R_H, was measure from 90 to 379 K. As expected, the anisotropy of the electrical resistivity, thermopower and thermal conductivity measured along 2-fold axes is small or negligible, and the anisotropy of R_H for magnetic field, B, along 2-fold axes is within the experimental error. At the same time there is a significant anisotropy in ρ, S, and κ values obtained for 2-fold axes and those measured for the periodic [00001] direction. In the Hall effect this anisotropy corresponds to the anisotropy of R_H for B parallel to [00001] ($R_H < 0$) and for B parallel to 2-fold axes ($R_H > 0$). The results agree well with the previous results for d-QCs [2-4] which are either performed on samples of the lesser quality or are incomplete in the sense that are not performed for the two distinct 2-fold axes. Also, there is correlation of the anisotropy in the transport properties of d-QCs and the anisotropy in $Al_{13}TM_4$ class of the approximants to decagonal quasicrystals [5-7].

References:

[1] B. Bauer, *et al.*, Phil. Mag. **86** (2006) 317-322.
[2] S. Martin*, et al.,* Phys. Rev. Lett. **67** (1991) 719.
[3] Y.P. Wang *et al.*, Phys. Rev. B **48** (1993) 10542-10545.
[4] A.D.Bianchi *et al.*, Phys. Rev. B **58** (1998) 3046-3056.
[5] A. Smontara, *et al.*, Phys. Rev. B, **78** (2008) 104204.
[6] J. Dolinšek, *et al.*, Phys. Rev. B, **79** (2009) 184201.
[7] P. Popčević, *et al.*, Phys. Rev. B, **81** (2010) 184203.

* Corresponding author. E-mail address: ana@ifs.hr