Magnetoresistance of Al-Cu-Co Quasicrystal

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Introduction

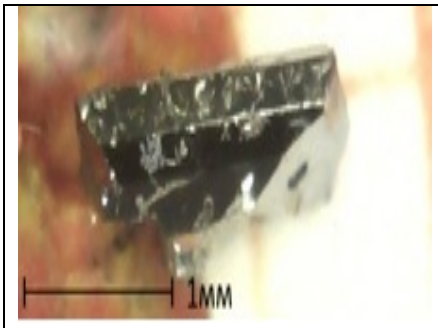
A large number of studies have been carried out to investigate new stable icosahedral and decagonal quasicrystals transport properties, as there was an expectation that these properties are unique due to the lack of translational invariance, see, for example [1] and refs therein. Thus, the transport properties, for example, electrical [2] and optical [3] conductivity, of two-dimensional decagonal quasicrystals are of particular interest as these materials have strong anisotropy of their in-quasicrystalline-plane properties towards the properties along the periodic axis. We planned study of Al-Cu-Co system at low temperature and high magnetic fields.

Experimental Results and Discussion

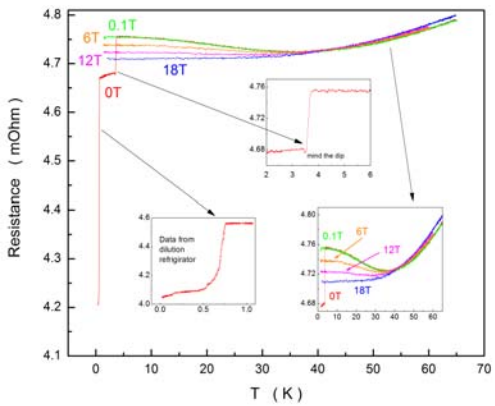
For this study we have grown several decagonal $Al_{65}Co_{16}Cu_{19}$ single quasicrystals of about 0.3x0.3x1 mm^3 size (see Fig. 1a). The periodic direction and quasiperiodic plane of the single crystal was identified by the Laue backscattering technique. We measured magnetoresistance of the $Al_{65}Co_{16}Cu_{19}$ quasicrystal in the temperature range 20 mK -70 K in the magnetic field of up to 18 T (see Fig. 1b), using SCM1 and SCM2 systems of the NHMFL DC field facility.

On the temperature dependence of the sample resistance measured at the zero magnetic field we observed a minimum of resistivity at about 37 K (see Fig. 1b). Thus, below 37 K the resistance rises up when the temperature drops down. This increase of resistance is suppressed by magnetic fields as seeing in Fig. 1b.

Also at low temperatures on the temperature dependence of resistivity at the zero field we found two transitions occurred at about 3.6 K and 0.7 K (Fig. 1b). At temperatures below 0.3 K the first and the second transitions were suppressed by very small magnetic fields of about .005 T and of about 0.1 T, respectively.



(a)



(b)

Figure 1. (a) Image of a decagonal $Al_{65}Co_{16}Cu_{19}$ single quasicrystal. (b) Temperature dependence of the resistance in $Al_{65}Co_{16}Cu_{19}$ quasicrystal at several magnetic fields. The field values are shown near the curves.

Conclusions

For understanding (a) the nature of the transition observed and (b) the non-monotonic temperature dependence of the magnetoresistance in $Al_{65}Co_{16}Cu_{19}$ more extended study, in particular, measurements of the material magnetization in the same broad range of temperatures and magnetic fields is required.

Acknowledgements

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References

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