Structure and magnetic properties of the Au-Ga-Ce approximant

Azusa Motouri [1], S. Suzuki[1], T. Yamada[2], T. Fujii[3], R.Tamura[1]

1 Department of Material Science and Technology, Tokyo University of Science, 6-3-1 Niijuku Katsushika-ku Tokyo, 125-8585, Japan
2 Department of Applied Physics, Tokyo University of Science
3 Cryogenic Research Center, The University of Tokyo, 2-11-16 Yayoi Bunkyo-ku Tokyo, 113-0032, Japan

[1]Corresponding author: 8219579@ed.tus.ac.jp

Rare-earth containing Tsai-type quasicrystals and their approximants have been a target of growing interest because of their unique structural and magnetic properties. The Tsai-type atomic cluster, which is a common building unit of the above compounds, is described by concentric five polyhedrons: tetrahedron, dodecahedron, icosahedron, icosidodecahedron, and rhombic triacontahedron, arranged from the cluster center to the outside. Rare-earth atoms are located at the vertices of the icosahedron. Recently, it has been shown that the tetrahedron at the cluster center can be replaced by a single rare-earth atom, and bulk magnetic properties are affected by the central magnetic rare-earth atom [1]. Very recently, heavy fermion behaviour was reported for the Ag-In-Ce 1/1 approximant, and particular attention has been paid to Ce-bearing Tsai-type compounds [2]. In this work, we have searched for a new Ce-based approximant in the Au-Ga-Ce system and investigated the relationship between its structure and magnetic properties.

In this study, alloys of various compositions were prepared by arc-melting and annealing at 973K for 50h. The phase purity of the samples was examined by powder X-ray diffraction using CuKα radiation. The lattice constant was determined using RIETAN-FP [3]. The temperature dependence of the electrical resistivity was measured by an AC four terminal method in the temperature range between 4 K and 300 K. Temperature dependence of the magnetization was measured using MPMS in the temperature range between 2 K and 150 K.

The powder X-ray diffraction patterns show that the Au-Ga-Ce 1/1 approximant possesses a wide single-phase region. The lattice parameter increases with increasing Au concentration. In addition, the lattice parameter is found to decrease with increasing Ce concentration. The latter observation suggests that a Ce atom occupies the cluster center with increasing Ce concentration. In our presentation, we will show the results of the single-crystal structural analysis on the approximants with different Ce concentrations and discuss the influence of the central Ce atom on the electron transport.

[1] Girma H. Gebresenbut, et al. Inorg. Chem. **55** 2001 (2016)
[2] K. Imura, et al., J. Phys. Soc. **86** 093702 (2017)
[3] F.Izumi and K. Momma, Solid State Phenom. 130 (2007) 15-20