Possible structural transformation in the Eu-Ag-In 2/1 approximant and its relation to the Cd-Yb quasicrystals

T. J. Sato[1,2], C. P. Gomez[2,3], A. P. Tsai[3,2]
[1] *NSL, ISSP, University of Tokyo, Tokai, Ibaraki 319-1106, Japan*
[2] *SORST-JST, Kawaguchi Saitama 332-0012, Japan*
[3] *IMRAM, Tohoku University, Sendai 980-8577, Japan*

Quasicrystals are characterized by sharp Bragg reflections with a point symmetry that is forbidden in a periodic lattice, such as the five-fold symmetry. For understanding of the formation and stabilization of the quasiperiodic structure, a key fact may be existence of approximant phase near the quasiperiodic compound in phase diagram. An approximant is a periodic crystal which has similar or identical atomic cluster in a finite length scale. For the binary Cd-Yb quasicrystal, there are two approximant phases are known to date; the 1/1 and 2/1 phases. The 2/1 phase has much larger atomic cluster in common to the quasicrystalline phase and thus is intriguing for the elucidation of the stabilization mechanism of the quasicrystalline phase. Recently, a 2/1 approximant phase was observed in the Eu-Ag-In alloy, which is supposed to be isostructural to the 2/1 Cd-Yb approximant. In a magnetic susceptibility study an abrupt change of the inverse-susceptibility slope was observed around 70 K, indicating change of electronic state of Eu ions at the temperature. Thus, the anomaly may possibly infer existence of certain structural distortion in the 2/1 approximant. To clarify this point we have performed neutron powder diffraction study using the IMR-HERMES powder diffractometer.

Powder samples of the Eu-Ag-In alloys were prepared by melting constituent elements in a standard manner. Because of the high absorption of the Eu, Ag, and In atoms, we have used an annular sample cell with the sample thickness of $t = 0.5$ mm. Nevertheless, the diffraction was very weak due to the absorption, and thus unusually long data acquisition time was necessary to record single diffraction pattern. Shown in Fig. 1 are the observed powder diffraction patterns at the room temperature and the lowest temperature $T = 4$ K. There is an apparent change of the lattice constant, resulting in the change of the Bragg peak positions in consistent way. In addition, some new peaks appear at the lowest temperature; most notable one is marked by a red arrow. This indicates a possibility of magnetic/structural transition between the two temperatures. Detailed analysis of the diffraction patterns is in progress.

Note: the experiment approved by PAC was on the Cd-Yb approximant itself, however, because of the unexpected UK airline confusion due to the terrorism possibility happened just a few days before the assigned HERMES beamtime, the sample delivery was delayed. Thus, we instead performed the most similar experiment with the samples in hand.

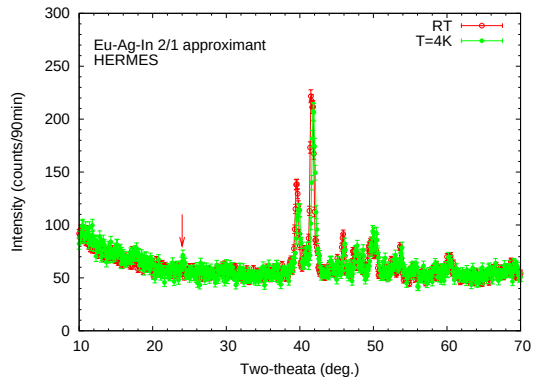

Fig. 1. Neutron powder diffraction patterns at $T = 4$ K (red) and RT (green) obtained at IMR-HERMES.