

Synthesis of the Ga-Pt-RE Tsai-type approximants

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The Tsai-type approximants have been extensively investigated because of their unique magnetic properties. For the Au-Al-Gd 1/1 approximants [1][2], the ground state magnetic order is found to sensitively depend on the Au/Al ratio. Inspired by this observation, the magnetic property of the Tsai-type 1/1 approximants has been studied in various alloys systems. On the other hand, that of the Tsai-type 2/1 approximants has been rarely studied, and the relationship between the degree of the approximation and its magnetic property has not been clarified yet. The Ga-Pd-RE (RE = Tb) system [3] is one of the examples which have both 1/1 and 2/1 approximants. In this study, we have investigated the formation condition of 1/1 and 2/1 approximants in the Ga-Pt-RE (RE = rare-earth) system by replacing Pd with Pt in the Ga-Pd-RE (RE = Tb) system.

Polycrystalline alloys of the Ga-Pt-RE (RE = La, Ce, Nd, Ho, Tm) systems were prepared by arc melting high purity Ga, Pt, La, Nd, Ho, Tm. The alloys were annealed under an Ar atmosphere and quenched in water. The phase purity of the samples was examined by the powder x-ray diffraction .

Figure 1 shows the powder x-ray diffraction patterns of the obtained approximants.

The calculated powder diffraction patterns from the reported structure of the Au-Al-Gd 1/1 approximant and the Au-Al-Ca 2/1 approximant are also shown for comparison. As can be seen, the 1/1 approximant was found to form after arc melting for the Ga-Pt-RE (RE = Ho, Tm) systems. It is also seen that the approximant phase formed depends on the atomic radius of the RE element: the 1/1 approximant does not form for RE = La, Ce and Nd, where the size of RE atom is relatively large. The 2/1 approximant was found to form after annealing at 1073 K for 48 h for the Ga-Pt-RE (RE = Ho, Tm) systems. The details of the formation conditions of the 1/1 and 2/1 approximants will be discussed in the poster presentation.

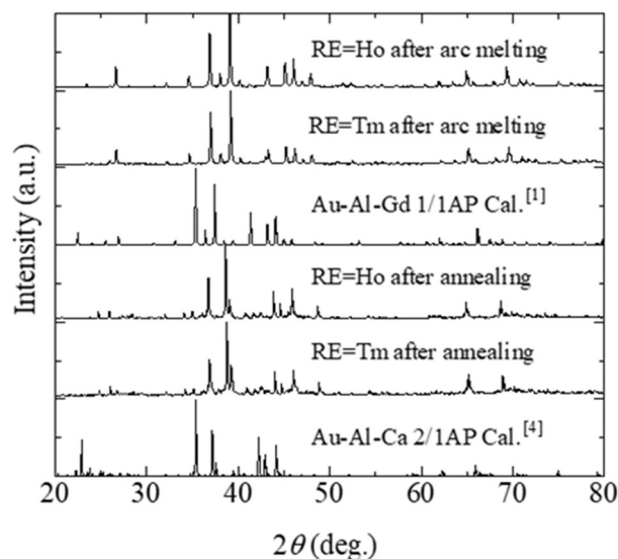


Fig.1: The powder x-ray diffraction patterns of $\text{Ga}_{52}\text{Pt}_{34}\text{RE}_{14}$ (RE= Ho, Tm) samples

[1] A. Ishikawa *et al.*, *Phys.Rev.B***98** (2018) 220403.

[2] A. Ishikawa *et al.*, *Phys.Rev.B***93** (2016) 024416.

[3] Y.-G So. *et.al.*,*Philoso.Mag.Lett.***98** (2017) 292

[4] J. Pham *et.al.*,*J.A.Chem.Soc.*,**140** (2018) 1337-1347.