Re-precipitation of Mg-Cd-Yb quasicrystals in Mg matrix and their interfaces

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Mg-Cd-Yb quasicrystal (Qc) [1] is derived from stable binary Cd-Yb quasicrystal [2] by partially replacing Cd with Mg. Stable Qc was identified in the compositional region of $Mg_xCd_{(84-x)}Yb_{16}$(x=0~60), which is much wider than that of the Zn-Mg-Y system or Zn-Mg-Zr systems. Two-phase equilibrium region of Qc and α-Mg (Mg) is also much wide and their eutectic reaction occurs at 460ºC, $Mg_{68}Cd_{24}Yb_8$. A unique orientation relationship between Qc and Mg has been recognized for Qc particle in Mg and eutectic structure in this system [3, 4]. Recently, we found that an alternative solutionizing and annealing treatments can reduce eutectic structure and promote re-precipitation of Qc particles in the Mg matrix. In this case, the Qc/Mg interface is expected to be equilibrium. In this study, the equilibrium interface structure is investigated by means of high-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) in order to get insights into the role of interface in stability of the Qc in Mg matrix.

Mg-Cd-Yb alloys prepared with induction furnace have been annealed at 460~520 ºC for 1~6h and subsequently quenched into water. Annealing for re-precipitation of Qc particles was performed at 300 ºC. Qc grains and microstructure have been observed and analysed with SEM (HITACHI SU6600) and TEM (TOPCON EM-002B, JEOL JEM-ARM 200F Cold).

Re-precipitated Qc particles in Mg matrix possessed clear facets showing a rectangle shape along Mg *a*-axis direction on Qc{2-f}// Mg *c*-axis direction for $Mg_{95}Cd_{4.5}Yb_{0.5}$ alloy. Sometimes, irregular hexagons or rectangles with twinning boundaries were observed. These precipitates and surrounding Mg matrix have the unique orientation relationship as previous reported: mutually perpendicular three [2-f] axes of Qc and *a*-axis, [01-10], *c*-axis of α-Mg are parallel respectively. Excellent matching of Qc {2-f} and Mg (0002) have been observed at the Qc/Mg interface with HAADF-STEM. These results are coincident with the interfacial stability in terms of the lattice matching of atomic plane estimated by means of X-ray diffraction [3, 4]. Stable interfaces of Qc{2-f}/Mg(0002), Qc{2-f}/Mg(01-10) could be the result of the shape of precipitates.

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