Poster Presentation

IT.P39

Chemical ordering in Al-Co-Ni approximants studied by Cs-corrected STEM with EDS

A. Yasuhara[1], K. Yubuta[2], K. Hiraga[2]

[1]JEOL Ltd., EM application Group, Tokyo, Japan, [2]Tohoku University, Institute for Materials Research, Sendai, Japan

Six-types of decagonal quasicrystals (DQCs) and some crystalline approximants have been found in Al-Co-Ni alloys with a wide compositional range from 8 to 25.5 at.% Co and from 20 to 5 at.% Ni with a nearly constant Al content of around 70 at.%, and so the stability of the six DQCs is considered to depend on a ratio of Co/Ni associated with chemical ordering of Co and Ni. However, the study of the chemical ordering of Co and Ni in the Al-Co-Ni DQCs is difficult because of next atomic numbers of Co and Ni, though arrangements of transition-metal (TM) atoms have been determined by Cs-corrected HAADF-STEM observations [1-2]. Besides, it was impossible to distinguish between Co and Ni in a W-(AlNiCo) crystalline approximant by single-crystal X-ray diffraction [3]. Our intention in the present paper is two-fold; the first is to study the structure of the Al-Co-Ni crystalline approximant by Cs-corrected HAADF- and ABF- STEM observations, and the second is to investigate the chemical ordering of Co and Ni in the structure. Using a Cs-corrected scanning transmission electron microscope (JEM-ARM200F), HAADF and ABF images were simultaneously acquired with an incident beam parallel to the b-axis. And atomic-resolution elemental maps were taken with a newly developed silicon drift detector (SDD). The chemical ordering of Co and Ni is clearly seen in the acquired elemental maps. Co atoms are enriched in atomic columns with a decagonal section of 1.2 nm in diameter, and Ni atoms are located in gaps between two-dimensional arrangements of the 1.2 nm atom clusters. It can be concluded that the area ratio of the Co-rich 1.2 nm atom clusters to the Ni-rich gaps results in various types of Al-Co-Ni DQCs with different arrangements of the 1.2 nm clusters.

[1] *A. Yasuhara, K. Saito and K. Hiraga, Aperiodic Crystals (Proc. of Aperiodic 2012), ed. by S. Schmid, R. L. Withers and R. Lifshitz, (Springer 2013), 219-224,* ***[2]*** *K. Hiraga and A. Yasuhara, Mater. Trans., 2013, 54, 493-497,* ***[3]*** *K. Sugiyama, S. Nishimura and K. Hiraga, J. Alloy & Compd., 2002, 342, 65-71*

Keywords: Cs-corrected Scanning transmission electron microscopy, Energy Dispersive X-ray Spectroscopy, Al-Co-Ni Crystalline approximants