PREPARATION AND ANALYSIS OF PR-GA-AL ALLOYS

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Pr-Ga-Al alloys were prepared from individual metals Pr, Ga, Al purified from oxide films in an inert atmosphere of the glove box. The metals were mixed in a certain proportion in crucibles and annealed at 832.4±1.7 °C and 366.2±6.3 °C for 19 hours and 53 hours respectively. Three ingots were obtained with different praseodymium content. X-ray phase analysis showed that the dominant phase of these alloys is $PrGa_6$. A formation of $Pr(GaAl)_2$ solid solution was also detected.

Praseodymium is one of the common rare earth elements. The phase diagrams of praseodymium alloys with p-elements are relatively well studied, although they require further researches. For example, the phase diagram of Pr-Ga alloys is studied poorly in the field of praseodymium concentrations of 30-40 wt.% [1,2].

The composition of the intermetallic compound $PrGa_4$ on the Pr-Ga phase diagram is indicated tentatively. Moreover, its structure is not known yet. The ternary phase diagram of the Pr-Ga-Al system is also not defined in the open literature.

Since Pr is a component of spent nuclear fuel (SNF), therefore, the aim of our investigation is a comprehensive study of alloys of this metal with a liquid metallic Ga-Al melt promising for SNF reprocessing.

Samples of individual metals Pr, Ga, Al were previously cleaned from oxide films, degreased with alcohol and stored in an inert box. According to the Ga-Al phase diagram [1], the eutectic composition was fixed: 99.2 wt.% of Ga (its melting point is 26.6 °C). The concentration of praseodymium was chosen in accordance with the poorly studied field of the Pr-Ga phase diagram. Three alloys were prepared. The compositions of the alloys are presented below. Their composition was determined by chemical analysis using an AES-ICP spectrometer Optima 2100DV. The deviations of analysis were calculated according to the error accumulation law.

Alloy	w(Pr), %	w(Ga), %	w(Al), %
#1	19.44±0.62	76.43±2.43	0.63±0.02
#2	27.15±0.86	68.31±2.17	0.57±0.02
#3	36.63±1.16	61.03±1.94	0.50±0.02

During the experiment, all alloys annealed into crucibles inside the experimental cell were held at 832.4±1.7 °C and 366.2±6.3 °C for 19 hours and 53 hours, respectively. The temperatures of alloys were recorded periodically using the K-type thermocouple.

After the experiment, the cell was cooled, and the alloys were extracted. Three ingots of these alloys were obtained. The first ingot was powdery. Ingots #2 and #3 were fragile and very hard, they have not sawn with hands and these ingots were cleaved at the edges. Therefore, the cut was carried out with a diamond saw to look at the radial

and longitudinal section of these alloys, as well as to prepare samples for X-ray phase analysis.

X-ray phase analysis showed that alloys #2 and #3 consisted only of a mixture of $PrGa_6$ intermetallic compound and $Pr(GaAl)_2$ solid solution (see figure 1). Moreover, the content of $Pr(GaAl)_2$ compound in the alloy #3 was more than in the second ingot.

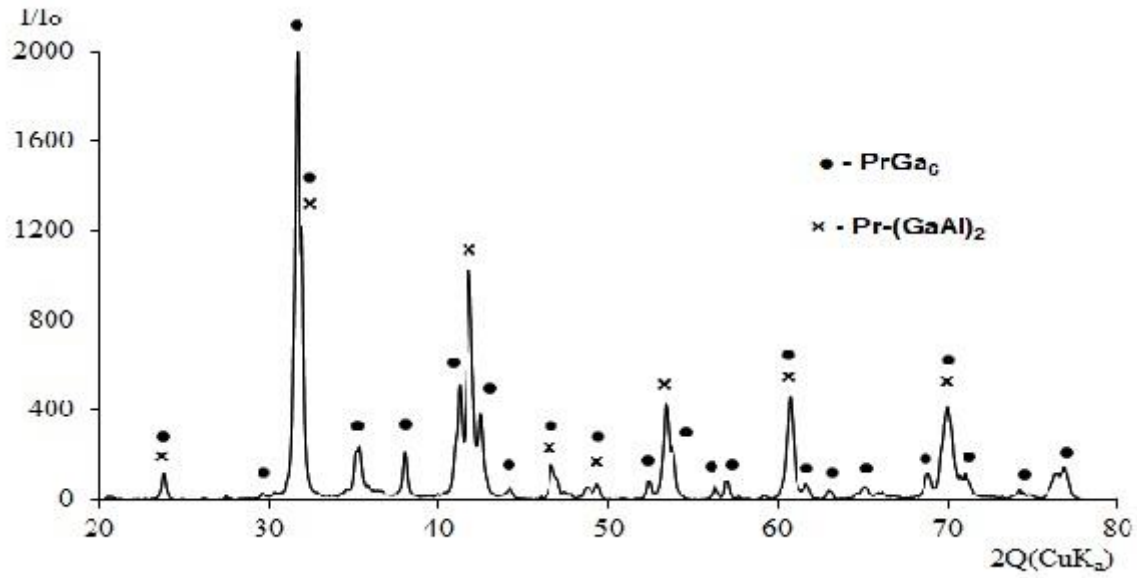

Fig. 1. XRD pattern of alloy #3.

1. Baker H., Okamoto H. et al. ASM Handbook. Alloy Phase Diagrams vol. 3, ASM International (1992).
2. Lyakishev N.P. Diagrammy sostoyaniya dvoinykh metallicheskikh sistem, vol. 2, Mashinostroenie (1997).