MS24 3D electron diffraction

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Characterization of the atomic structure of the $Al_{79.5}Mn_{16}Pt_{4.5}$ R-phase by 3D electron diffraction

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Abstract

An investigation of the Al-Mn-Pt alloys revealed an extension of the compositional region of the high-temperature "Al_3Mn" T-phase towards ~$Al_{79.5}Mn_{16}Pt_{4.5}$ [1]. The grains of the $Al_{79.5}Mn_{16}Pt_{4.5}$ T-phase, annealed at 800°C, contained nanometric plate-like inclusions [1], which were asserted to the so-called R-phase. Similar co-existence of the T and R phases was reported in the Al-Mn-Pd system at equivalent compositions ([2] and references therein). The precipitation of the R-phase from a supersaturated T-phase matrix was supposed to take place during cooling from the annealing temperature. The small size of the precipitates and their low fraction did not allow study of their structure. Investigation of the relevant Al-Mn-Pt alloys, annealed at 700 °C, confirmed the formation of the stable R-phase in a small compositional region around $Al_{79.5}Mn_{16}Pt_{4.5}$, its equilibrium with the T-phase of very close composition, and allowed to construct a partial 700°C isothermal section.

Regarding structural model of the R-phase, it is noteworthy to mention the $Al_{60}Mn_{11}Ni_4$ R-phase, which has been reported to exist in the Al-Mn-Ni system [3]. Although its presence was not confirmed in more recent Ref. [2], atomic model of this phase, proposed in [3], was found to be applicable to the Al-Mn-Cu R-phase. From another hand, this model did not fit the Pd and Pt containing R-phases. Latter is a subject of current investigation.

The atomic structure of the $Al_{79.5}Mn_{16}Pt_{4.5}$ R-phase was studied using the 3D electron diffraction (3DED) method. Its crystal structure was revealed as orthorhombic, C*mcm* (63), a = 7.730 Å, b = 24.035 Å and c = 12.597 Å. An atomic model of the R-phase was deduced using direct methods applied to the 3DED data and compared to that of the Al-Mn-Pt T-phase of very close composition. Some discrepancies between the present model and that of Ref. [3] were noted and explained.

References

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