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Narmin Mammadli

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Mammadli Narmin Rasim gizi

Azerbaijan State Oil and Industry University, nemo.memmedli@gmail.com

***Abstract* – In the alloying of aluminum-based composite materials with transition metals (Ni, Cr) the influence of metallurgical pressure and heat treatment technologies on their structure and properties has been considered. It has been found that the composition of these elements in the nanoscale leads to their extreme solubility in aluminum and the formation of dispersed phases. Significant solving of Guinea-prestone (GP) zones formed during deformation has been observed. As a result, recommendations on the industrial application of aluminum-based compositions with high mechanical properties have been developed.**

***Keywords* – electrical conductivity, matrix, alloying, alloy, refractory**

I. INTRODUCTİON

Among metal ores, aluminum ore is the most widespread on the earth (up to ~ 7%). Along with this and other specific features, light weight of aluminum opens up a wide range of opportunities for the production of items and structures using aluminum and its alloys. However, aluminum alloys compared to iron, nickel, chromium and other metal alloys have low mechanical properties. Therefore, in addition to maintaining the specific properties of aluminum alloys (high electrical conductivity, ressistance to corrosion and fire, low specific gravity, etc.), improving their mechanical properties is always on the agenda. For this purpose, many high-strength aluminum alloys have been created. Such alloys are industrial-type high-strength and fire-resistant alloys, which are structurally matrix or solid solution type. These matrix-type alloys are based on Al-Cu and Al-Zn-Mg-Cu, which are widely used as deformable alloys. However, when comparing them with cast aluminum alloys - silumin, it appears that these alloys have low casting properties, so it is impossible to use them in the production of shaped castings. On the other hand, although silumin is a leader among cast aluminum alloys, it has small mechanical properties, low fire resistance and other very serious defects. Therefore, to increase the performance characteristics of aluminum alloys the use of special metallurgical technologies - alloying, heat and pressure treatment methods may be more effective. However, all alloys obtained with such complex technologies are very expensive for wide application. Therefore, the development of new alternatives based on innovative technologies in the production of such high-quality aluminum alloys can be considered promising.

One of such alternative variants is the alloying of aluminum with transition metals. There is a lot of work in this field [1-10]. However, the correct selection of alloying transition metals and the role of these metals in the composition of aluminum to achieve the desired effects in the subsequent processing methods should be significant. For example, the formation of anomalous extreme saturated aluminum solid alloys and large amounts of efficacies in aluminum alloys alloyed with transition metals can lead to significant dispersion solidification during subsequent heat treatment. Such reinforcing phases can lead to an increase in the strength, mechanical and other performance properties of the alloy. On the other hand, alloying with transition metals gives such aluminum alloys quite good casting properties.

However, it is important to know which metals are used in the alloying of aluminum with transition metals. For example, elements such as Zn, Mg, Cu, Zr have already been used for this purpose and extensive research has been conducted [11]. We believe that the use of Cr and Ni for this purpose can be considered promising, and research in this area will be scientific.

The main important issue is the amount and size of these elements used during the melting of aluminum. On the other hand, the issues as deformations properties of alloys with such transition metals and dispersion strengthening in heat treatment have not been studied. Therefore, such an approach to the issue requires the study of many problems. Among these problems, the formation of dispersed phases in the aluminum matrix and the assessment of their behavior in the subsequent processing (pressure and heat treatment) is of greater scientific and technological interest. The dissertation is aimed at solving such important scientific and technical issues.

II. THE GOAL OF THE WORK

It consists of the development of metallurgical, pressure and heat treatment technologies of aluminum alloys with transition metals such as Cr and Ni, the study of their structure and properties.

For this purpose, it is important to address the following issues:

1. Study of the composition of the aluminum alloy alloyed with Cr and Ni and the impact of metallurgical technology on its structure and properties: Assessment of the role of two types of transition metals in formation of eutectic type alloy - soluble in aluminum (Cr) and sparingly soluble (Ni);

2. Study of plastic deformation of aluminum alloys alloyed with transition metals and assessment of the degree of deformaion effect on these alloys;
3. Research of the effect of heat treatment (annealing and wear) regimes on the structural formation and dispersion hardening stages of aluminum alloys alloyed with transition metals;
4. Development of recommendations for the application of the research results to production and technical assistance in the organization of production of new aluminum alloys with improved operational, technological and economic characteristics based on these recommendations at the relevant enterprises of the Republic of Azerbaijan.

Solving of these issues allowed to obtain the following results. During the melting of aluminum alloys alloyed with transition metals, positive effect mechanism of the transfer of these metals to the melting process has been reveald and the extreme solubility of Cr and Ni in aluminum in nanoscales, the possibility of dispersed phases formation have been determined.

It has been found that the tensile curves of deformed aluminum alloys alloyed with transition metals after annealing and natural wear have a stepwise character. This clearly confirms the effect of deformation wear on traction. The nature of the tensile diagram curves also varies depending on the degree of deformation. It is shown that with the increase of deformation degree (for example, 65%), the GP zones in the aluminum alloy become significantly soluble, in other words, the matrix is extremely saturated with alloying elements (Cr, Ni).

In the heat treatment of aluminum alloys alloyed with Cr and Ni (annealing + wear), the small amount of these elements in some zones can be explained by the limited diffusion of atoms at low heat treatment temperatures, although there are already vacancies and dislocations in the alloys. The saturation of the GP zones with alloying elements is explained by their incompatibility with the matrix (Al) of the crystal lattice; this slows down the subsequent enrichment process.

Metallurgy, pressure and heat treatment technologies of aluminum alloys alloyed with Cr and Ni with high mechanical and operational properties have been developed. For this purpose, low alloyed experimental compositions of Al2,0 Cr-1,5Ni type have been proposed and their superiority compared to the existing aluminum alloys has been confirmed. Recommendations for the industrial application of these alloys have been developed.

III. RELİABİLİTY OF THE OBTAİNED RESULTS

The issues raised for the research have been solved through theoretical research and laboratory experiments. The accuracy of the obtained results has been ensured using traditional instruments, measuring instruments, devices and designs used for research.

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