ISSN 2091-5527
№ 2/2024

O‘zbekiston

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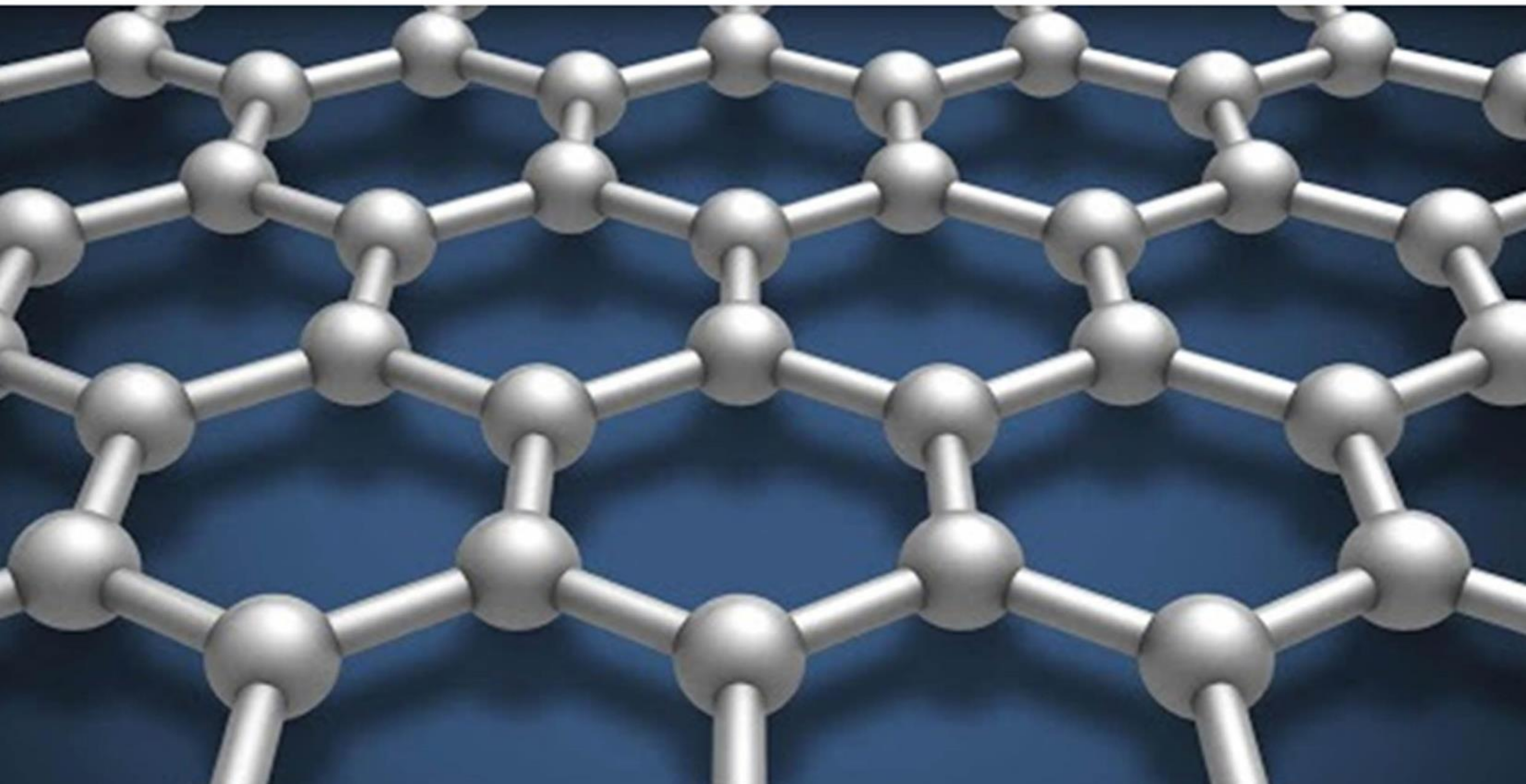

Узбекский научно-технический и производственный журнал

Композиционные материалы

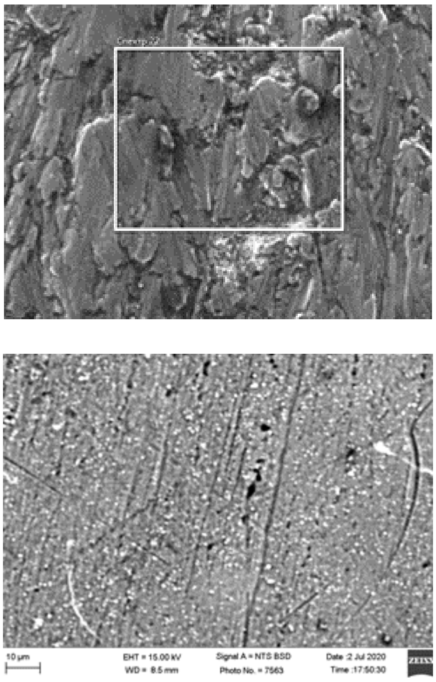

Figure 1. a) the structure of the resulting alloy without use of a protective layer of flux b) The structure of the resulting alloy is obtained after using a protective layer of refining flux.

The development and optimization of protective flux compositions represent a significant advancement in the field of aluminum alloy melting. By effectively removing impurities and improving the structure of the alloy, innovative flux formulations contribute to the production of high-quality aluminum components with enhanced performance and reliability. Further research and development efforts in this area hold the potential to drive continued improvements in aluminum alloy manufacturing processes and expand the range of applications for these versatile materials.

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Keywords. Aluminum, non-metallic inclusions, amount of gas, amount of oxide, mechanical properties.

Annotation. This article presents the results of research work on the development of technology for reducing non-metallic inclusions when melting aluminum alloys. In particular, a technology for reducing aluminum oxide and hydrogen, which are the main quantitative components of non-metallic inclusions, is presented.

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UDK 621.74

DEVELOPMENT OF A PROTECTIVE FLUX COMPOSITION FOR MELTING ALUMINUM ALLOY

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Introduction. Aluminum alloys are widely used in various industries due to their lightweight, high strength-to-weight ratio, and excellent corrosion resistance. However, the presence of impurities such as oxides, hydroxides, and metallic contaminants can degrade the mechanical properties and surface finish of the alloy. The melting process is a critical step in aluminum alloy production, during which these impurities must be effectively removed to ensure the quality and performance of the final product [1]. Protective fluxes are commonly employed to facilitate the removal of impurities and improve the structure of the alloy during melting.

Resource saving in the melting of aluminum alloys is of particular importance in view of the peculiarities of heat exchange processes in which alloys are saturated with gas and non-metallic inclusions. In this regard, research is being conducted worldwide to optimize the melting processes of aluminum alloys and improve existing melting process technologies. The protective flux plays a major role in the melting of aluminum alloys, where it reacts actively with the alloy, and at the same time protects the alloy from the environment [2]. All over the world, research is actively underway to develop new compositions of protective fluxes that prevent aluminum oxidation with oxygen and saturation of the melt with gas inclusions [3].

To explore the formation of aluminum oxides and the diffusion of gases into the melt, it is necessary to understand the interaction of aluminum and moisture in the furnace atmosphere. Since the combustion products of natural gas have water vapor in their composition, this reaction is inevitable in all gas furnaces [4-6]. Atmospheric moisture reacts with molten aluminum, followed by the formation of an oxide film and atomic hydrogen between aluminum atoms. As a result, the oxides not only remain on the surface, but also some of them enter the melt.

The main non-metallic inclusions in aluminum alloys are gas and oxides. Where oxygen will react with aluminum and create film on the surface of the alloy and gasses will diffuse to the alloy which in further provide the porosity of the product [9].

Objects and research methods. The main non-metallic inclusions in aluminum alloys are aluminum oxide Al2O3 and hydrogen H2. The gas impurities present in the metal negatively affect the physical and mechanical characteristics of aluminum and its alloys. To obtain a high-quality structure of aluminum alloys, it is necessary to protect the melt from the effects of the furnace atmosphere. To determine the effect of the integrity of the oxide film on the melt surface, as well as the composition of the protective flux on the diffusion of non-metallic inclusions into the melt, 4 flux compositions with different carbon content were used. The composition of the flux was developed taking into depend on the furnace atmosphere, which has an excessive content of hydrogen and oxygen. Table1 and Table 2 show the composition of fluxes used in research work in the melting of aluminum alloys under the conditions of the joint venture UZAVTOINZI LLC. Table 1 provides a comparative analysis of the use of flux for melting aluminum alloys in various gas furnaces.

Table 1

№	The purpose of the flux	The components of the flux in weight percentages						
		NaCl	KCl	C	$MgCl_2$	$CaCl_2$	NaF	$BaCl_2$
1	As a protective layer for remelting aluminum alloys in gas furnaces	50	30	10	10	-	-	-
2	As a protective layer for remelting aluminum alloys in gas furnaces	50	20	20	-	10	-	-
3	As a protective layer for remelting aluminum alloys in gas furnaces	40	20	25	-	-	15	-
4	As a protective layer for remelting aluminum alloys in gas furnaces	30	30	30	-	-	-	10
5	As a protective layer for remelting aluminum alloys in gas furnaces	20	45	35	-	-	-	-
6	As a protective layer for remelting aluminum alloys in gas furnaces	40	40	10	-	-	10	-
7	As a protective layer for remelting aluminum alloys in gas furnaces	40	-	20	10	30	-	-

Free carbon located in the melting zone can restore aluminum and take away oxygen from it. To determine the effect of the free carbon content, carbon of various amounts was introduced into the composition of the flux. Table 2 shows the composition of the developed flux using free carbon.

Table 2

№	The purpose of the flux	The components of the flux in weight percentages						
		NaCl	KCl	CaF_2	$MgCl_2$	$CaCl_2$	NaF	C
1	As a protective layer for remelting aluminum alloys in gas furnaces	50	20	20	-	-	-	10
2	As a protective layer for remelting aluminum alloys in gas furnaces	40	20	20	-	-	-	20

3	As a protective layer for remelting aluminum alloys in gas furnaces	40	20	5	-	-	5	30
4	As a protective layer for remelting aluminum alloys in gas furnaces	50	30	10	-	-	-	10
5	As a protective layer for remelting aluminum alloys in gas furnaces	50	25	5	-	-	-	20
6	As a protective layer for remelting aluminum alloys in gas furnaces	40	10	10	-	-	10	30
7	As a protective layer for remelting aluminum alloys in gas furnaces	40	-	20	10	10	-	20
Heat of melting								
1	Specific heat of melting, cal/g	123,5	74,1	__	70	54,2	27,8	__
2	Melting point, ºC	804,3	790	1330	712	772	962	2800
3	Density, g/sm^3	2,163	189	3,18	2,32	2,152	__	2,33

Results. The analysis of the results showed that a change in the composition of the protective flux leads to changes in the structure of the obtained alloys. For example, the use of fluxes with a high carbohydrate content helps to reduce the amount of oxides in the melt, which has a positive effect on the quality of the alloy. It has also been found that optimizing the composition of the flux can improve the mechanical properties of alloys, such as strength and corrosion resistance.

To determine the consequence of the flux on the quality of the resulting melt, laboratory studies were carried out. Experimental melting of aluminum to determine the effect of melting modes on the quality of the alloy was carried out in the laboratory conditions of the enterprise.

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Keywords. Alloy, processing, flux, quality, melting, pouring, structure.

Annotation. This article presents the results of research on the development of flux composition for melting aluminum alloys. The results of studies on the content of inclusions in the aluminum melt depending on the composition of the flux used are also presented. The developed flux composition was optimized based on the results of experimental melts in electric and gas furnaces.

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