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Analyze of Microstructure of Composition Material Al-Si-Fe System

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In this work describe new method receipt composition material AL-SI-FE system. For describe the composition material used the method of power metallurgical. As source material are used technically pure Al and Si, as well as steel 1008. Source powder mingled from correlation 59 %Al-9 %Si-32 %Fe. 2 stage compaction with mechanical and thermal activation ensure produce composition material without crack and void. After baking speed cooling allows to suppress turning the phase Al8Fe2Si in phase Al9Fe2Si2. The microstructure sample was study by scanning electronic microscope. On microstructure is seen that sample has a no rifts and voids that will provide high values of the mechanical properties.

Keywords: Composition Material, AL-SI-FE, Microstructure, Al8Fe2Si, Mechanical Activation, Thermal Activation.

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1. INTRODUCTION

On modern stage of development of the science and technology all greater attention is spared development new perspective material. Emphases is spared composition material, reception which impossible usual classical methods. Composition materials are examples of such material. Industrial use products got from new composition materials, forecasts essential spare resource and energy. In particular composition material of the system Al-Si-Fe long ago attracted the interest many scientist. Using these compositions more perspective that is conditioned their characteristic. The high contents aluminum in composition material provides the small weight in contrast with steel. Forming intermetalids possess the high strenght a feature. The main ways of the reception of the material are: smelting and the repeated resmelting pure component in given correlation and the following spraying and precipitation on coolled substrate, with the following forming and long annealing, or milling in ball mill, with the following operation forming and annealing. Besides, meets the reception cast sample, but with undertaking long annealing under fixed temperature [1-3]. Emphases are spared powdered metallurgy at study of the alloy: pulverizing, preliminary forming, sintering. However in work [4] is indicated that reception of the bulk from the system Al-Si-Fe alloy by methods of gas precipitation, preliminary forming and forging without additional sintering allows to get the alloy, having fine structure and without remaining porosity. Herewith microstructure and porosity of the alloy are sensitive to the temperature of the forging.

The authors of the work [5] indicate that temperature greatly influences on ductility and superductility aluminum alloy, and that most elongation is discovered nearly or above temperature of the melting, and local melting greatly links the superductility an area. In superductility material fluid phases promote the manifestation of the superductility effect, reducing concentrators of the stresses, exists intercoupling between superductility features and structured change when deformation.

The content of silicon and ferrous in alloy renders the defining influence superductility characteristic, shown by alloy. So in work [6] is evaluated influence silicon on corrosion stability, when increase the contents silicon before 20 weight percents brings about growing the corrosion stability. In work [7] is also noted reduction of wear capability of the alloy when increase the contents silicon, is however noted at increasing to hardness.

The Authors of the work [8] note the negative influence of the high content of ferrous on mechanical properties of the alloy in view of formation needle-shape ferrous contained phases in process of the crystallization.

In work [9] is shown, influence of the chemical composition on phase formation. The authors have defined the conditions of the intermetalids shaping, having hexagonal crystalline lattice.

The aim of this study is an analysis microstructure, formed in composition material Al-Si-Fe system.

2. MATERIALS AND METHODS

As source material are used technically pure Al and Si, as well as steel 1008. All source material were pulverized in mill, are then excluded with reception of powder to factions 0,3-0,5 mm. Source powder mingled from correlation 59 %Al-9 %Si-32 %Fe. After mixing powder subjected to the mechanical activation by way of the joint refinement in ball mill during 60 minutes. Then received powder compaction by hydraulic press in briquette by diameter 30 mm, thickness 20 mm. Compaction were realized with effort 25 tons and endurance under load 5 minutes. For activation of the processes of the interaction component material, is solved also to conduct the thermal activation. The

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heating of the sample was realized in two stages. In the first place the heating realized for degassing before 500 °C. Earlier called on studies had shown that at heating before the temperature 500 °C change the phase composition, distinguished by optical microscope does not exist. The endurance by 500 °C was 30 minutes. The following step was a heating before the temperature 1000 °C. During such temperature of the heating is provided intensive interaction component composition material. The endurance by this temperature during 60 min. provides full transition source pure component in intermetalic joints. Bulk was subjected to refinement after forming intermetalic joints and the repeated compaction in briquette for eliminating interparticles voids and air voids. The repeated compaction is also organized by load 25 tons and 5 minute endurances under load.

During the repeated mixing is realized compaction not heterogeneous material, but powder with uniform phase composition that provides got compact best features.

3. RESULTS AND DISCUSSION

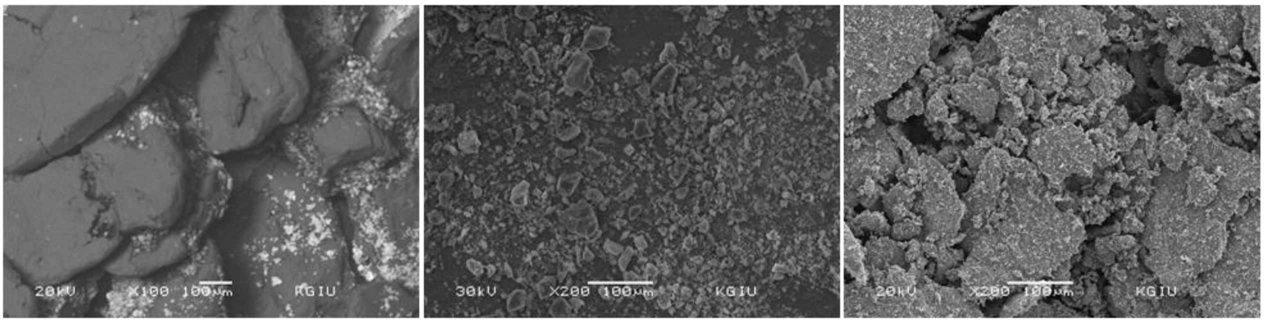
All source material were refinement in ball mill. As a result of refinement are received powders, view of which is shown on fig. 1.

In view of its ductility aluminum particles intensive interact between itself with shaping conglomerate. When refinement the aluminum particles are in the first place formed squamuliform of the particle, then form of the particles approaches to spherical. Silicon in view of its frailty intensive is reduced with forming the particles mainly size 0,143-0,05 mm. When refinement ferrous are formed particles different on size as it is submitted for drawing 1 within the range of 0,5-0,05 mm. For the reason undertaking the mechanical activation of mixture realized joint refinement the particles powder. As a result of joint pulverizing occurs even mix component of the material, further pulverizing the large particles and mutual saturation atom nearby particles. Earlier called on studies have shown that under baking occurs the interaction of the particles with formation new intermetalic join upon their border of the section. At temperature and time of the endurance renders the principle influence upon shaping the phase composition of the got material. In given study is solved use high temperature baking for activation of the processes of the interaction by component composition material. Processing, promoting shaping the single-phase composition material will promote increasing a quality material and growing its mechanical features. By compacting big amount gas agglomerates in interparticules space, preventing reception of the compact material. At heating before necessary temperature occurs intensive output a gas that causes the breach of the form sample, its cracking and ballooned. Using degassing by 500 °C allows to get the qualitative sample after baking. The temperature 500 °C is chosen in base data about influence of the temperature of the heating on the interaction of the particles. During 500 °C essential phase shaping does not exist and intensity of the output gas excludes the destruction a sample. As a result of slow cooling after baking causes shaping the frail phase Al9Fe2Si2. The particles of the phase Al9Fe2Si2 have quip needle shape or road shape, and shaping big amount large phase component exists under slow cooling that will greatly reduce the mechanical feature of the got material. After baking speed cooling allows to suppress turning the phase Al8Fe2Si in phase Al9Fe2Si2. Microstructure of sample after baking is submitted on fig. 2a.

As shown on fig. 2a, structure of the material is porous and presented by main phase Al8Fe2Si and needle shape phase Al9Fe2Si2 (on drawing light), penetrating main phase. The image is received on scanning electronic microscope in mode of the analysis composition material in backspace electron.

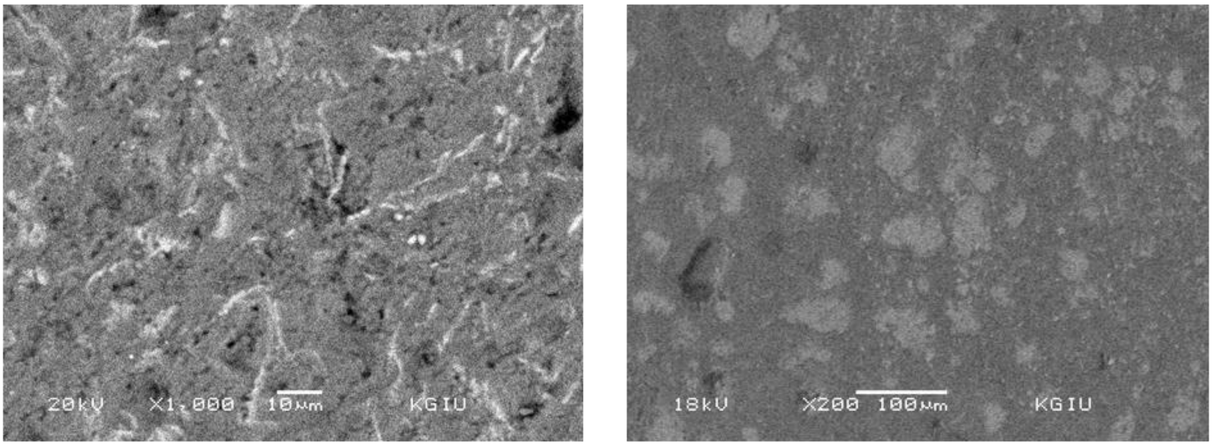
The reception of the compact material from heterogeneous material more difficult than from uniform. In connection with than after the reception mainly single-phase material, bulk were subject to repeated pulverizing and compaction. Such step provides compacting uniform alike powder on composition.

Annealing got compact at the temperature of the existence of the phase Al8Fe2Si [9] provides the reception an unfailing composition material. On fig. 2b is presented microstructure sample, got on scanning electronic microscope in backspace electron in mode-shade. On microstructure is seen that sample has a no rifts and voids that will provide high values of the mechanical properties.



a b c

Fig. 1 – SEM image powers aluminum (a), silicon (b) and ferrous (в) after refinement



a b

Fig. 2 – SEM image (BEC) of the microstructure composition materal after baking by 1000 °C (a), and following annealing during 30 min by 610 °C – BES (b)

4. CONCLUSION

In a result of performed studies is designed method of the reception composition material Al-Si-Fe system, including baking, pulverizing, compaction and annealing. It is studied microstructure of material on scanning electron microscope.

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