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MODERN TRENDS OF DEVELOPMENT OF GRANULAR METALLURGY

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The tendencies of improvement of granulation plants and processes of gas-jet and centrifugal plasma sputtering of liquid metal are considered. The possibility of obtaining granules of composites based on titanium and inconditionetallic alloys of the Ti-Al system by the method of ultrafast cooling is shown.

Keywords: powders, spherical granules, centrifugal and gas-jet spraying, composites, inconditionetallides, physical and mechanical properties

Entry. Development of modern technique, in connection with growing market tendencies and competition, needs creation of materials, which reliably work at the conditions of the high temperature loading, action of aggressive environment, wear, and also improved technologies of their making.

One of such technologies there is granule (powder-like) metallurgy, which is widely used for creation of new materials and alloys, and also production of metallic products on their basis.

Modern state of technology. Theoretical bases of process of granulation of metallic fusions in detail are considered in work [1]. Modern granule metallurgy is examined as base effective technology of making of new materials with unique properties.

The basic realized methods of making of granules today are:

– gas-jet nebulized of liquid metal;

– centrifugal plasmic nebulized.

The gas-jet nebulized is nebulized of liquid metal in ceramic crucible, which results in feed of noticeable quantity of non-metal particles which stipulate the decline of material durability descriptions. On the second technology the making of granules is carried out by nebulized of electrode of the set alloy, which is revolved with high speed, by high-energy plasma.

In the conditions of AOJ «Composite» (Russian Federation) for the making of granules use technology of centrifugal nebulized of electrode which is quickly revolved, in a protective atmosphere at the butt-end plasma heating and speed of cooling of fusion 10^3-$5 \cdot 10^4$ ºC/s on setting of centrifugal nebulized (of SCN) with the making of material of the set factious composition [3].

Except for gas admixtures, the metallic including which get to them as a result of wear of steel drums during melting of electrode in setting of SCN are in granules

present. Effectively to reduce their content allows realization of dispersion and electromagnetic separation of powders.

At the necessity of further improvement of quality and properties of the prepared products apply technologies of isostatical hot-pressed and isothermal.

The finishing stage of technology is implementation of corresponding thermal treatment. For example, for the alloy BT6 the mode of thermal treatment consists of the followings stages: annealing at temperatures 750 °C, self-control during 2.0 hours, cooling on air; tempering at temperatures 850 °C, self-control – 1.0 hour, ageing at temperatures 500 °C, self-control – 2.0 hours and next cooling with a furnace.

Technology and setting of making of spherical granules of metals and alloys was worked out by a firm «Spheramet» (Russian Federation) with use the method of centrifugal nebulized of fusion from skull crucible which is revolved with the managed speed.

In technology of granulation firms there is realized tiny method of formation of granules, which eliminates fascination of rare gas and formation of internal emptiness's in a spherical granule. The diameter of working chamber of setting (2000 mm) allows to granulate practically all metals, alloys and intermetallics, getting the zero-defects spherical granules by the size of from 10 to 800 mcm with fine-textured structure.

The capacity of setting is tested during granulation of carbide of tungsten with content of carbon 3.8 % with the temperature of melting about 2550 °C. It is set that application of granule technology allows to decrease the sizes of particles of titanium carbide in 4.5 times and titanium boride in 10 times. Thus evenness of their distribution rises in the structure of alloy substantially and the form of excretions changes from needle-shaped (traditional technology) to rounded.

It is also suggested to construct metallic composites with the spherical granules of different chemical composition, mine-out defect-free crystallization by methods of high-speed crystallization. Principle of construction of granule composites with the set properties consists in forming of combination of granules of different of chemical, phase and factious compositions in necessary proportions, and is based on the methods of crystallography of metals and alloys - forming of the dense packing of bullets and cavities for them.

On the basis of the known properties of titanic alloys and intermetalides possible properties of granule composites were expected from the conditions of additive deposit of components.

On a present time at the conditions of AOJ «Electromechanics» (Russian Federation) the new modern high-performance setting of centrifugal nebulized (SCN) is worked out and made, that allows to get fine-disperse granules from different alloys. A process of nebulized on SCN is automated, and speed of rotation of billet can arrive at more than 25000 min^{-1}. It allows to get the basic working range of titanic granules the size of 60-70 mcm and partly granules by the size of 20-40 mcm and less. Technology answers cooling speeds for the making of amorphous structure of granules and allows to get alloys with the unique complex of properties.

Application of methods of the ultrafast cooling (UO) appears very perspective for expansion of production of intermetallic alloys of the system Ti-A1. Such alloys have unique hot-resistance, however them in the construction of turbo-engines subzero enough plasticity hinders wide application at a room temperature. The noted method opens possibility of increase of plasticity of інтерметалідних alloys by deserializing and growing shallow structure.

Conclusions. Creation of more perfect setting of granulation and development of the new technological modes of process of granulation of titanium and titanic alloys, open possibility of creation of new materials and alloys with unique properties, and also products from them. It will allow in the nearest prospect to extend a production and application of intermetallic alloys, granule composites, alloys with a дрібнокристалічною and amorphous structure with the high level of hot-resistance, endurance, with the increased module of resiliency and others.

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