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MODELING OF CARBIDES COMPOSITION IN WELDED ALLOY

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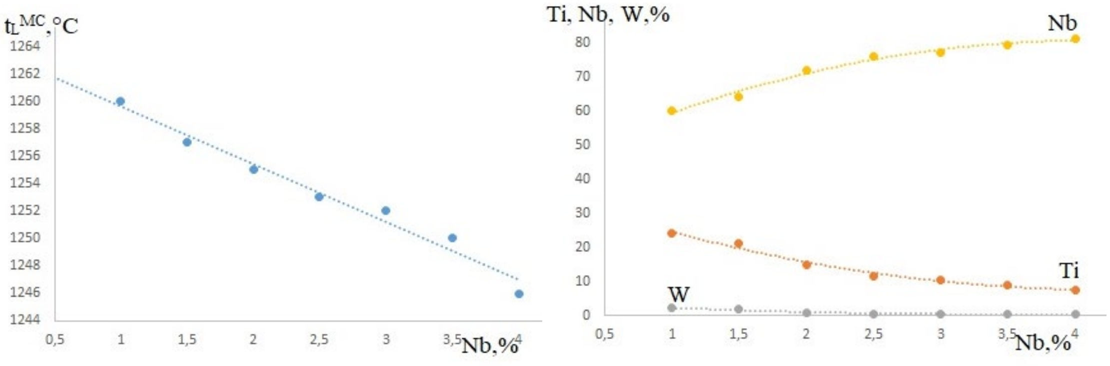
One of the main ways to improve the manufacturability of structures, the coefficient of metal utilization, and to reduce the labor intensity and energy consumption of products is the widespread use of welded structures. Welding of nickel alloys is associated with serious difficulties caused by their special physicochemical properties, namely, a great tendency to form porosity when welding nickel and nickel alloys. This is due to the fact that in the molten state nickel-based alloys significantly increase the solubility of gases such as nitrogen, hydrogen, oxygen, and upon crystallization and cooling of the metal, their solubility in the alloy sharply decreases, which leads to the formation of pores. There is also a high tendency of the metal to form crystallization cracks. This is due to the formation of low-melting eutectics at the grain boundaries. The most negative influence on the embitterment of the metal is exerted by carbon, which is released in the form of graphite, and sulfur, which is released in the form of nickel sulfide. When welding nickel and its alloys, it is necessary to increase the groove angle, in comparison with steel welding, since the metal of the weld pool of nickel and nickel alloys is less fluid and melted to a shallower depth of. Also, when welding Ni-Cr-based alloys, a refractory chromium oxide film may form, which impedes the formation of a weld. Thus, among the main tasks arising in the welding of nickel and nickel alloys are ensuring reliable protection of the welding zone from atmospheric gases, the use of high-purity welding consumables, as well as deoxidation and degassing of the weld pool.

The change in the temperature of the carbide liquidus for carbides of the MC type is practically not observed when Ti is added to the alloy. However, this leads to a change in the composition of primary carbides and, at a content of more than 4%, to the precipitation of the η-phase (such as Ni-17Ti-4Nb-1Al-0.22Cr). The introduction of more than 2.7% Ti leads to a change in the base of the carbide from niobium to titanium, while the titanium content in the carbide increases to 55%.

An increase in the concentration of niobium in the alloy leads to a decrease in the temperature of formation (precipitation) of MC carbides (Fig. 1), which is explained by a change in the interatomic bond forces. The formation of primary carbides in this system begins with an Nb concentration of 1%, and its content in the carbide ranges from 60 to 81%. At the same time, the titanium concentration in carbide decreases from 24 to 7%.



a b

Fig. 1. Temperature dependence of the dissolution of carbides of the MC type (a) and the amount of titanium, niobium, and tungsten in the MC carbide (b) on the content of niobium in the alloy composition

Chromium is an element that influences the formation of secondary carbides; it has a noticeable effect on the temperature of dissolution (precipitation) of carbides. It was found that the corresponding dependences have a complex character and are described by the following equations.

Secondary carbides are formed at a chromium concentration, in this system, at the level of 10%. With an increase in the Cr content in the alloy, the temperature of dissolution (precipitation) of carbides increases, as does its content in the secondary carbide. In this case, the concentration of nickel and molybdenum decreases to 3.5 and 8.8%, respectively, according to parabolic dependences. When the concentration of chromium in the alloy is 31%, a solid solution based on Cr is formed, thus chromium ceases to dissolve in nickel.

Tungsten does not affect the temperature of dissolution (precipitation) of carbides $M_{23}C_6$, it is at the level of 1280 °C. An increase in the concentration of tungsten in the alloy leads to a change in the content of alloying elements in the carbides of this system. Nickel and molybdenum content decreases to 2.7 and 4.4%, respectively, and tungsten content increases to 18%.

Thus, the calculated data for determining the type and chemical composition of carbides showed good convergence and agreement with the experimental data obtained by electron microscopy.

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LANGUAGE SKILLS THAT ARE FUNDAMENTAL REQUIREMENTS FOR ENGINEERING UNDERGRADUATE STUDENTS AT A TECHNICAL UNIVERSITY

The XXI century represents the era of globalization and growing developments and up-to-date achievements in all spheres of the life of society. People around the world feel the necessity to respond modern demands and be ready to adapt to new work and social environments, which are offered to them due to current innovations. Every person wants to be an active member of the society and have the right to choose and develop his/her career to satisfy the basic needs. Thus, all these factors say about the importance to develop in students both professional and language skills at the same level. Being equipped with professional knowledge means be able to solve a great number of tasks at the work place. However, in order to be a successful employee you need to have good communication skills, which give a person an opportunity to convey information to people clearly and simply, in a way that means things are understood and get done.