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The Using of Special Alloy Elements and Its Influence on Alloys Structures

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Summary:
In this present work-paper it is being presented new alloy methods of ferrous metals, of rare ground and its influence on alloy structures and on its physical and technological characteristics. Unlike the classical alloy elements like: Ni, W, Cr, V, Mo, Mn etc, the new elements like: Be, Zr, Ta, Nb have a different influence on alloyances, totally unknown up to present, fact that demands a fundamental research on these new alloy elements.

1. Introduction

The evolution of market in generally and of technology particularly, leaded to necessity to search and to obtain new materials with superior properties, having the purpose to satisfy the market's different and growing demands. In this tendency it can be fitted the obtaining methods of new steels with superior properties. Besides using new techniques it is frequently used the alloy of different metals that not so long ago were considered rare metals. This appreciation due to the consideration that these metals are found rarely in the ground was crippled by the recent research. These new materials from the rare grounds group have an influence on metal alloys, and are welcomed in order to improve the physical and technological properties.

2. Theoretical grounds

The metals have the property to alloy between them in special temperature and pressing conditions. These new metals obtained keep the general characteristics of their component elements.

The alloy can be obtained in large variety of composition with different properties.

An alloy ranking it can be realized by sharing the metallically elements in four groups: T1, T2, B1, B2.

In panel no.1 it can be seen the classification of metallically elements from the alloy properties point of view.

PANEL NO. 1

Metale											Elemente din grupa B				
T_1		T_2									B_1		B_2		
Li	Be														
Na	Mg										Al		Si		S
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se
Rb	Sr	Y	Zr	Nb	Mo	Te	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po
		Lantanidele şi actinidele													

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The elements that belong to T1 group are highly electro positives. The T2 group contains transition elements (3d,4d,5d,4f,5f). The B1 group is grouping the elements with a stronger metallically element, and B2 is grouping the elements that have a weaker metallically element.

The binary alloys can be classified in 4 categories:

a) Alloys between the metals from T group
b) Alloys between a metal from T group and other from B group.
c) Alloys between the metals from B group
d) Interstitial alloys in which one of the components is an non-metallically element.

As we pass from the metals from a) category trough those of d) category, its properties are becoming lesser and lesser metallically, gaining a more and more pronounced character of chemical agent.

The alloys can be classified in three categories:

1) Mechanical mixtures in which the elements are not solving each other reciprocal;
2) Solid liquids in which the components are being dissolved partially or totally;
3) Inter-metallically agents

At the solid liquids the gradually replacement of one type of atom with other it is done aleatory modifying the dimensions of elementary cell, but without changing the structure. These alloys assure the possibility of inclusion of some faulties/gaps into the system.

The perfect order and total crystallography disorder in alloys are two extreme cases that are depending on temperature.

Taking in consideration the concentration relation between the alloy components we can obtain an ordered surface on the entire part of alloy or in some temperature areas. In conditions like these, phase transition phenomenon type order – disorder occurs.

The crystalline structure and alloy phase are depending on the rapport between the electrons number and atoms number or on the free electron number that rests upon one alloy atom.

On interstitial alloys, the atoms of alloy element are taking place in positions situated between the knots of the network of base element. Interstitial alloy examples are given in panel no.2.

Panel no. 2 – Interstitial alloys

Zr-H	Th-H	Th-C
Ta-H	Zr-N	Zr-C
Ti-H	U-N	Hf-C
	Nb-N	U-C
	Ti-N	Nb-C
	W-N	Ti-C
	Mo-N	W-C
	Mn-N	Mo-C
	Fe-N	V-C
		Fe-C

3. Special alloy elements

Of all new or older alloys, the most used are interstitial alloys (panel no. 2), but also the alloy with elements form B1, B2, T1, T2 groups (Panel 1). So called rare elements are found in nature as well as usual metallically known elements.

I was determined that the lithium can be found in earth shell in a proportion by 120 time more than the plumb, and cerium by 4 times more . The strontium is in a proportion of 70 times more, the rubidium 45 time more, the zirconium 25 times more and the beryllium 8 times more then the plumb.
Due to the fact that nobody considers that the plumb is a rare metal, results that the metals mentioned above cannot be considered rare metals.

By introducing small quantities of alloy elements, we can improve considerably some of the steel's properties, with consideration the practical necessities.

One of the first rare metals used in the modern technology was the wolfram. At the end of the 19^{th} century it was discovered - with surprise – that when the lathe's knifes are made from hard steels, this fact allows a considerable increase of working speed fact that implies the increase of work's productivity. After a lot of experiments the researchers reached to the conclusion that this performance is due to the introduction f wolfram into steel, in 5% proportion. The result was the wolfram production increase as well as continuous improvement of alloy methods obtaining in this way the "high speed steel" label. The race for obtaining of new superior properties and qualities was only at a beginning. The metallurgists responded to the new demands, inventing one after another new hard alloys, some of them surpassing the diamond due to their high wolfram carbide content.

The wolfram introduced in some steels is increasing them their resistance to corrosion and their mechanical performances. On the shape of pure technical metal, it is being used to manufacture electric bulb's filaments, electronic tubes and some special equipment.

The molybdenum assure some special properties for steels, the same as those obtained by alloy with wolfram, but it has three times more energy, fact that allows the quantity reduction of molybdenum used for alloy. The researchers showed that molybdenum can replace some type of steels, even nickel the most highly spread alloy element but also the weakest. In a complex alloy, together with other metals we can obtain a very advantageous combination of different mechanical properties.

The vanadium is also a rare metal, highly spread in modern technique having a remarkable plasticity and in the same time a high hardness superior to steel. Its affinity to oxygen and nitrogen, elements that reacts easily with, even when these gases are dissolved into steel, it makes vanadium to be useful in obtaining of omogenier and finer structures. The vanadium quantities necessaries are very small, like 0,1 – 0,15%. Vanadium oxide has the property of acceleration by ten times or hundreds times more the chemical reactions. Being a metal with few ore of its own, it is extracted from other metals ores, being present as accompanist, like from he ashes of some sulfurous oils or from some of the coals.

Another rare metal that it was started to be used approximately 25 years ago was the niobium. It is always accompanied by tantalum whose physics and chemical properties are similar with and it influences in the same way the steel quality. The common alloy of those minerals in stainless steel structures improves considerable the workability, welding and stabilization of steel properties at high temperatures. This last one property makes it possible using the alloyed steels with niobium and tantalum in manufacturing of gas turbines and jet engines. The high melting temperature and the resistance to chemical agents are making possible the utilization of niobium in construction of atomic reactors.

The tantalum, whose properties and utilization domains are the same with the niobium, has also some specific applications. The higher melting temperature that's passing 3000 C degrees makes it useful in construction of some electric bulbs and vacuum equipment. Its resistance to sulphuric acid, nitric acid, hydrochloric acid recommends it in construction of some machines, chemical and laboratory equipment.

Its greatest property is its so called "biological tolerance" – the property of not destroy the living tissues. As result, under the shape of fine bands and wires it found itself a large usage in surgery.

The niobium and tantalum can also assimilate large gas quantities during the warming at high temperatures, fact that allows its using to create the most advanced vide in electronics.

Its high melting temperature (approx. 4000 C degrees) and its hardness closed with the one of the diamond make from the niobium and tantalum carbides precious materials for producing alloy plates that allow a high working metal speed.

The hafnium and zirconium have similar properties and there are used together in steel alloy, They are increasing the mechanical qualities, the resistance to wearing very useful for cutting tools.

The zirconium has a special utility in construction of nuclear reactors due to its property of not assimilating, due to resistance to the chemical agents, and due to its remarkable mechanic properties. It also changes in a good manner the non-ferrous metals properties.

The zirconium oxide being resistant to very high temperatures(2900 C degrees) it is used in manufacturing of special refractory, anti-acid paints, abrasion of optical lens and as a catalyst for of obtaining benzenes with high octane number. Zirconium salts are being use din clothes water-proof, to produce typography inks, car paint, and some of the plastics.

Extra beryllium increases the resistance to corrosion and to high alloys of the steel, nickel and chrome. The calculus shows that in nuclear reactors, after a lot of collisions with beryllium atoms, the neutrons speed decreases from 20 000000 m/s to less than l200 000 m/s, in such way that fast electrons are becoming slow ones.

The lithium in alloy with other ferrous metals assures also the obtaining of finer structures, having the ability of assimilating the gases. Its most important utility is the one of nuclear fuel in reaction with deuterium, replacing the uranium, harder to obtain.

A special situation has those 115 elements known as "lanthanides" or "rare grounds". Being hard to separate them, for alloy is it used one of their combination known as "mismetal". Their addition is improving the structure of stainless steels and refractory. For this it is needed small quantities of 0,002 – 0,003 % of rare grounds. They also improve the steels casting.

In the airplane industry it is used more and more frequently are being used magnesium and aluminums alloys because there are very resistant at high temperatures.

The titanium is also one of the most precious alloy elements, improving the chemical and physical anti – corrosion properties of the steels.

These examples are showing that due to the technological process and modern technology, a lot of rare metals have found very important applications for them. For all these the most spread is the alloy of steel, that with the halp of metals mentioned above - named and "steel's vitamins" – is improving their performances and get new special properties.

4.Conclusions

1. The alloys are complex materials obtained through the way of diffusion of two or more elements, from which at least one – the base – is a metal.

2. Taking into consideration the components number, alloys systems can be: binaries, ternary or polynary. .

3. Adding alloy elements from rare grounds group is leading to improvement of physical and technological of the alloys.

4. For the new alloy elements thoroughness, like one from the rare grounds group a fundamental research is necessary.

5.Bibliography

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