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INCREASING THE INITIAL HARDNESS OF HIGH-CHROMIUM DEPOSITED METAL WITH METASTABLE AUSTENITE

ПІДВИЩЕННЯ ПОЧАТКОВОЇ ТВЕРДОСТІ ВИСОКО ХРОМИСТОГО НАПЛАВЛЕНОГО МЕТАЛУ З МЕТАСТАБІЛЬНИМ АУСТЕНІТОМ

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Popularisation of high-carbon high-chromium steels for tool hardening and restoration by cladding is connected with their relatively low cost and wear resistance. In addition, the metal clad with steels of this class allows to obtain in the structure of the clad metal a sufficiently large amount of metastable austenite [1-2].

According to standard EN14700 cladding materials of groups Fe6 and Fe8 are proposed to be used at the following types of wear. For materials of group Fe6: g-resistance to abrasion, p-impact resistance; s-edge retention; For materials of group Fe8: g-resistance to abrasion; p-impact resistance; t-heat resistance [3]. Chemical composition, hardness and recommended structure of the weld metal are given in Table 1.

Table 1

Standart data [2]

Alloy	**Chemical composition, %**							**Hardness HRC**	**Structure**
	C	**Cr**	**Mn**	**Mo**	**W**	**V**	**Nb**		
Fe6	≤2,5	≤10	≤3	≤3	-	-	≤10	48-55	M+C*
Fe8	0,2-2	5-20	≤3	≤5	≤2	≤2	≤10	50-65	M+C*

* – Martensite+carbides

In this case, the standard regulates the chemical composition and hardness of the weld metal and recommends adhering to the structure of martensite + carbides.

However, a study of some clad metal compositions shows that it is difficult to obtain martensite directly after cladding without heat treatment. This requires the introduction of expensive niobium, but the result can be unpredictable. As practice and analysis of literature data shows, the main factor determining the hardness of the clad layer is the chromium-carbon ratio. In addition, a fully martensitic matrix in the structure of the clad metal may not provide high heat resistance and may lead to fracture and chipping of the clad layer during operation. Therefore, some producers of surfacing materials do not follow the recommendations of the standard regarding the structure of the clad layer and leave a rather large amount of metastable austenite in the structure.

For example, metal clad with coated electrodes of Fe6-E-X120Cr10Si2Mn type (Figure 1) has up to 85% of metastable austenite and 15% of ledeburite in its structure, while maintaining high heat resistance and work hardenability. Grains of austenite allow to keep high plasticity for this chemical composition at hardness level in the 4th cladding layer 46-48 HRC.

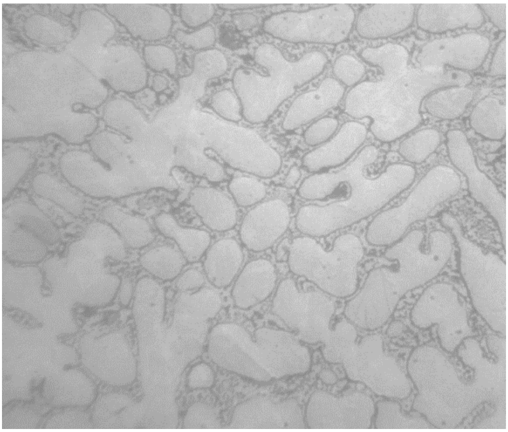

Fig. 1. Microstructure of X120Cr10Si2Mn cladded metal, 46,1HRC (x800)

Reduction of the chromium-carbon ratio and additional alloying with boron at the level of 0.1-0.15% allow to start incomplete martensitic-bainitic transformation inside metastable grains in the range of continuous cooling rates from 10 to 100 C/min (Figure 2).

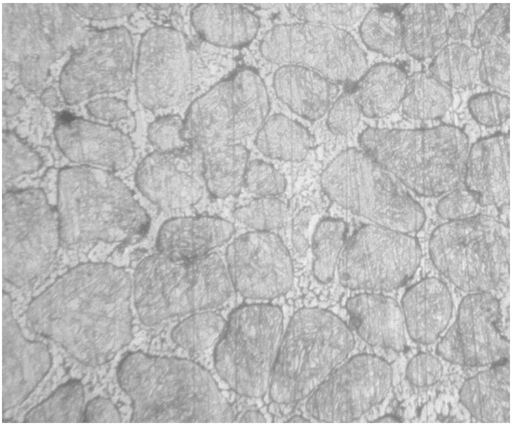

Fig. 2. Microstructure of X85Cr8Si2Mn+B cladded metal, 54,1HRC (x800)

Thus, reduction of chromium-carbon ratio with additional alloying of the clad metal with boron allows to obtain a favorable structure consisting of ledeburite interlayers and austenite-martensitic grains, which have not lost the property of further martensitic transformation of metastable austenite during operation.

Bibliography

1. Попов С.М, Антонюк Д.А., Нетребко В.В. Триботехнічні та матеріалознавчі аспекти руйнування сталей і сплавів при зношуванні.: Навчальний посібник. Запоріжжя: ЗНУ, ВАТ «Мотор Січ», 2010, 368 с.
2. Попов С.М. Дослідження впливу залишкового аустеніту та твердої надлишкової фази на зносостійкість наплавлювальних сплавів/ *Вісник Національного технічного університету «ХПІ»* Збірник наукових праць. Серія: Нові рішення в сучасних технологіях. Х.: НТУ «ХПІ», 2013, №16(989), С. 10-14.
3. ДСТУ EN 14700:2019 Матеріали зварювальні. Зварювальні матеріали для наплавлення (EN 14700:2014, IDT)
4. Malinov L. S., Malinov V. L., Burova D. V., Anichenkov V. V. Increasing the abrasive wear resistance of low-alloy steel by obtaining residual metastable austenite in the structure. *Journal of Friction and Wear*, Vol. 36, 2015, No.3, p.237–240. https://doi.org/10.3103/S1068366615030083