Full Paper _____ *Thematic Section:* Research into New Technologies.
Reference Object Identifier – ROI: jbc-02/16-48-10-14 *Subsection:* Composite Materials.
Publication is available for discussion in the framework of the on-line Internet conference "*Butlerov readings*".
http://butlerov.com/readings/
Submitted on December 05, 2016.

Application of composite agglomerates based on WC and TiC produced by electrochemical technology for preparation of antiwear coatings by direct laser cladding

© **Alexander V. Varaksin**,[1] **Viacheslav L. Lisin**,[2]* **Victor A. Kostilev**,[1]* **Leopold I. Leontiev**,[2] **Elena V. Ignatieva**,[2] **Aleksey B. Shubin**,[2] and **Sophia A. Petrova**[2+]

[1] *"Technology of Tantalum" Co Ltd. Lenin St. 131. Upper Pyshma. Sverdlovsk, 624096. Russia.*
Phone: +7 (922) 211-88-44. E-mail: npp-nauka@yandex.ru
[2] *Laboratory of Physical-Chemistry of Metal Melts. Institute of Metallurgy.*
Urals' Division of RAS. Amundsen St., 101. Ekaterinburg, 620016. Russia.
Phone: +7 (343) 267-88-94. E-mail: danaus@mail.ru

*Supervising author; +Corresponding author

***Keywords**:* tungsten carbide, titanium carbide, laser cladding, metallographic analysis.

Abstract

In the work the possibility of the direct laser cladding of composite agglomerates (40-160 mkm) based on the WC and TiC in the nickel-chromium matrix obtained by electrochemical technology has been studied, and the comparison with the industrially produced Ni-based powder for cladding Hoganas 1535-30 has been done. The pure composite powders contained carbides of refractory metals and their mixtures with the industrial 1535-30 powder were tested. The composites were 1) the cobalt-covered WC in a chromium-nickel matrix, and 2) the titanium-covered TiC in a chromium-nickel matrix. The HN77TÛR, processed electrochemically into the powder of the corresponding compound, was taken as the matrix. The studies have shown that the powders, based on WC and TiC in the chromium-nickel matrix, produced by the electrochemical technology and agglomerated according to the scheme 'roll briquetting-classification-sintering' satisfy the requirements for the powders for the laser cladding and allow one to obtain the coatings with geometrical and mechanical properties improved compared to the imported powders. The best geometry of the laser track was obtained for the powder mixture with a narrow particle size distribution close to 40 mkm deposited at laser power of 1000 W. The cover obtained had the highest clad height and the most symmetrical shape. The tracks obtained from the powder mixture with wider particle size distribution (40-100 mkm and 100-160 mkm) were more asymmetrical but had also no cracks and were nearly nonporous. Despite the relatively high porosity, the tracks formed from the pure powders demonstrated an increase of hardness up to 1.5-2 times compared to the pure 1535-30 powder. The investigation of the microstructure of the coatings has shown that the laser cladding of the agglomerated composite powders contained the cobalt-covered tungsten carbide in the chromium-nickel matrix allows to get precipitation hardening alloy, and thus these powders can be used to form the wear-resistant coating.

References

[1] F. Uchiyama, K. Tsukamoto, P. Fons. Three-Dimensional Device Fabrication Using the Laser Spray Process Technique. *Proc. ITSC*, Japan, Kobe. **1995**. P.259-262.
[2] G.A. Turichin, E.V. Zemlyakov, E.Yu. Pozdeeva, J. Tuominen, P. Vuoristo. Technological Possibilities of Laser Cladding with the Help of Powerful Fiber Lasers. *Metal Science and Heat Treatment.* **2012**. Vol.54. No.3-4. P.139-144.
[3] A.V. Varaksin, V.L. Lisin, V.A. Kostilev, L.I. Leontiev, R.G. Zakharov, S.A. Petrova. Production of Composite Powders Containing Metal Carbides. *Butlerov Communications.* **2015**. Vol.43. No.8. P.102-110. ROI: jbc-02/15-43-8-102
[4] U. De Oliveira, V. Ocelik, J.Th.M. De Hosson. Analysis of Coaxial Laser Cladding Processing Conditions. *Surface and Coating Technologies.* **2005**. Vol.195. P.127-136.
[5] A.V. Varaksin, V.L. Lisin, V.A. Kostilev, L.I. Leontiev, R.G. Zakharov, S.A. Petrova. Electrochemical Production of Superdispersed and Nanosized Powders of Metal and Their Carbides. *Butlerov Communications.* **2014**. Vol.37. No.1. P.76-83. ROI: jbc-02/14-37-1-76

[6] A.V. Varaksin, V.L. Lisin, V.A. Kostilev, L.I. Leontiev, R.G. Zakharov, S.A. Petrova. Electrochemical Metal Plating on Superdispersed and Nanosized Carbides of Tantalum and Tungsten. *Butlerov Communications.* **2014**. Vol.37. No.1. P.68-75. ROI: jbc-02/14-37-1-68
[7] http://metallicheckiy-portal.ru/marki_metallov/stj/XH77TYR