ТЕЗИСЫ ДОКЛАДОВ

**МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ
«Перспективные материалы с иерархической структурой
для новых технологий и надежных конструкций»**

**X МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ
«Химия нефти и газа»**

Томск

Издательский Дом ТГУ

2018

DOI: 10.17223/9785946217408/275

FORMATION OF STRENGTHENED LAYERS AND COATINGS USING HYBRID TECHNOLOGIES INCLUDING ULTRASONIC TREATMENT

^{1,2}Kovalevskaya Zh.G., ¹Klimenov V.A., ^{1,2}Sharkeev Yu.P.

¹*National Research Tomsk Polytechnic University, Tomsk, Russia*

²*Institute of Strength Physics and Materials Science SB RAS, Tomsk, Russia*

Hybrid technologies assign fundamentally new opportunities at the present stage of the manufacturing development. One of the trends is using the ultrasonic impact device for the formation of strengthening layers and coatings.

The most advantageous method is the surface treatment by ultrasonic device with the static load of ultrasonic oscillations with the frequency of 20 kHz. The ultrasonic device is fixed on the turning or milling tool. This device executes a feed motion and can process flat surfaces as well as solids of rotation. The process has a great reliability and repeatability due to the precise control. There is no established international term for this method. It is called ultrasonic nanocrystal surface modification (UNSM) [1], ultrasonic burnishing [2], vibration-assisted ball burnishing (VABB) [3], ultrasonic finishing treatment (UFT) [4] and others.

High-frequency impacts initiate the modification of the surface layer with the gradient change of the structure in depth while UFT. The nanosized or ultrafine-grained structure with the large amount of microstructure defects is formed on the surface. Such a structure accelerates the diffusion processes. Therefore, the UFT is used as the pre-process of the surface alloying [1, 5]. Plastic deformation in the surface layer during UFT increases the density of the porous materials and improves the quality of the surface. Therefore, the UFT is used as the post-process for the deposition of gas-thermal coatings and producing products with the SLM method [6]. The ultrasonic treatment can be used as the pre-, post- and simultaneous process during the gas-thermal coatings deposition. The ultrasonic treatment of the substrate and coating material favorable affects the adhesion, structure and quality of the coating surface [7, 8].

This report is devoted to the review of the hybrid strengthened technologies combined with the UFT, including those developed by authors.

References

1. Wu B., Wang P., Pyoun Y.-S., Zhang J., Murakami R. Study on the fatigue properties of plasma nitriding S45C with a pre-ultrasonic nanocrystal surface modification process // *Surface and coatings technol.* 2013. V. 216. P. 191–198
2. Huuki J., Laakso S. V.A. Surface improvement of shafts by the diamond burnishing and ultrasonic burnishing techniques // *Int. J. Machining and Machinability of Mater.* 2017. V. 19. № 3. P. 246–259.
3. Jerez-Mesa R., Travieso-Rodriguez J. A., Gomez-Grasa G., Lluma-Fuentes J. Development, characterization and test of an ultrasonic vibration-assisted ball burnishing tool // *J. of Mater. Processing Technol.* 2018. V. 257. P. 203–212.
4. Kovalevskaya Zh.G., Uvarin P.V., Tolmachev A.I. Some features of the formation of the surface microrelief of steel under ultrasonic finishing treatment // *Russian J. of Nondestructive Testing.* 2012. V. 48. № 3. P. 153–158.
5. Kovalevskaya Z.G., Klimenov V.A., Goncharenko I.M., et al. Chromium alloyed steel nitriding within close-to-critical temperature range // *Adv. Mater. Res.* – 2014. – V. 1013. – P. 146–152.
6. Salmi M., Huuki J., Ituarte I. F. The ultrasonic burnishing of cobalt-chrome and stainless steel surface made by additive manufacturing // *Progress in Add. Manuf.* 2017. V. 2. № 1–2. P. 31–41.
7. Klimenov V.A., Kovalevskaya Z.G., Ul'yanitskii V.Y., Zaitsev K.V., Borozna V.Y. Effect of ultrasound treatment of the substrate on the formation of the coating in detonation spraying // *Welding Int.* 2010. V. 24. № 10. P. 803–807.
8. Kovalevskaya Zh.G., Kovalevskiy E.A., Khimich M.A. The character of fracture of iron based thermal coating at fretting // *IOP Conf. Ser.: Mater. Sci. Eng.* – 2016. – V. 124. – [012126, 4 p.].