

## Advantages of Express-Methods in Investigation of Mechanical and Physical Properties of Aluminum Alloys

Maxim Puchnin<sup>1</sup>, Evgeniy Anisimov<sup>1</sup>, Jiří Cejp<sup>1</sup>, Igor Kunka<sup>1</sup>, Sébastien Vicens<sup>2</sup>

<sup>1</sup>CTU in Prague, Department of Materials Engineering, Karlovo nám. 13, 121 35, Prague 2, Czech Republic,  
E-mail: maxim.puchnin@fs.cvut.cz, evgeniy.anisimov@fs.cvut.cz

<sup>2</sup>Polytech Nantes, Department of Materials Engineering, 1, quai de Tourville BP 13522, 44035 Nantes Cedex 1.

The investigation of mechanical properties of aluminum alloys by using express-methods is discussed in the present paper. Such properties are hardness, elastic modulus  $E$  and yield strength  $R_{p0.2}$ . Tensile test with extensometer and automated ball indentation test (ABI) with 5 mm ball indenter performed in order to obtain the correlations for the basic mechanical properties of aluminum alloys. The results of newly developed method of revealing the microstructure, which involves plastic deformation, show its potential of applicability in engineering practice when measuring the microstructural and submicrostructural features.

**Keywords:** Automated ball indentation, tensile test, submicrostructure, grain size, EBSD

### Acknowledgements

Research was supported by the Innovation Centre for Diagnostic and Application of Materials CZ.2.16/3.1.00/21037 and by the research grants: SGS13/186/OHK2/3T/12 – Research on the influence of surface treatment on the improvement of service life and reliability of exposed water turbine's components, TA02011121 – Progressive Material-Technological Increase in Efficiency of the Turbine Blades Production CRP2013-C15/2 - Creating the conditions for a comprehensive teaching master's and doctoral students focusing on metallic materials.

### References

- [1] MICHNA, Š., LUKÁČ, I., LOUDA, P., et al. (2007). *Aluminum materials and technologies from A to Z*. 630 p. ISBN 978-80-89244-18-8. Adin Co.
- [2] MICHNA, S., NÁPRSTKOVÁ, N. (2012). Research into the causes cracking of aluminum alloys of Al – Cu during mechanical machining, *Manufacturing Technology* Vol. 12, Issue 12, pp. 47-51.
- [3] BRŮNA M., KUCHARČÍK L. (2013). Prediction of the Porosity of Al Alloys, *Manufacturing Technology* Vol. 13, Issue 3, pp. 296-302.
- [4] MATJUNIN V. M. (2008). *Metallovedenie v teploenergetike*, 328 p. Moskva, Izdatel'skij dom MPEI.
- [5] GOST 22762-77, *Metally i splavy: metod izmerenija tverdosti na predele tekuchesti*, Gosudarstvennyj komitet standartov soveta ministrov SSSR, Moskva.
- [6] GOST 18835-73, *Metally: Metod izmerenija plasticheskoj tverdosti*, Gosudarstvennyj komitet standartov soveta ministrov SSSR, Moskva.
- [7] ASTM WK381, *Standard Test Methods for Automated Ball Indentation Testing of Metallic Samples and Structures to Determine Stress-Strain Curves and Ductility at Various Test Temperatures*.
- [8] MATJUNIN V. M. (2006). *Operativnaja diagnostika mehanicheskikh svojstv konstrukcionnykh materialov: posobie dlja nauchnyh i inzhenerno-tehnicheskikh rabotnikov*. 216 p.. Moskva, Izdatel'skij dom MPEI
- [9] HILL R, STORAKERS B, ZDUNEK A. B. (1989). *A theoretical study of the Brinell hardness test*. Vol.423, pp. 301–330. Proceedings of the Royal Society of London.
- [10] BIWA S, STORAKERS B. (1995). *An analysis of fully plastic Brinell indentation*. Vol.43, pp. 1303–1333. Journal of Mechanics and Physics of Solids.
- [11] BRINELL I A. (1900). *II Congress Int. Des Methodes d'essai*, Paris.
- [12] ANISIMOV, Evgeniy, PUCHNIN, Maxim. (2014). Reduction of Elastic Modulus of Titanium Alloy Ti-6Al-4V by Quenching. *Key Engineering Materials*, Vol. 586, pp 15-18. Trans Tech Publications, Switzerland. doi:10.4028/www.scientific.net/KEM.586.15.
- [13] HURLEY P.J., HUMPHREYS F.J. (2003). *The application of EBSD to the study of substructural development in a cold rolled single-phase aluminium alloy*. Vol. 51, Issue 4, 2003, pp. 1087-1102. Acta Materialia.
- [14] TRET'JAKOV, A.; TROFIMOV, G.; GUR'JANOVA, M. (1971). *Mehanicheskie svoistva stalej i splavov pri plasticheskom deformirovanii*, 64 p. UDK 621.7.011. Moskva „Mashinostroenie“.

Paper number: M201442

Copyright © 2014. Published by Manufacturing Technology. All rights reserved.