Scientific Books of Abstracts
Vol. 2, pp 62-62
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Online: 2023-11-21

Testing Surface Properties of 3D Printed Metals

Ljubojević Pavle[a*], Marinković Aleksandar[b] and Lazović Tatjana[c]

University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, Belgrade, Serbia

[a]pljubojevic@mas.bg.ac.rs, [b]amarinkovic@mas.bg.ac.rs, tlazovic@mas.bg.ac.rs[c]

Keywords: Tribology, Wear, Testing Methods, 3D Printed Metals

Abstract. The rapid development of additive manufacturing technologies has opened novel opportunities for producing metal components with a variety of uses. 3D printing of metals provides the capability to produce parts with complex geometry and offers design freedom that cannot be achieved through conventional methods. That is the reason why 3D printed metal parts are increasingly finding applications in areas such as automotive, aerospace, and tool manufacturing. Surface properties of 3D printed metal components are of great importance for the functionality of machine systems, because they often operate under conditions where contact stresses occur.
There is just one standard that deals with the measurement and characterization of the surface texture of 3D printed metals – ASTM F3624-23 [1]. Generally, methods for testing surface properties are divided into two groups: non-destructive and destructive methods. The most commonly non-destructive methods for the determination of surface roughness are SEM, EDS, and XRD analysis. Also, all other ultrasonic thermographic, laser, atomic force microscopy (AFM), X-ray, magnetic, and eddy current methods (ETC) can be applied, but their limitations must be taken into account. Usually, post-processing methods are used to reduce the roughness of parts. It has been shown for stainless steel 316L that shot peening can reduce up to 50% of the average surface roughness [2]. Tribological properties are very important in cases where contacting parts is in the relative motion.For determining tribological properties well-known testing methods are adapted for 3D printed metals. The most commonly used are dry erosion, slurry erosion and high-stress abrasion tests on stainless steel 316. Testing procedures of ASTM B611 and ASTM G65 standards are used for determining wear properties of 3D printed cemented carbide, which is not metal, but that procedures can be applied on 3D printed metals [3]. For measuring the hardness of 3D printed metals the Vickers method is most frequently used. A large number of parameters such as AM technology, printing direction, post-processing, and layer thickness influence surface properties. In general, surface characteristics of 3D printed metals are not extensively researched and can represent a significant area for investigation, especially when considering all influencing parameters.

Acknowledgment.

This work was supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract No. 451-03-47/2023-01/200105, dated 03.02.2023).

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