7^{th} *World Tribology Congress, WTC 2022*
July 10-15, 2022, Lyon, France

Effect of SLM printing parameters and anisotropy on tribological properties of 18Ni300 in dry contacts

Urban Klanjšček[1)] and Mitjan Kalin[1)*]

[1)]Laboratory for Tribology and Interface Nanotechnology, Faculty of Mechanical Engineering in Ljubljana, Slovenia
*Corresponding author: mitjan.kalin@tint.fs.uni-lj.si

Printed 18Ni300 maraging steel is widely used in tool industry. However, due to nature of this process for tribological applications surfaces need to be additionally processed. Quality of polished printed components has a vast influence on wear, fatigue and eventually service life of the part. Interface integrity highly depends on printing processing parameters, majorly identified as laser power and laser scanning speed. In this study the wear, friction and wear mechanisms, with wide range of printing processing parameters of 18Ni300 material, on top and side surfaces, against steel ball, under dry conditions was systematically investigated.

Keywords (from 3 to 5 max): additive manufacturing, tribology, dry sliding

1. Introduction

Selective laser melting (SLM) technology is a layer-wise powder-based additive manufacturing method capable of building complex 3D components [1]. As printed, surface integrity is not suitable for direct tribological applications due to high roughness that changes with different directions of building, which is not equivalent to that expected from conventional manufacturing techniques and causes increase cost for post-processing operations. After post processing surfaces still comprise of distinct properties of SLM process as surface porosity, hardness and textured microstructure, which changes with different processing parameters [2]. Furthermore, different build orientations also affect all this changes thus affecting tribological performance under different contact conditions [3]. Accordingly, in this work we present the tribological analysis of SLM printed surfaces, printed by varying processing parameters of laser power and scanning speed. The sliding speed and pressure, under dry contact condition, on both side and top surfaces, which are ground and polished, is varied to evaluate tribological properties.

2. Methods

Triblogical samples of 18Ni300 for top and side surfaces were printed with M290, with different parameters as presented in Table 1. Testing surfaces were grounded and polished to achieve roughness of R_a = 0.1 μm. With digital microscope HRX-01 the porosity was observed on polished surfaces. Micro hardness was measured with Vickers hardness indenter. Using reciprocating tribotester TE77 and 100Cr6 ball, at three different pressures and sliding speeds COF was measured. Wear rate was measured and calculated with interferometer Bruker-ContourGT-K0. Analysis of the wear mechanisms was conducted using SEM microscope.

Table 1: SLM parameters

Machine	M290
***P* [W]**	170-350
***v* [mm/s]**	640-1600
***h* [μm]**	110
***d* [μm]**	40

3. Results and discussion

Preliminary tribological results show changes in tribological properties depending on different laser scanning power and speed. With changes in printing parameters the surface porosity changes drastically as shown in Figure 1. With changes in energy density there are different mechanisms of pore formations, as well as microstructural effect on hardness. With hardness and porosity alterations the tribological response is different. On dry contacts the pores can reduce wear, where the particle debris can get pushed into pores, but at higher porosities the toughness of material lowers, thus increasing the wear. Both coefficient of friction and specific wear are also highly influenced by pressure and sliding speeds, which changes on different printed surfaces.

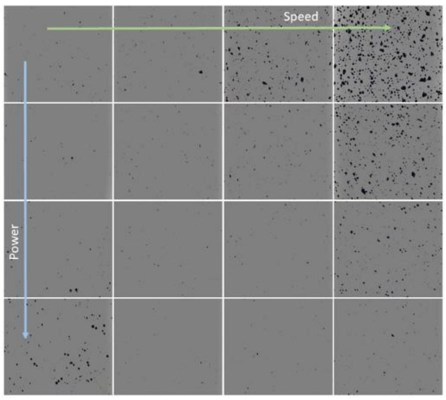

Figure 1: Top surface porosity of prepared samples.

4. References

[1] Townsend, A. et al., "Surface texture metrology for metal additive manufacturing: a review," Precision Engineering, 46, 2016, 34-47.

[2] Hua, L. et al., "Dry sliding wear performance and behaviour of powder bed fusion processed Ti–6Al–4V alloy," Wear, 440-441, 2019, 230103.

[3] Yang, Y. et al., "Wear anisotropy of selective laser melted 316L stainless steel," Wear, 428-429, 2019, 376-386.