

## WETTABILITY OF COMPLEX FRACTAL SURFACES - MULTISCALE CORRELATION

K. Peta<sup>a\*</sup>, K.J. Kubiak<sup>b</sup>, R. Talar<sup>a</sup>, C.A. Brown<sup>c</sup>  
\*katarzyna.peta@put.poznan.pl

<sup>a</sup> Institute of Mechanical Technology, Poznan University of Technology, 60-965 Poznan, Poland

<sup>b</sup> University of Leeds, School of Mechanical Engineering, LS2 9JT, Leeds, United Kingdom

<sup>c</sup> Mechanical and Materials Engineering Department, Worcester Polytechnic Institute, Worcester, Massachusetts 01699 USA

### KEYWORDS

Surface topography; Texturation; Fluid lubrication, Contact angle

### ABSTRACT

The complexity of surface morphology can significantly influence the wettability, lubrication, and, in consequence, wear of materials in tribological contact [1]. Therefore, wettability (Fig. 1) can be an important factor in contact lubrication by bioinspired fluids, for example, in medical applications.

This research aims to find a correlation between the fractal complexity of the surface prepared by Electrical Discharge Machining (EDM) (Fig. 2) and the wettability at different length scales. The best observation length scale (Fig. 3) and EDM discharge energy are explored to analyse the surface roughness parameters and lubrication properties of the surface prepared on Ti6Al4V (Fig. 1).

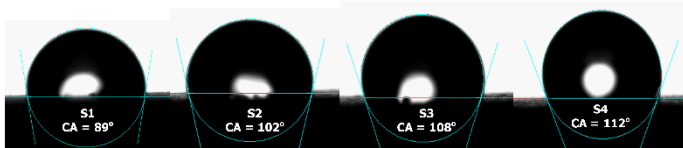


Fig. 1 Surface contact angles of EDM surface on Ti6Al4V.

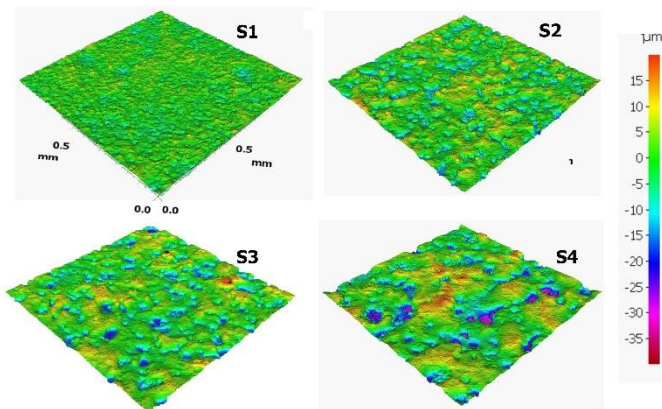


Fig. 2 3D surface images for parts created by discharge energies: S1 – 7.6 J, S2 – 49.4 J, S3 – 129.2 J, S4 – 399.4 J.

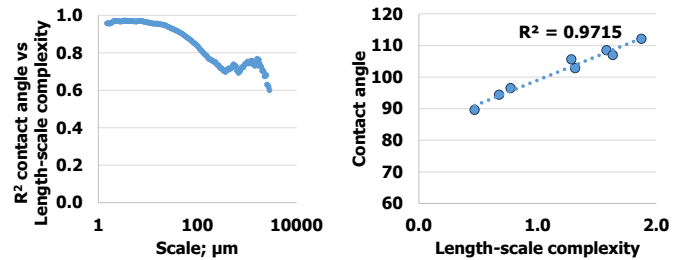


Fig. 3 Scale-dependent parameters: a) coefficient of determination between contact angle and fractal complexity, b) contact angle versus fractal complexity at specific scale.

The best correlation can be observed at a length scale of 3.56  $\mu\text{m}$ , where  $R^2$  is 0.97.

Based on the obtained results, the following preliminary conclusions can be drawn:

- The strongest correlations are found at the finest scales, with the best scale at 3.56  $\mu\text{m}$ .
- The contact angle is directly proportional to the geometric complexity of the surface.
- The EDM discharge energy affects the surface geometric complexity and contact angle.
- The precision of topographic measurements is important in establishing many kinds of correlations with surface functionalities, such as, topographic components of wetting [2].

### ACKNOWLEDGMENTS

This research was funded by the National Science Centre, Poland, under the program MINIATURA 7, grant number: 2023/07/X/ST8/01233.

### REFERENCES

- [1] K Peta, T Bartkowiak, P Galek, M Mendak, Contact angle analysis of surface topographies created by electrical discharge machining, *Tribology International* 163, 2021.
- [2] K Peta, G Love, CA Brown, Comparing repeatability and reproducibility of topographic measurement types directly using linear regression analyses of measured heights, *Precision Engineering* 88, 2024.