

# Tribological behavior of WC/C coated AISI 420 steel in artificial saliva

Sara Blunk<sup>1</sup>, Ricardo Torres<sup>1</sup>, Letícia Bembem<sup>2</sup>, Mirella Manosso<sup>3</sup>, Paulo Soares<sup>1</sup>

<sup>1</sup> Department of Mechanical Engineering, Pontifícia Universidade Católica do Paraná, Curitiba - Brazil

<sup>2</sup> Neodent, Curitiba - Brazil

<sup>3</sup> Straumann Group – Base – Switzerland

blunk.sa@gmail.com



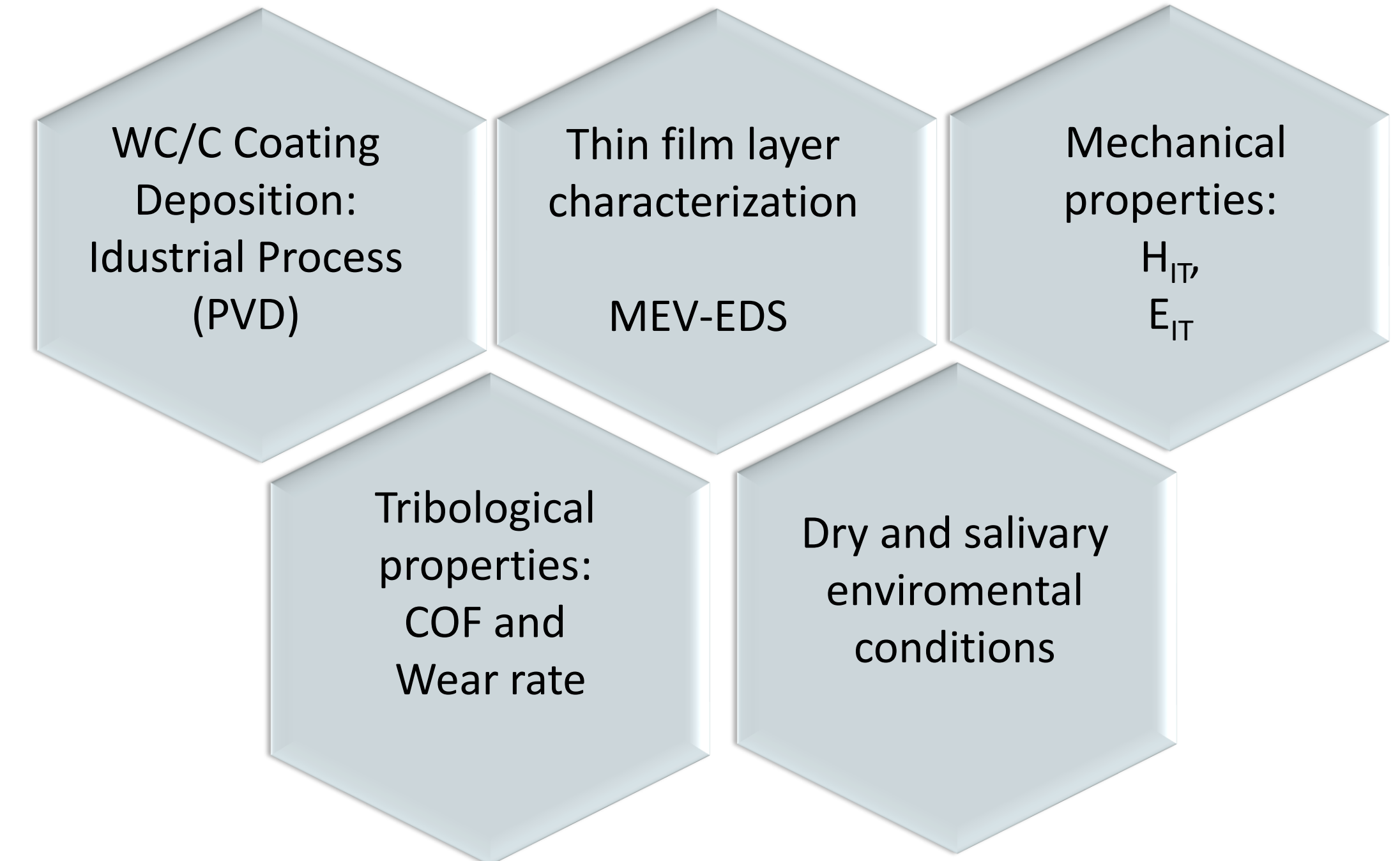
## INTRODUCTION

Tungsten carbide (WC/C) coated AISI 420 steel has been used on indental instruments such as milling cutters and drills due to their unique combination of properties. Wear resistance is one of the most important issues and the salivary environment is particularly important to consider, as it can induce a wear mechanism on the surface of dental instruments.

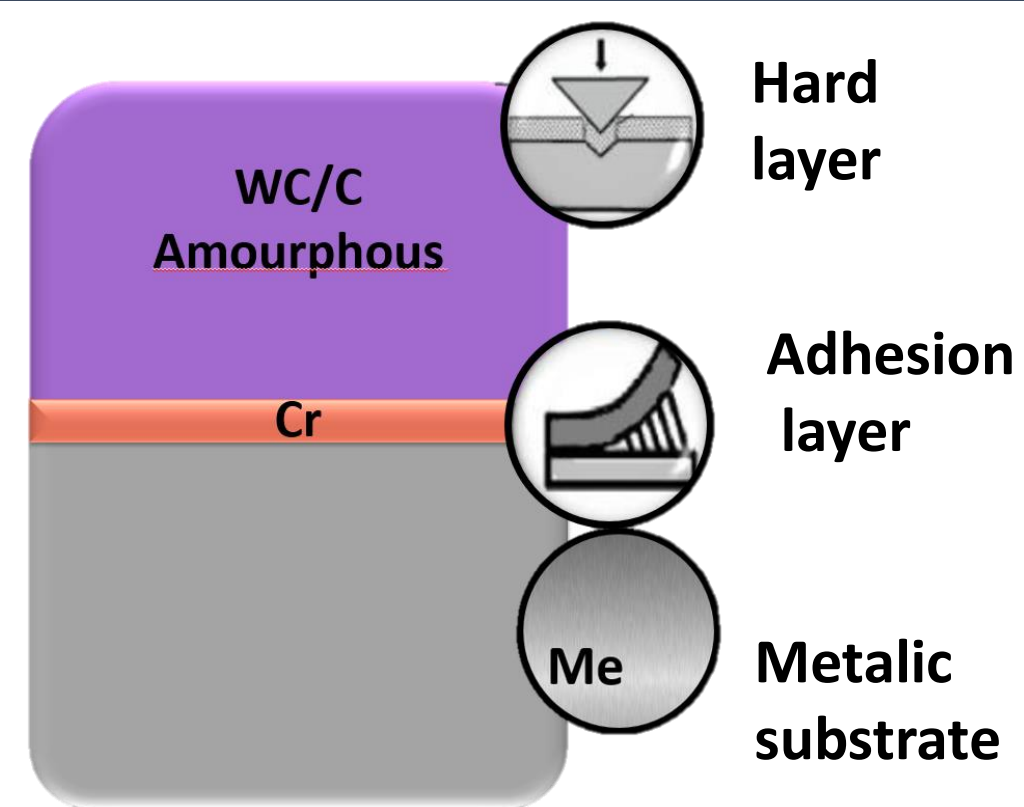
Aim of this study: investigate the mechanical and tribological properties and how the salivary environment affects the tribological behavior of the AISI 420 and WC/C coated AISI 420.



## EXPERIMENTAL



## RESULTS



### 1. Microstructural Characterization:

#### M340 Composition

Martensitic Stainless Steel (53 HR<sub>C</sub>)

Element	C	Cr	Mo	Si	Mn	S
% wt.	0.51	16.8	1.0	0.45	0.45	0.001

Table 1. Chemical composition of M340 stainless steel.

### 2. Mechanical Properties

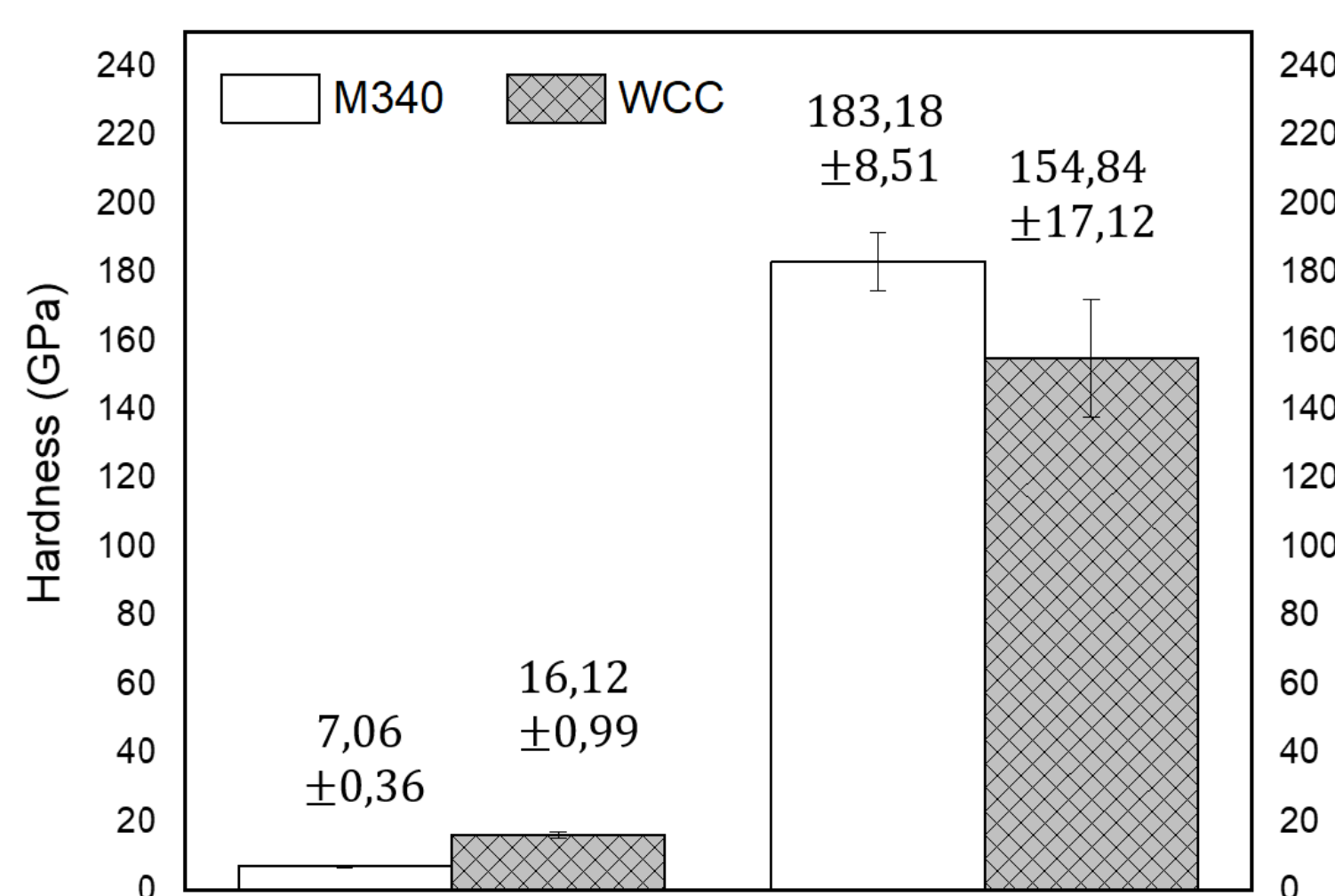


Fig. 3. Hardness and Young's Modulus of M340 substrate and WC/C layer.

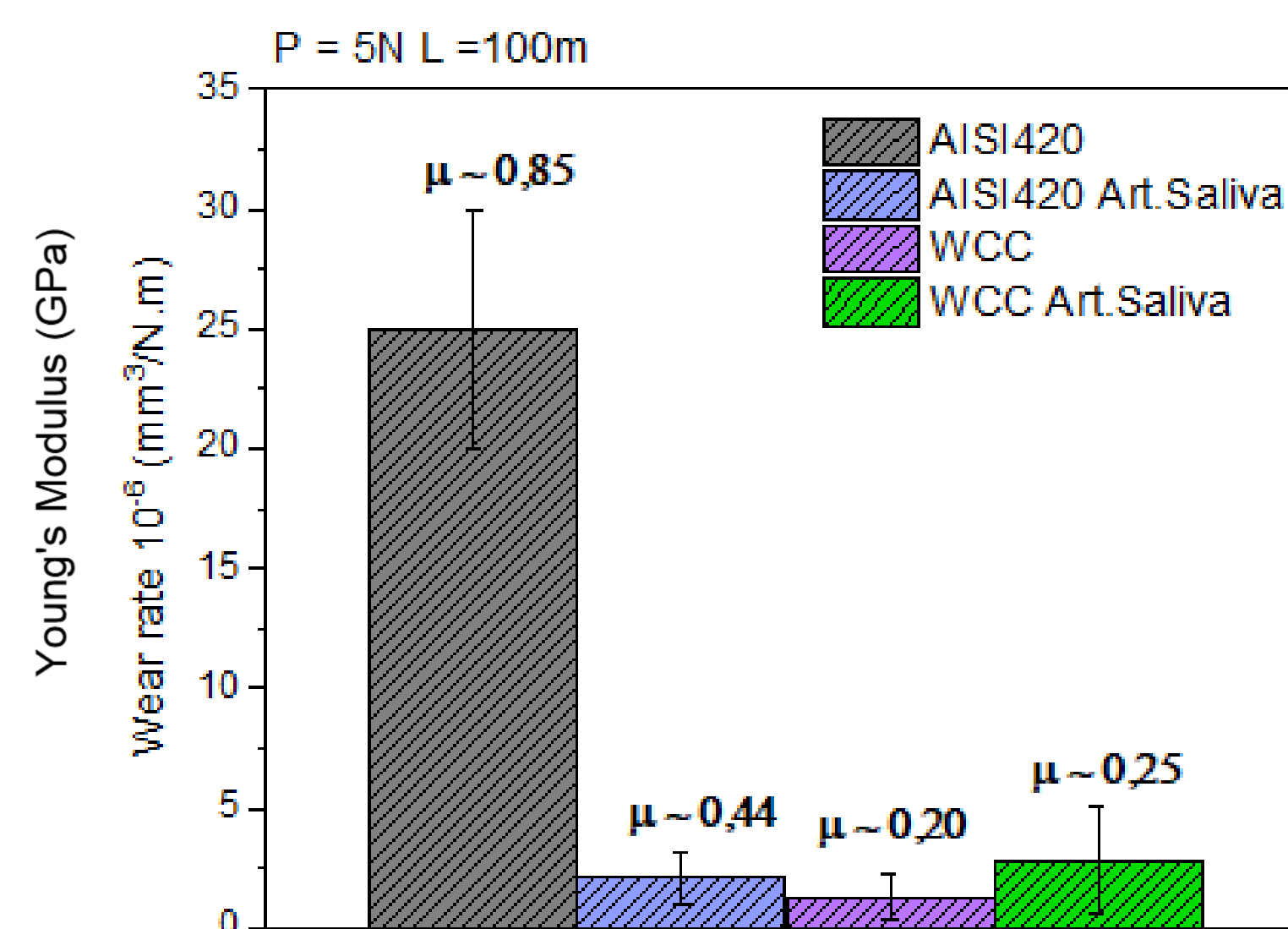


Fig. 4. Wear rate for M340 substrate and WC/C coating.

### 3. Tribological Properties

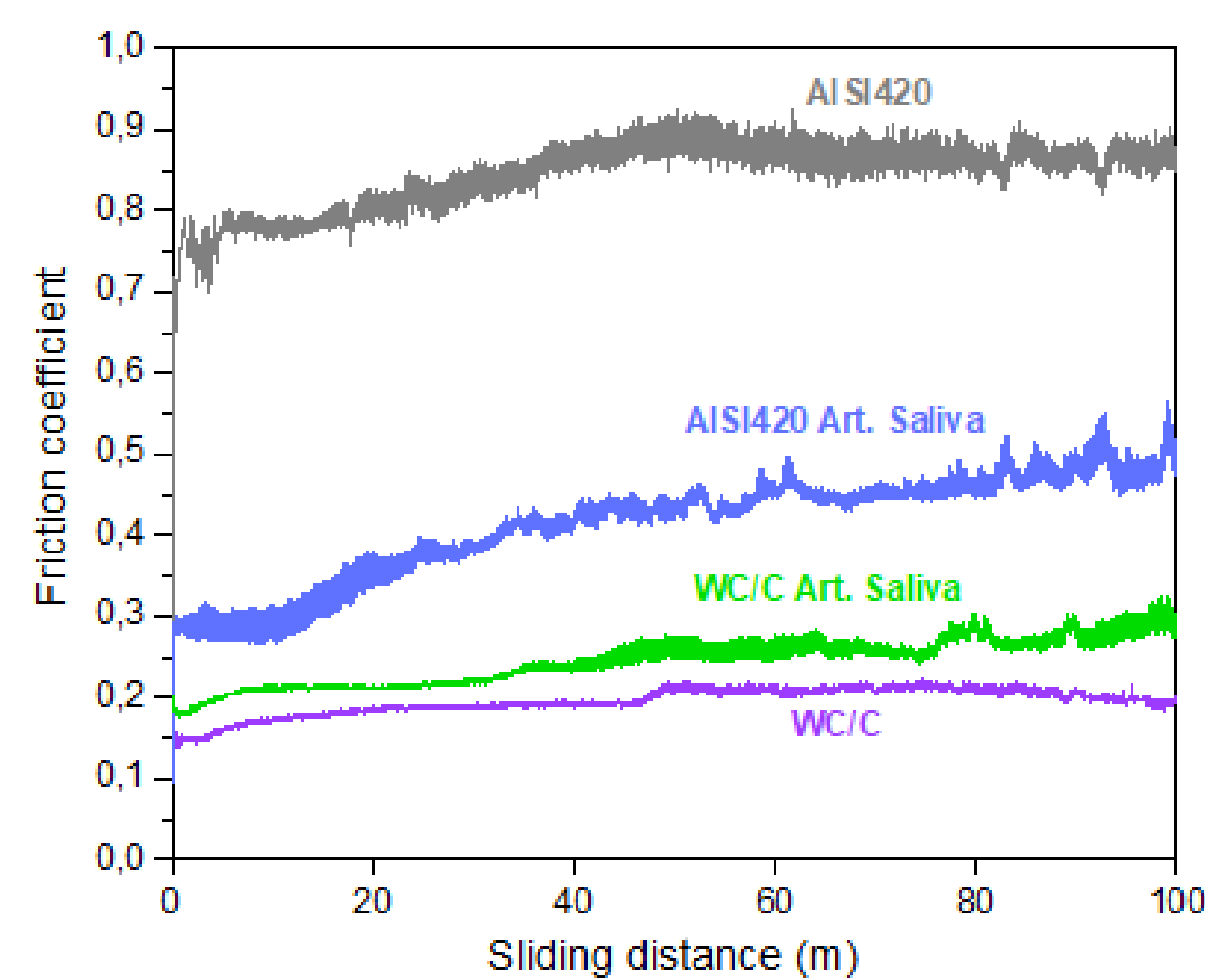
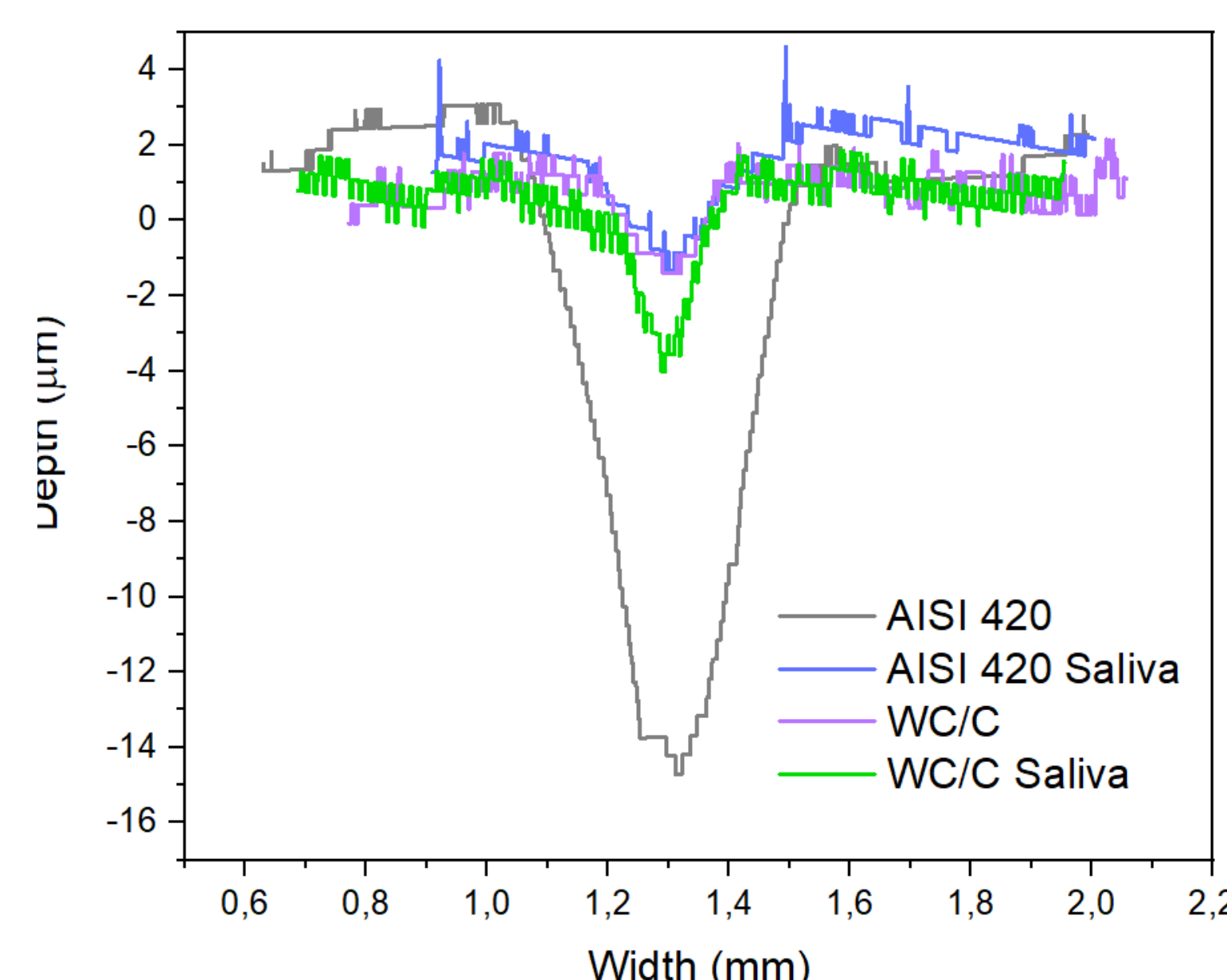


Fig. 5 and 6. COF curves of worn M340 substrate and WC/C coatings and profile of wear groove.



### WC/C Coating

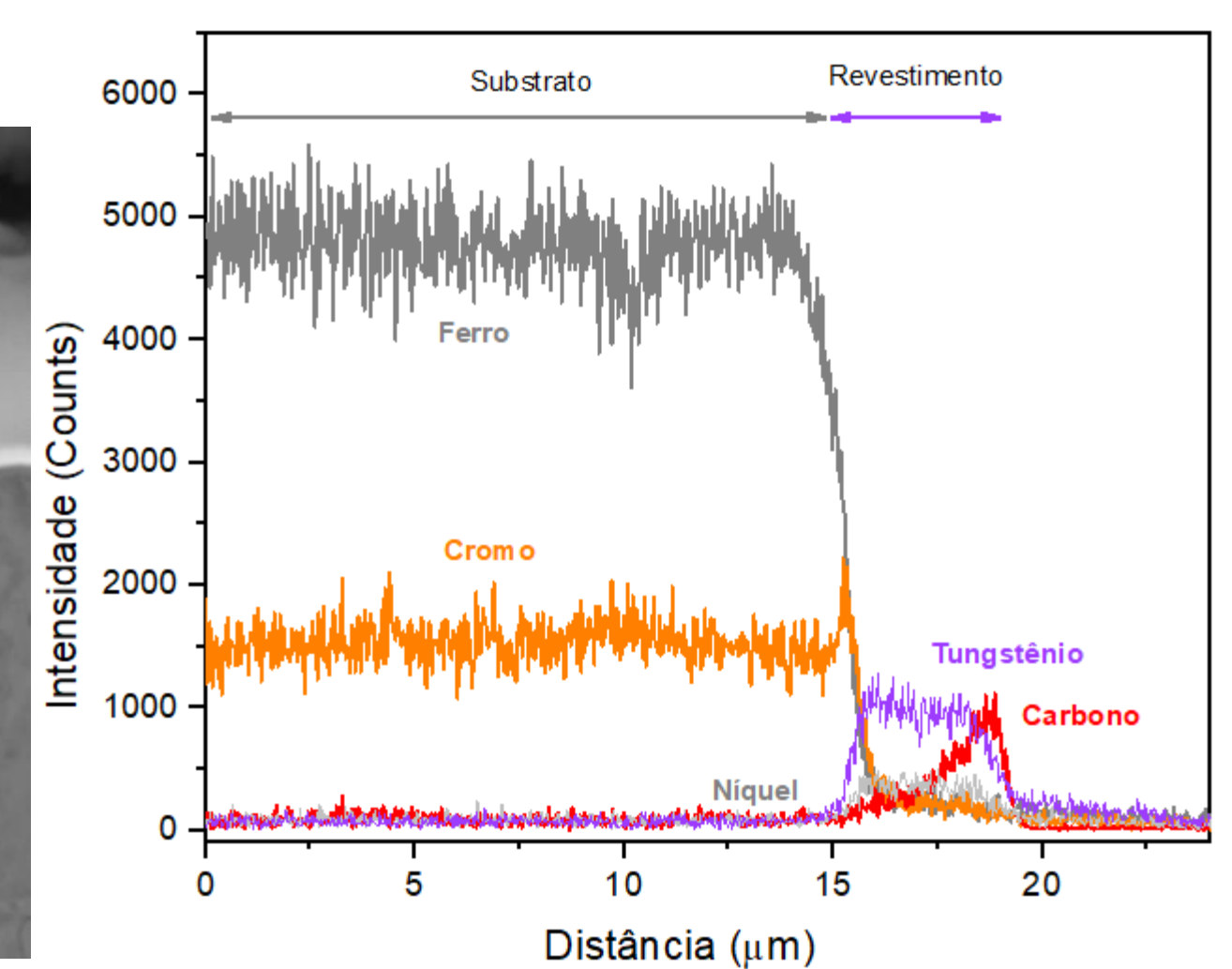
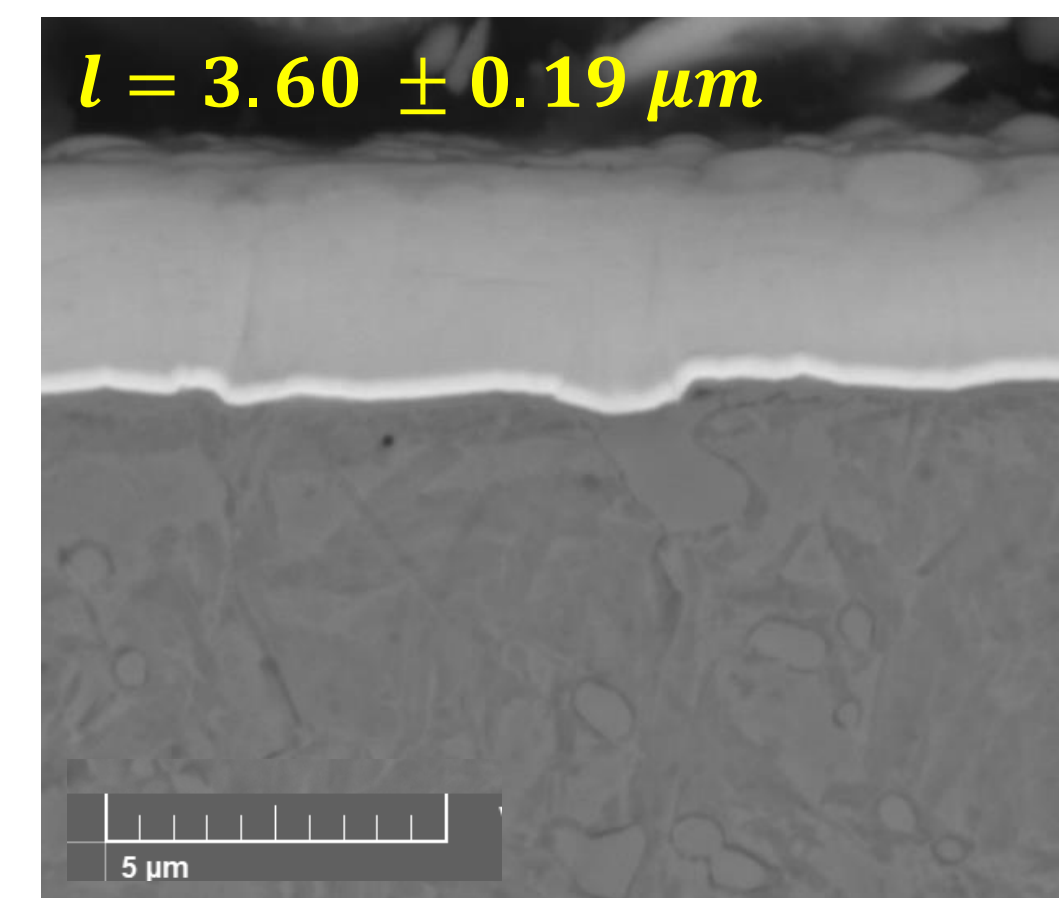


Fig.1 and 2. SEM images and Line EDS of WC/C cross section coating on M340 stainless steel.

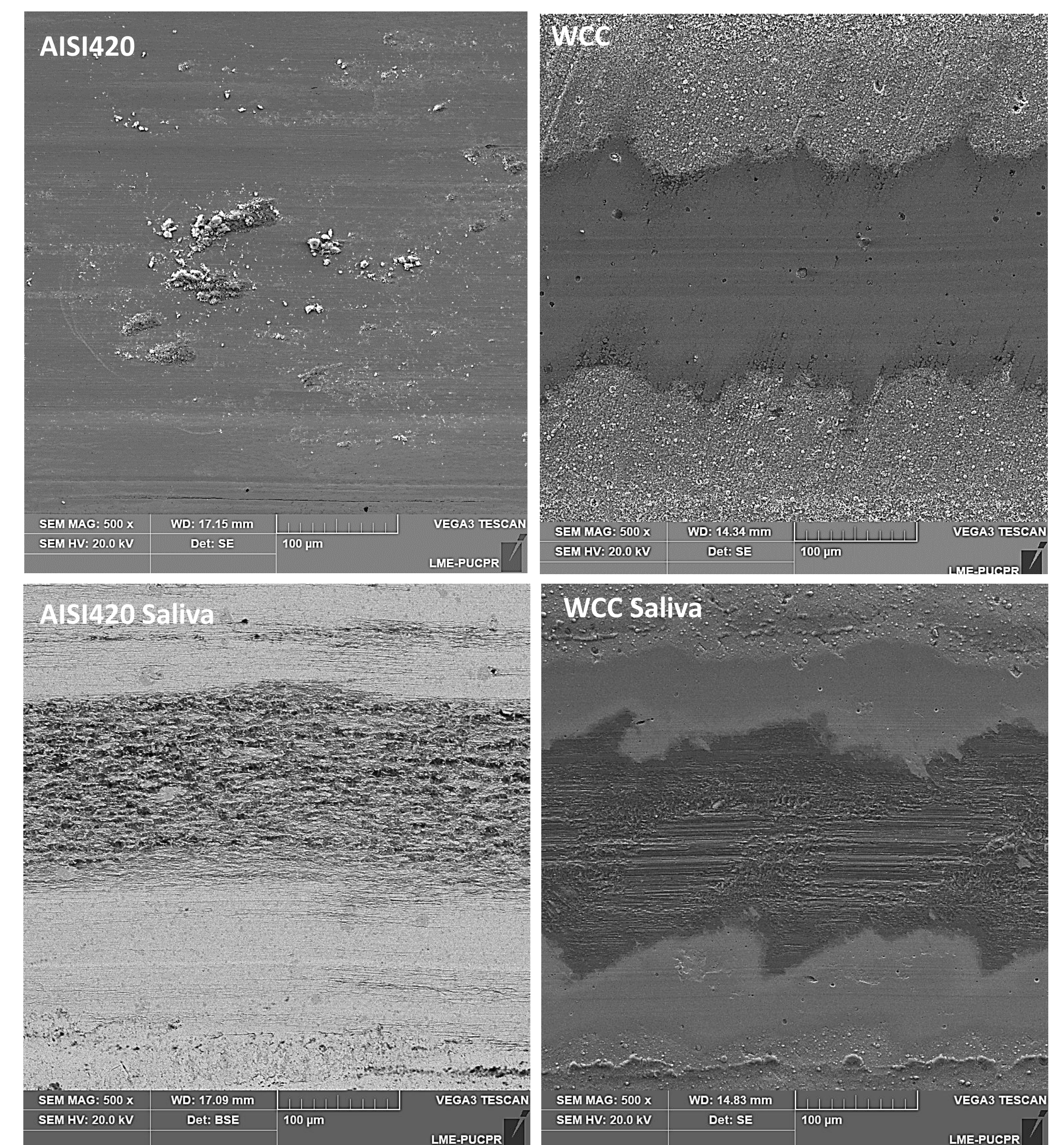


Fig.7, 8, 9 and 10. Scanning electron microscopy (SEM) of trail wear of M340 substrate and WC/C layer. (500 x)

## CONCLUSIONS

- Hardness and elastic modulus increased with the WC/C coating deposition
- Wear resistance of WC/C coated AISI420 is higher than uncoated 420.
- COF of WC/C coated steel is lower than uncoated M340, the artificial saliva decreased COF for AISI420 and for WC/C there was a little difference.
- Under the salivary environmental, the wear rate decrease for AISI 420 and increase for WC/C
- Applying the carbide tungsten coating can be used to improve the performance and longevity of tools.

## REFERENCES

- Tavsanoglu, T., Begum, C., Alkan, M., & Yucel, O. (2013). Deposition and characterization of tungsten carbide thin films by DC magnetron sputtering for wear-resistant applications. *Jom*, 65(4), 562-566.
- Holmes, D., Sharifi, S., Stack, M.M. (2014) Tribo-corrosion of steel in artificial saliva, *Tribology International*, Volume 75, 80-86.

## ACKNOWLEDGEMENTS

This work was carried out with the financial support of CNPq (Grant 140188/2021-5 PQ2). The authors would like to thank Neodent for providing the samples, and CAPES/PROEX (673/2018).