Tribocorrosion behavior of Si/Zr sol-gel coated 316L stainless steel: the effect of the substrate surface state

Stephania Kossman[1]*, Leonardo Bertolucci Coelho[2], Alex Montagne [1], Alberto Mejias[1-3], Adrien Van Gorp[1], Thierry Coorevits[1], Matthieu Touzin[4], Marie-Eve Druart[5], Mariana Staia[1], Marc Poorteman[2], Marie-Georges Olivier[2,5]

[1]Arts et Métiers Institute of Technology, MSMP, HESAM Université, F-59000 Lille, France
[2]Department of Materials Science, Faculty of Engineering, University of Mons, 7000 Mons, Belgium
[3]Université de Lille, IUT-A, département GMP, F-59650 Villeneuve d'Ascq, France
[4]Université de Lille, CNRS, INRAE, ENSCL, UMR 8207 - UMET - Unité Matériaux et Transformations, F-59000 Lille, France
[5]Materia Nova asbl, Avenue Copernic 1, 7000 Mons, Belgium

September 14th, 2020

Materials

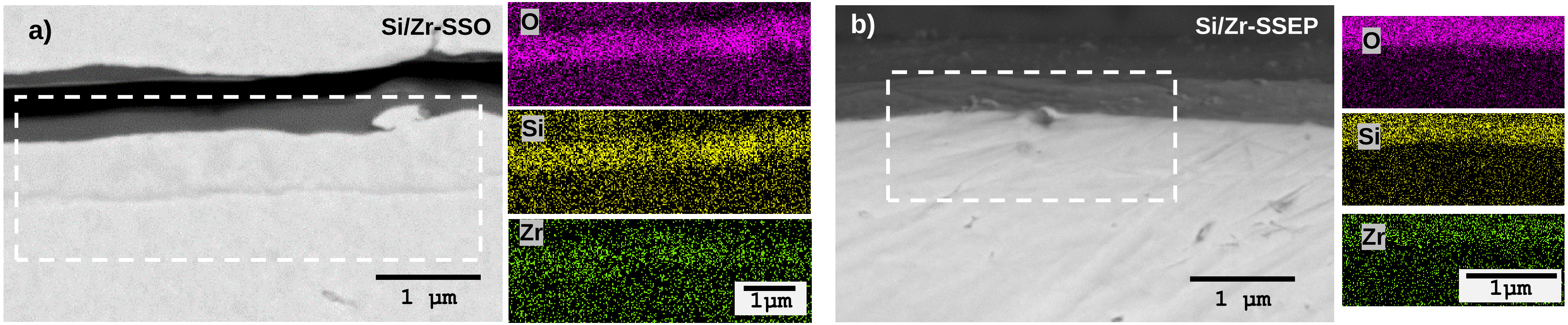


Fig. 1 SEM-EDS analysis of the cross-sections of (a) SSO-SG and (b) SSEP-SG systems.

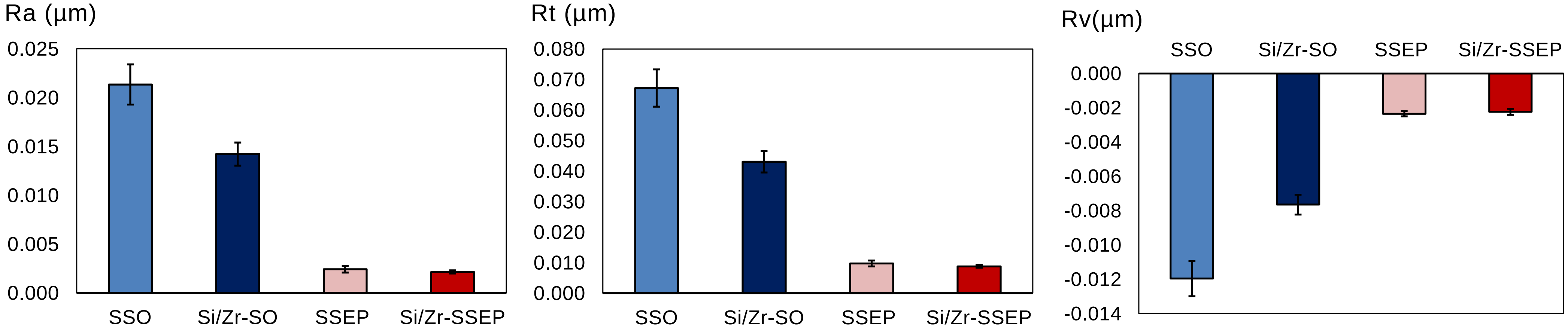


Fig. 2 Morphology multiscale analysis results, showing roughness parameters *R*a, *R*t and *R*v comparing coated and uncoated surfaces. The scale of pertinency [17] was approximately 2 µm for these parameters.

Dr. Leonardo Bertolucci Coelho – leonardo.bertoluccicoelho@umons.ac.be

Tribocorrosion results

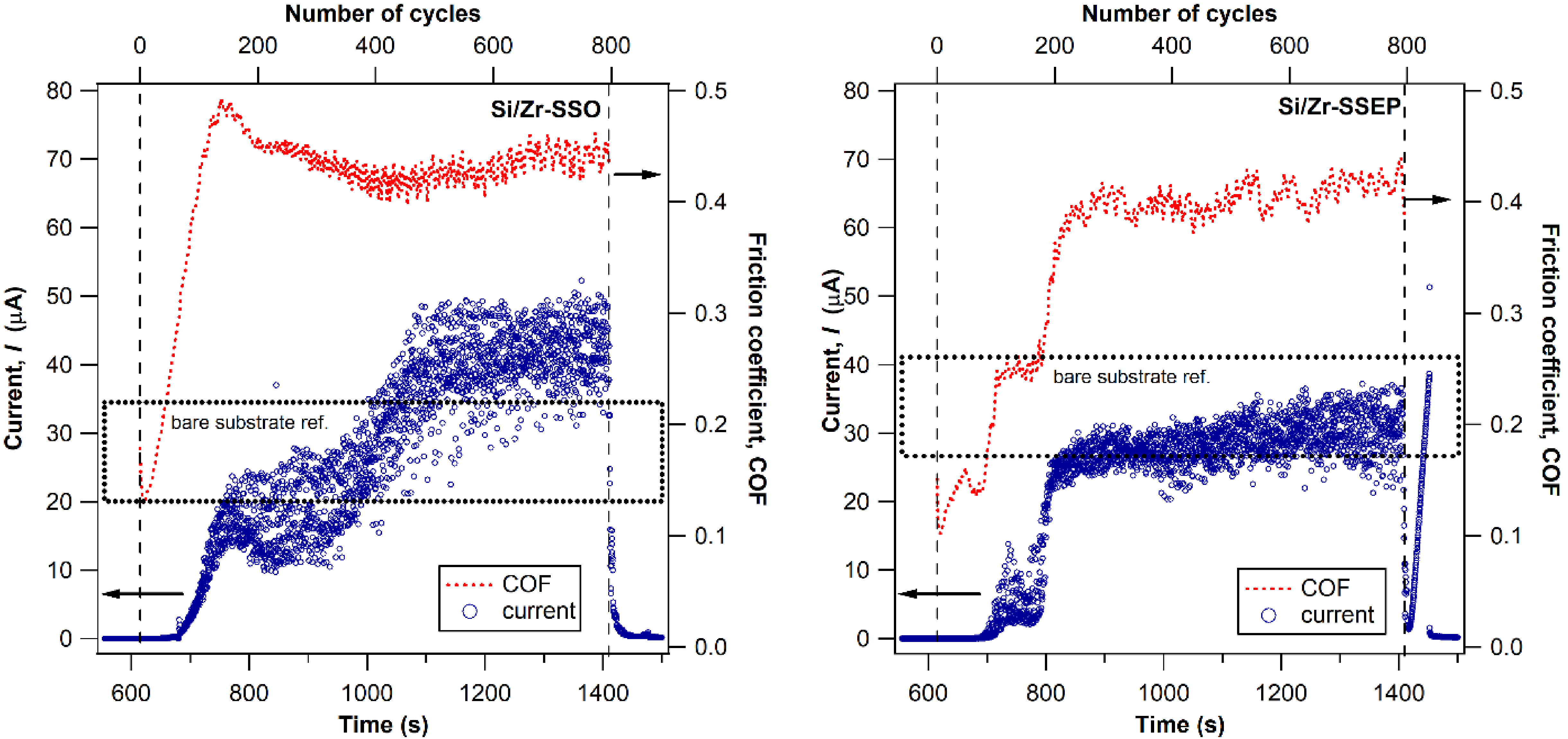


Fig. 3 Current and friction coefficient as function of time (number of cycles). The regions delimited by the dotted lines correspond to the range of current values for the bare substrates under the same testing conditions [14].

Tribocorrosion results

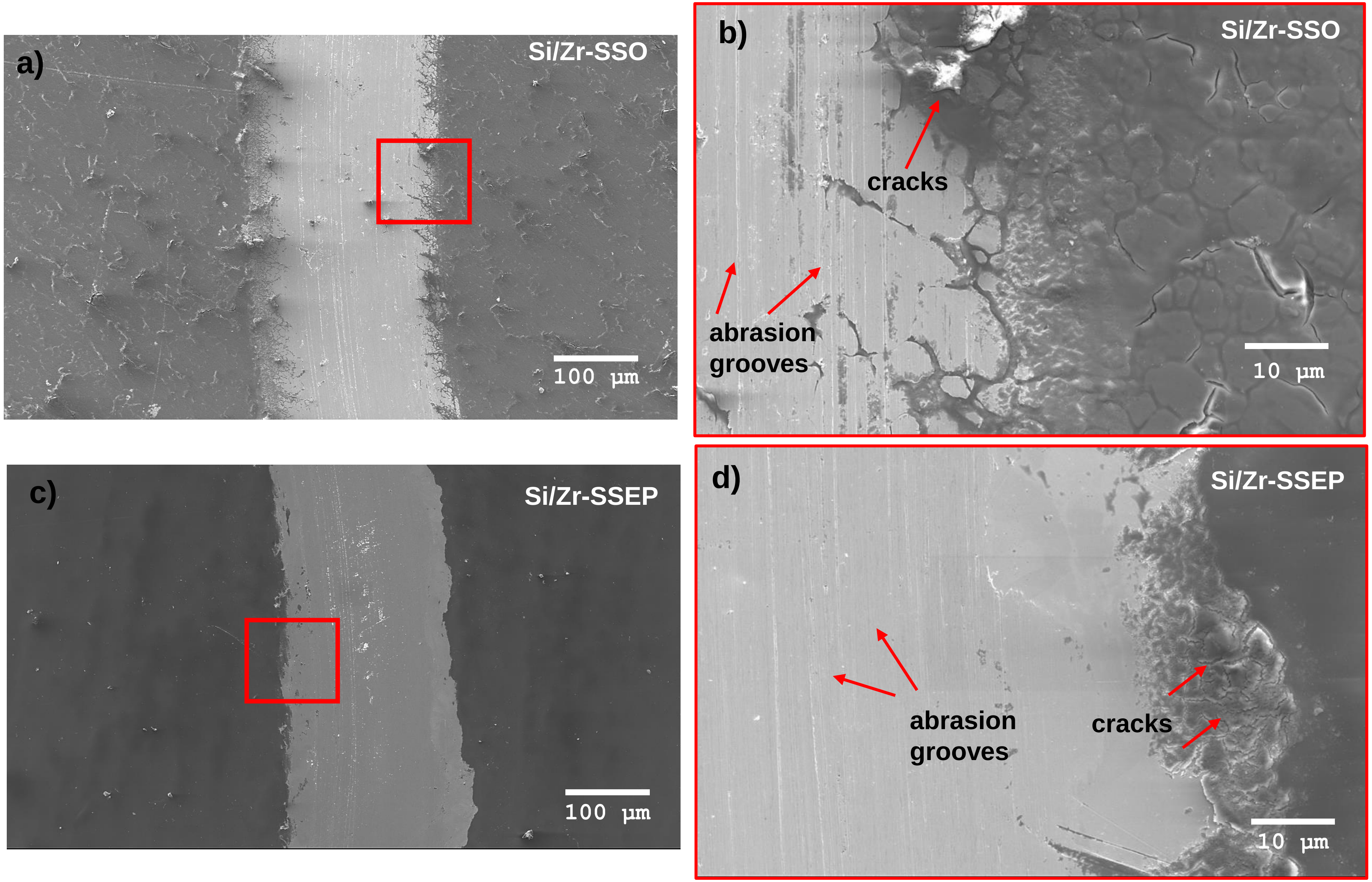
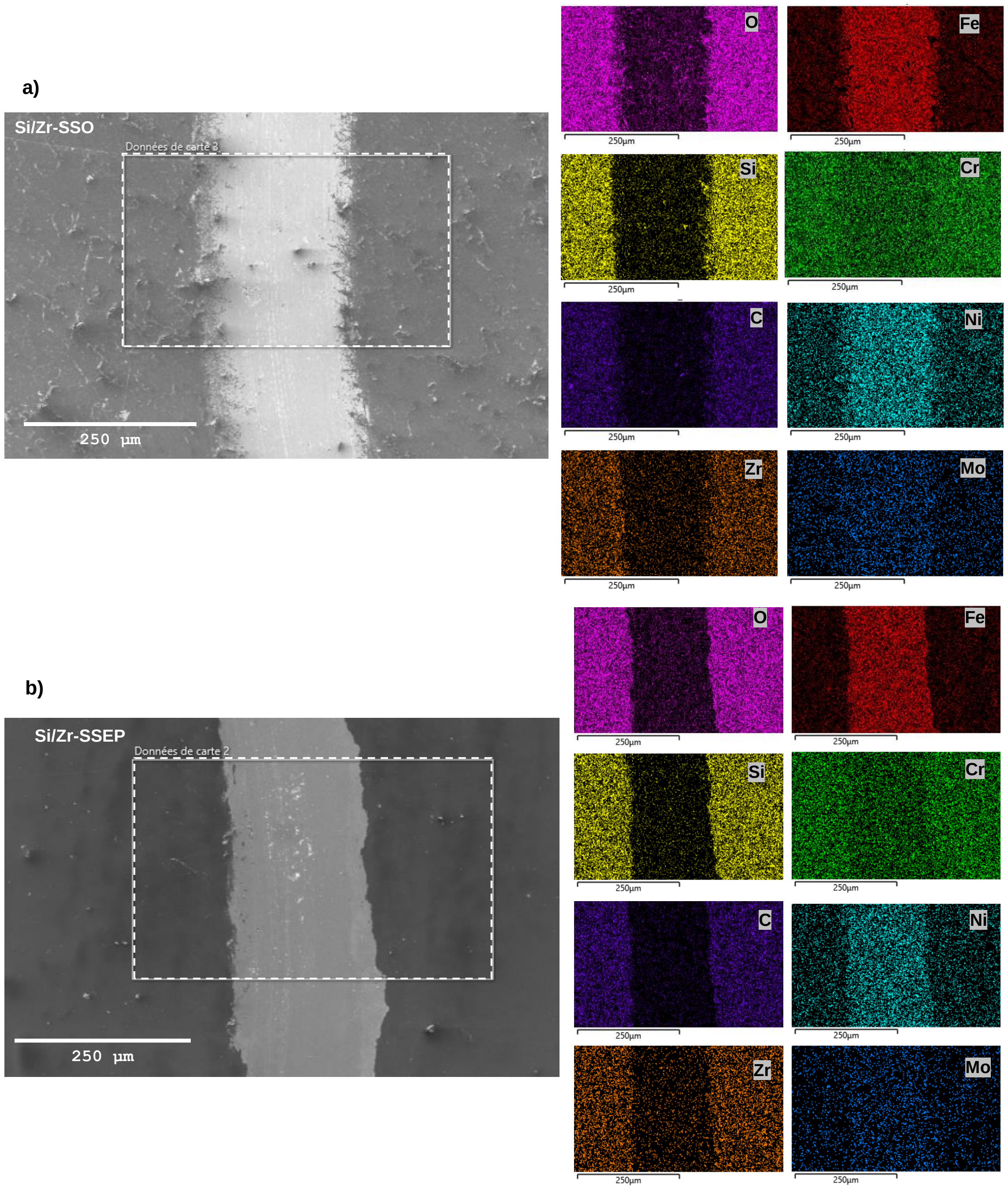


Fig. 4 SEM micrographs (secondary electron mode) of wear tracks after tribocorrosion tests under potentiostatic control (+200 mV vs. Ag/AgCl/KCl$_{sat}$): a-b) Si/Zr-SSO, c-d) Si/Zr-SSEP.

Dr. Leonardo Bertolucci Coelho – leonardo.bertoluccicoelho@umons.ac.be



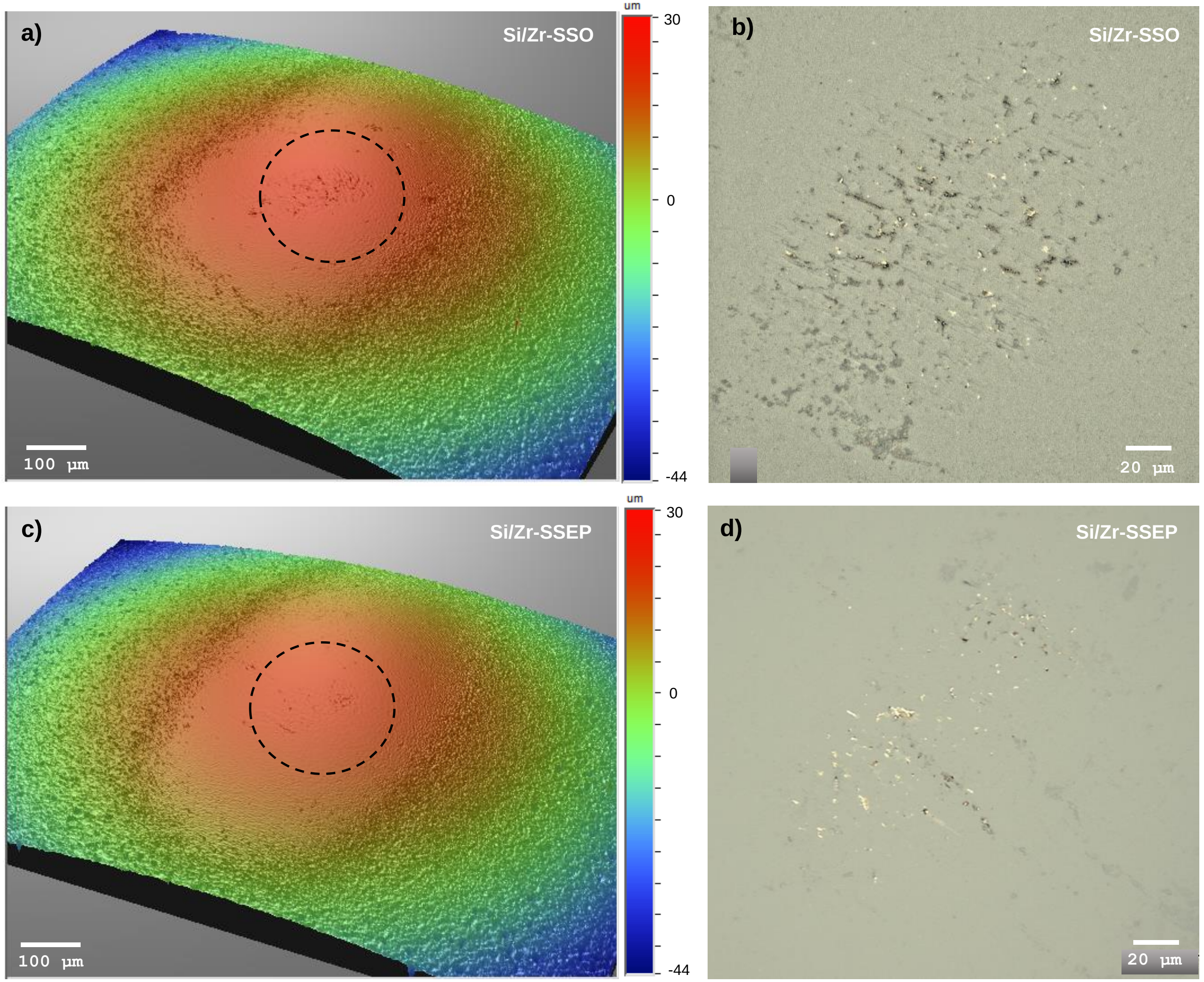


Fig. 7 3D Optical profilometry analysis (a,c) and 2D optical microscopy images (b,d) of alumina balls after tribocorrosion tests. Optical microscopy images correspond to regions inside the circles in the profilometry analysis.

Fig. 6 SEM-EDS analysis of wear tracks after tribocorrosion tests: a) Si/Zr-SSO system, b) Si/Zr-SSEP.

Dr. Leonardo Bertolucci Coelho – leonardo.bertoluccicoelho@umons.ac.be

Conclusions

- The Si/Zr sol–gel coating showed a good surface coverage indistinctly of the 316L surface state.

- The surface state of the 316L substrate affected the thickness of Si/Zr sol–gel coatings, with the smoother surface (SSEP) presenting half of the thickness (about 320 nm) of the estimation for the rougher surface (SSO).

- The final Si/Zr sol–gel topography depends on the underneath surface. The coating produces a smoothing effect on rougher surfaces such as SSO, notably filling the valleys of the topography. Reducing approximately by 30% the roughness parameters. For smoother surfaces (SSEP), the sol–gel coating replicated the surface topography.

- The tribocorrosion behavior of the sol–gel/316L coated systems were affected by their topography, revealing a detrimental effect for rougher surfaces (SSO).

Université de Mons
Dr. Leonardo Bertolucci Coelho – leonardo.bertoluccicoelho@umons.ac.be