EFFECT OF TRACES OF ETHANOL AIRBORNE CONTAMINATION ON THE TRIBOLOGICAL BEHAVIOUR OF SnO_2 COATING

K. Jia [b], O. Heintz [c], T. Filleter [b], N. Martin [a], J. B. Sanchez [a], M. C. Marco de Lucas [c], G. Colas [a*]
*Guillaume.colas@femto-st.fr
[a] Univ. Franche-Comté, CNRS, institut FEMTO-ST, F-25000 Besançon, France,
[b] University of Toronto, MIE Department, 5 King's College Road, M5S 3G8, Toronto, Canada
[c] Laboratoire Interdisciplinaire Carnot de Bourgogne (ICB), UMR6303 CNRS-Université de Bourgogne, 9 avenue Alain Savary, BP 47870, 21078 Dijon Cedex, France

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ABSTRACT
Whatever the purity of the materials making up dry lubricants, once exposed to the air, they come into contact with ubiquitous ambient contamination. Unexpectedly, the generation of a small quantity of particles (low wear) may be the result of a complex competition between different physico-chemical mechanisms involving the materials in contact and their internal and external contaminants (from the gaseous environment), and giving rise to lubricating interfaces through mechanically activated chemical reactions [1–4]. Traces of contaminants (in the ppm or ppb range) are enough to initiate the creation and maintenance of this lubricating and anti-wear interface [4].

The present study aims to study how volatile molecular compounds, at 1,000ppm concentration, may impact friction and wear of thin coatings. The choice has been made to work with SnO_2 thin films and ethanol vapor. SnO_2 is indeed sensitive to the adsorption of ethanol molecules and it is used as the sensitive material in ethanol gas sensors. SnO_2 has been subjected to friction in dry N_2 and dry N_2 contaminated with 1000 ppm of ethanol vapor. Contact conditions were sliding speed of 8 mm/s, mean contact pressure of 330 MPa, ambient temperature, 100Cr6 sliding counterpart, and 500 cycles of friction in reciprocating motion. Fig. 1 shows the significant impact of both the environment and contamination on the coefficient of friction, with a reduction in average friction by a factor of 2.5 to 3. The impact on material damage and wear is also significantly lower. Initial surface analyses show that material composition at the interfaces varies, notably in the proportion of iron oxides. There is probable creation of a mixed Fe-Sn-O compound whose proportion varies from one condition to another.

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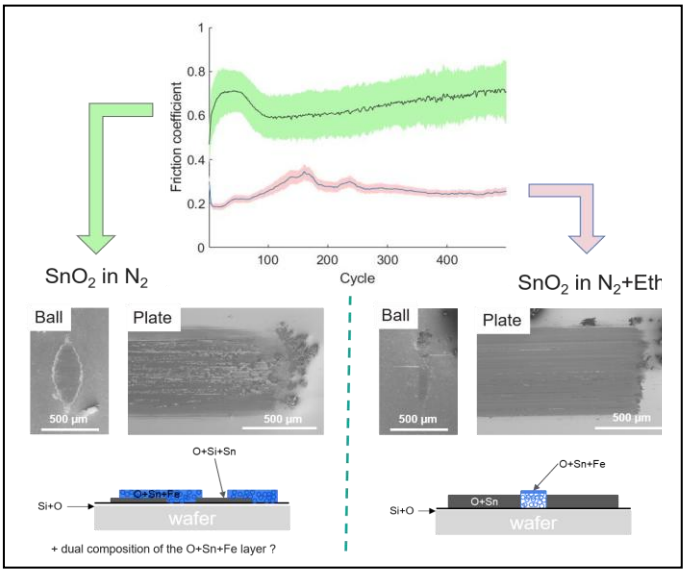

Figure 1 - Friction coefficient with standard deviation, SEM images and schematic of the contacts. From test performed in pure and contaminated dry nitrogen environments.

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