MICROMECHANICAL EXPERIMENTS TO EXTRACT MECHANICAL PROPERTIES OF A TRIBOFILM FORMED IN A Ti6Al4V/DLC CONTACT BY FRETTING

H.H. Ding[a], G. Guillonneau[a], V. Fridrici[a], S. Sao-Joao[b], J. Geringer[c], J. Fontaine[a], Ph. Kapsa[a].
*gaylord.guillonneau@ec-lyon.fr
[a] Laboratoire de Tribologie et Dynamique des Systèmes, UMR CNRS 5513 ECL-ENISE-ENTPE,
Université de Lyon, Ecole Centrale de Lyon,
36 avenue Guy de Collongue, 69134 Ecully cedex, France,
[b] Université de Lyon, IMT Mines Saint-Etienne, Centre SMS, LGF UMR5307,
F - 42023 Saint-Etienne France
[c] Université de Lyon, IMT Mines Saint-Etienne, Centre CIS, INSERM U1059, SainBioSE,
F - 42023 Saint-Etienne, France

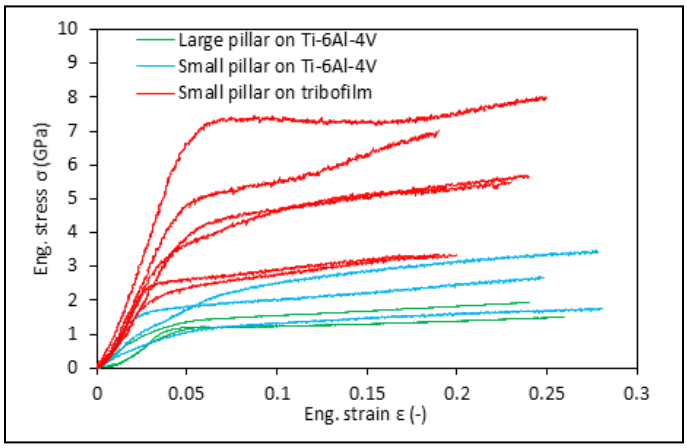
KEYWORDS
Fretting; Tribofilms and 3rd bodies; Coating, microcopillar compression

ABSTRACT
Fretting wear of Ti6Al4V versus DLC coating has been investigated [1,2]. It was shown that a tribofilm is formed during fretting. It is mainly composed of oxidized debris of Ti6Al4V, involving a decrease of wear rate and friction.

This study aims at understanding the mechanical properties of the tribofilm responsible of its "lubricating" effect. These mechanical properties have been measured by nanoindentation and by micropillars compression tests. Nanoindentation tests have been performed on the tribofilm, the DLC coating and the titanium alloy. Micropillars have been FIB-machined on the tribofilm and on the titanium substrate. These pillars have been compressed with a diamond flat punch, using an *in situ* Alemnis indenter, installed in a SEM, in order to extract their mechanical behavior (fig. 1).

The results revealed that the tribofilm Young's modulus, hardness, and Yield stress are higher than the ones from the titanium alloy. Consequently, these high properties could be responsible of the good tribological properties of the tribofilm. Surprisingly, the hardness, calculated from the yield stress obtained by micropillar compression, is higher than the one measured by nanoindentation. It was shown there is no substrate influence on hardness measured using y micropillar compression, which is the case by nanoindentation.

Fig.1 Stress–stain (σ–ε) curves measured micro-pillar



compression.

ACKNOWLEDGMENTS
This work was supported by the LABEX MANUTECH-SISE (ANR-10-LABX-0075) of Université de Lyon, within the program "Investissements d'Avenir" (ANR-11-IDEX-0007) operated by the French National Research Agency (ANR). The authors would also like to thank the China Scholarship Council for its financial support.

REFERENCES
[1] Ding HH, Fridrici V, Geringer J, Fontaine J, Kapsa P, Wear; 406–407, 2018, 53–67.
[2] Ding HH, Fridrici V, Bouvard G, Geringer J, Kapsa P. Tribol Lett; 66, 2018, 11.