ELECTRICAL PROBING OF SHEARED METALLIC ROUGH INTERFACES

N. Foy [a], E. Chevallier [a*]
*eddy.chevallier@u-picardie.fr
[a] Laboratoire “Physique des Systèmes Complexes” (P.S.C. – E.A. 4663),
33 rue Saint Leu, 80039 Amiens, France

KEYWORDS
Experiments in tribology, Physics of friction, Contact and adhesion, Electrical contact resistance.

ABSTRACT
Contact between rough surfaces is realized by tiny contact spots [1] where their number, distribution, shape or their size – so their geometrical properties – depend from the roughness, the used materials, and the stress applied on the contact interface. Many studies describe the multi-contact interfaces state under stresses and are currently used in many ways [1 - 5].

In this work we expose the results of the experimental study about the shear stress applied on multi-contact interfaces made from metallic rough surfaces [5 - 8]. We use different kind of metal (Copper, Steel, Brass…) and different surface polishes to explore a wide range of mechanical parameters. To probe the contact interface, we use a pair of cylindrical samples - sized to have a homogeneous current distribution in the bulk - in which a constant DC current is applied thus to measure the voltage at each end of the set during an increasing shear stress. Through these measurements we deduce the contact resistance vs. the shear stress and so, highlight the contact area evolution.

Results show that the contact resistance decrease with the shear stress. A first hypothesis consists in to consider that either real contact area, the contact number, or both increases with shear stress. As shown in Figure 2, some occasional resistance rises during shearing shows that spots rearrangement phenomena seems to occur.

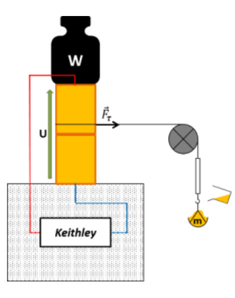

Fig.1 Experimental setup: metallic cylindrical samples in contact, undergoing a normal and a tangential stress. Voltage is measured at each end of the set during the shear increasing.

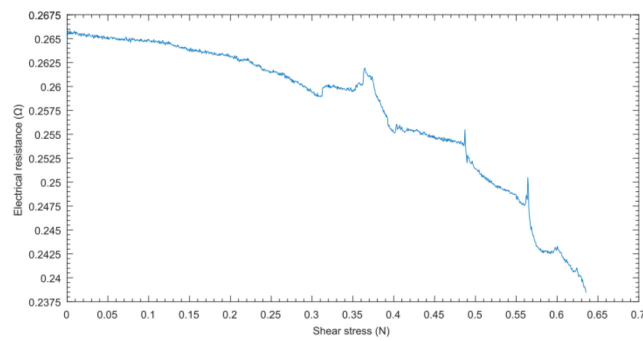

Fig. 2 Contact resistance vs. shear stress of an Al/Al interface

REFERENCES
[1] Greenwood, J.A. and Williamson, J.B.P., Contact of nominally flat surfaces, 295, Proceedings of the Royal Society of London. Series A. Math. and Phys. Sciences (1966)
[2] Dietrich, J. H. and Kilgore, B. D., Direct Observation of Frictional Contacts: New Insights for State-dependent Properties, PAGEOPH, Vol. 143, No. l/2/3. (1994)
[3] Chevallier, E., Foy, N., Bouzerar, R., Jonckheere, B. and Ait Mohamed, S., Multi-contacts Interface: Electrical Properties of Dynamical Interface, NME 2018, Vol. 2, 37-46. (2019)
[4] Hoon Jang, Y. and Barber, J. R., Effect of contact statistics on electrical contact resistance, Journal of Applied Physics, Vol. 94, N°11. (2003)
[5] McFarlane, J. S. and Tabor, D., Relation between friction and adhesion, 202, Proceedings of the Royal Society of London. Series A. Math. and Phys. Sciences. (1950)
[6] Courtney-Pratt, J. S. and Eisner, E., The effect of a tangential force on the contact of metallic bodies, 238, Proceedings of the Royal Society of London. Series A. Math. and Phys. Sciences. (1957)
[7] Brizmer, V., Kligerman, Y., and Etsion, I., Elastic-plastic spherical contact under combined normal and tangential loading in full stick, Trib. Letters, Vol. 25, N°1. (2007)
[8] Prevost, A., Scheibert, J. and Debrégeas, G., Probing the micromechanics of a multi-contact interface at the onset of frictional sliding, Eur. Phys., Vol. 36, N°17. (2013)