A NEW METHOD TO MEASURE SHEAR SURFACE MECHANICAL PROPERTIES

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Mechanical systems in most applications exhibit contacts, which imply friction and/or wear mechanisms at the interface scale. The understanding of the tribological behaviour is closely related to the shear flow of the system components, which may be scale dependent. Microcompression and indentation techniques are usually used in order to measure and predict the surfaces mechanical properties. However, these techniques describe hardly the main flow mode consistent with tribological applications, which is shear.

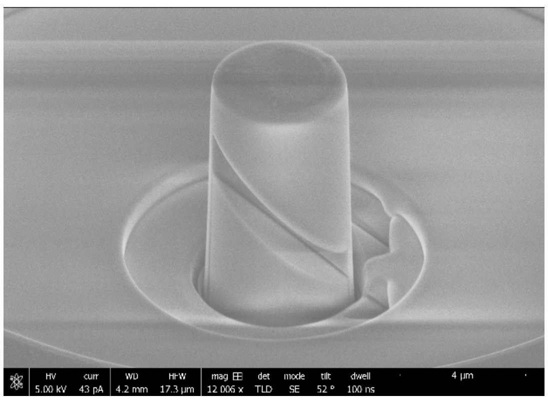
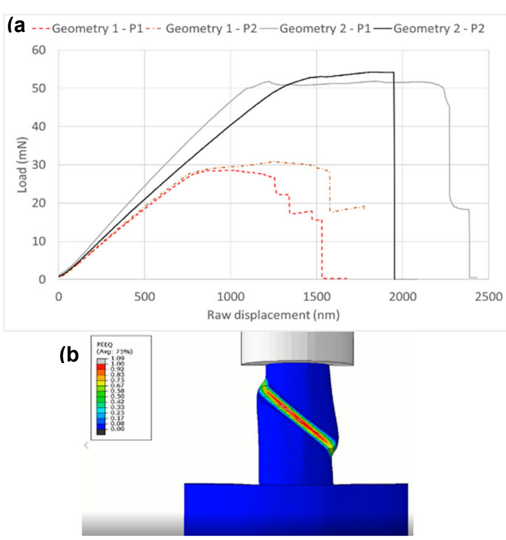


Figure 1 – SEM image of a Microshear Compression Specimen machined using FIB on Fused silica

To that end, a new method was developed, allowing the measurement of shear properties at the micron scale [1]. It consists in using an *in situ* microindenter to compress modified micrometric pillars, FIB machined, with a geometry inspired from a macroscopic technique using the "Shear Compression Specimen" [2]. On figure 1, an example of "Microshear Compression Specimen, machined on fused silica, is presented.

The geometry was validated on model materials and results show a good reproducibility and a localized plastic deformation in the gauge (see figure 2). A multiparametric study was performed via FE simulations focusing on the different factors that may affect the accuracy of measurements: pillar and load misalignment, groove angle, sliding between the pillar head and the flat punch, etc, and will be presented. Interestingly, the geometry of the Microshear Compression Specimen enables easily experiments at higher strain an d strain rates, than microcompression. High strain rates experiments by microshear (until 2000s^{-1} strain rate) and microcompression (until 1000s^{-1} strain rate) will be presented, compared and discussed.



[1] Guillonneau G. et al., "Plastic Flow Under Shear Compression at the Micron Scale – Application On Amorphous Silica at High Strain Rate", JOM (2022)
[2] Dorogoy A. et al., "Modification of the Shear-Compression Specimen for Large Strain rate", Exp. Mech. (2015)

Figure 2 – (a) Load – Displacement curves measured experimentally for various geometries and (b) equivalent plastic deformation distribution obtained via FE simulation