



## *Evaluation of Properties of Cleaning Brushes (Sponges) on The UMT Series Tribometer*

**Summary:** The introduction of new materials and the increasing challenges of reduced line widths have generated considerable interest in the area of post-CMP cleaning technology. Understanding the relationship between applied load, relative speed, resulting friction and the effectiveness of the particle removal are of prime importance for characterizing the cleaning process.

testing.

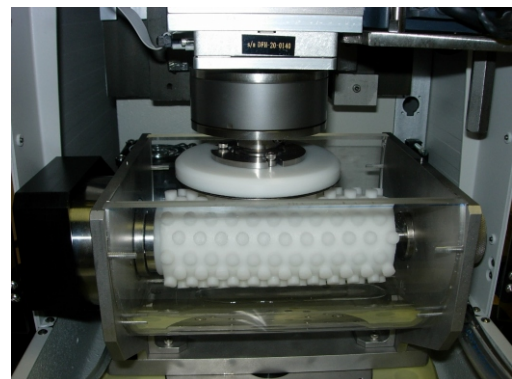
In addition to friction, the UMT can also be used to evaluate mechanical properties of brushes such as elasticity, compression, creep, wear etc. The tester has a fully automated PC-based motor control and data acquisition, with a user friendly software interface in Windows-XP multitasking environment.



**Disc Brush Configuration**

**Instrumentation** The friction, durability and mechanical properties of the brushes were evaluated utilizing Tribometer UMT-2M

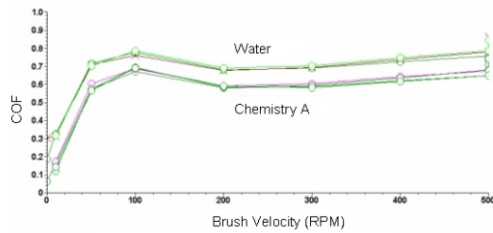
The UMT can accommodate both cylindrical and disk brushes on the lower drive. The upper drive can hold disks/wafers of 2, 3 or 4 inch diameter. The brush can be rotated at a high RPM (0 - 500RPM). The ultra accurate strain gauge sensor performs simultaneous measurements of the normal load, friction and coefficient of friction with very high resolution and repeatability. The normal load sensor provides feedback to the vertical motion controller, actively adjusting the upper specimen position to control the load during



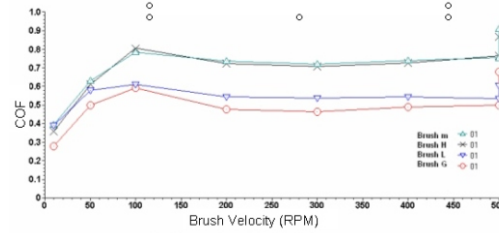
**Cylindrical Brush Configuration**

The following tests were done to characterize cleaning brushes.

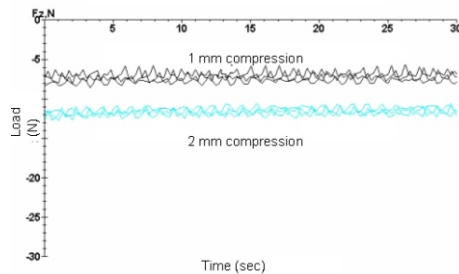
**Experimental procedure:** the wafer was rotating at 100 RPM. The chemistry/wafer flow rate was 60 ml/min. The coefficient of friction, friction and load were continuously monitored in-situ. Stribeck curves were obtained to show the effect of brush speed at different compressions. The creep and elasticity of the brushes were evaluated to characterize the mechanical properties.



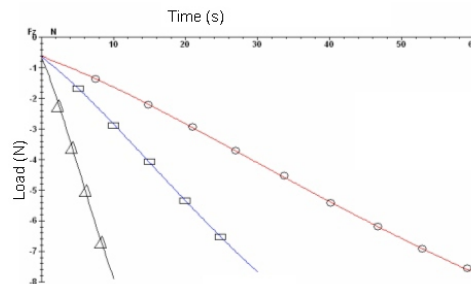
**Figure 1. Stribeck curves with two cleaning chemistries**



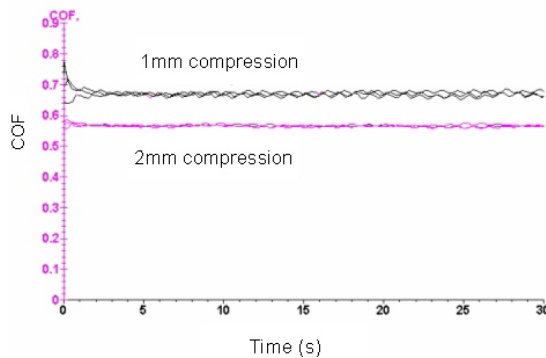
**Figure 4. Stribeck curves for different brushes**



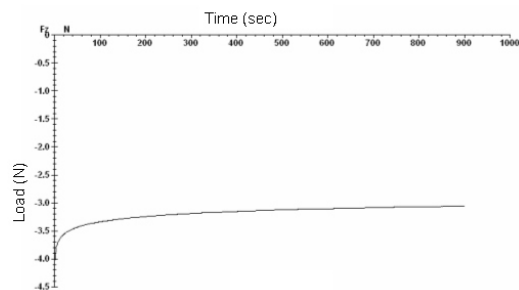
**Figure 2. Load at different compression levels**



**Figure 5. Brush Elasticity at different loading rates**



**Figure 3. Coefficient of friction at different compression levels.**



**Figure 6 Creep at 2mm compression**

## Conclusions

1. It is important to conduct brush (sponge) testing at precisely controlled loads and speeds that correspond to the real life.

2. The Stribeck curves at variable brush speeds differ for different materials and cleaning chemistries.

3. The UMT can comprehensively characterize cleaning brushes of various shapes (discs, cylindrical etc).