

Effect of Slurry & Pad Characteristics on the Tribology of ILD CMP

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Driving Force

Characterization, fundamental understanding and control
of the magnitude of shear forces
in the pad-slurry-wafer region
is an integral element in developing optimal planarization processes
for low k dielectric applications

Tribological mechanism and effective pad life may
be related to one another

Adoption of 'smart' abrasives, novel pads and
improved pad conditioning schemes
will be required to impart customized shear forces on the wafer
during CMP

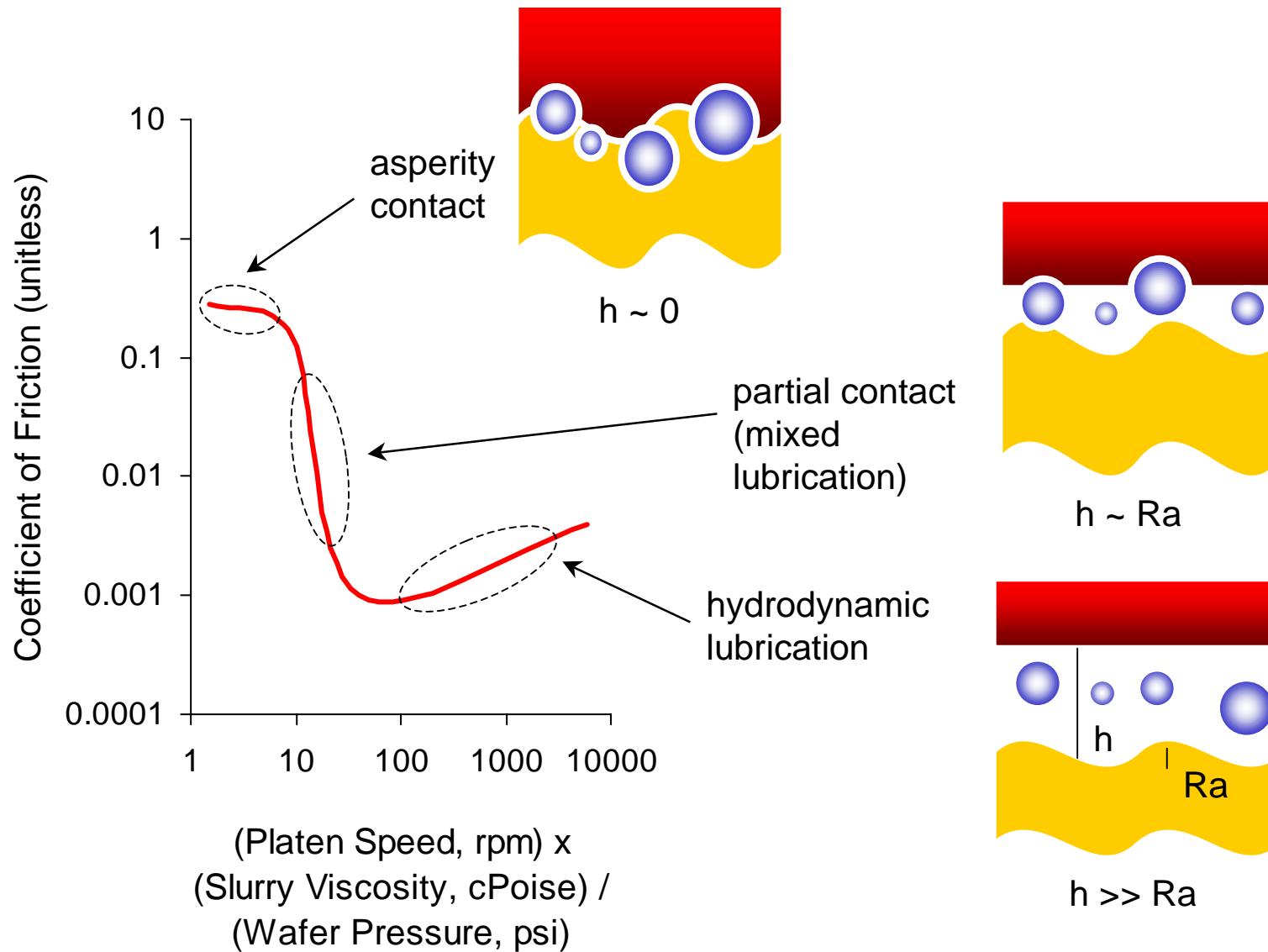


Outline

- Generic Stribeck curve theory and its application in CMP
- Experimental procedure
 - Slurry systems
 - Process conditions
 - Pad conditioning schemes
- Results & Discussion
 - Stribeck curves
 - Pad conditioning
 - Mono-modal & Bi-modal slurry abrasive systems
- Future plans



Lubrication in Journal Bearings & the Stribeck Curve

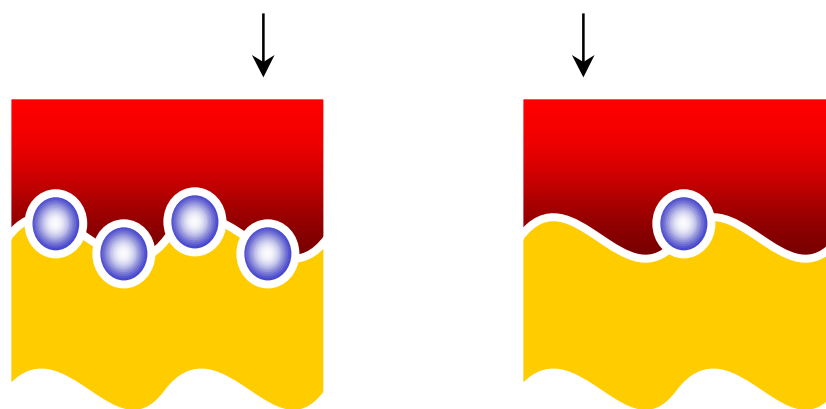
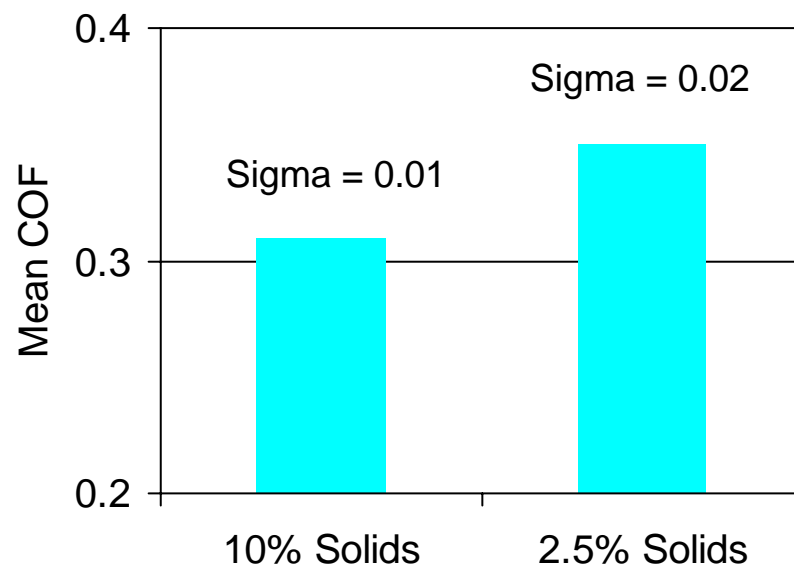
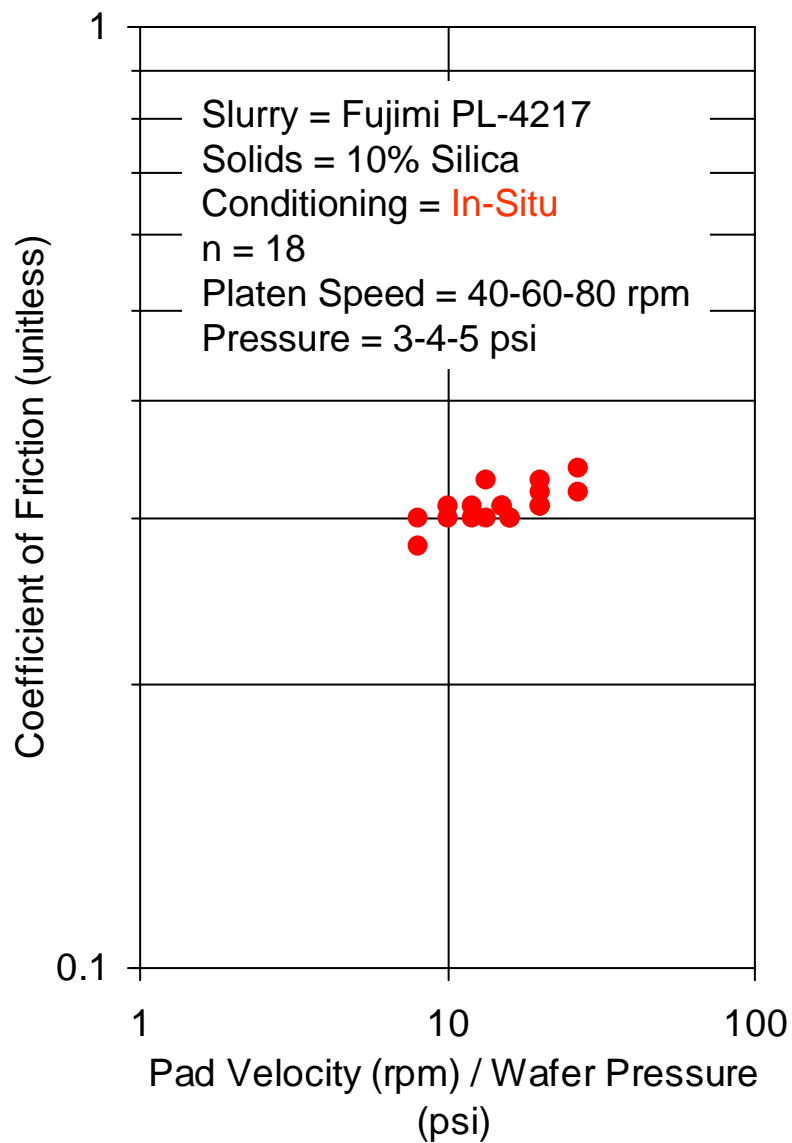


Experimental Procedure

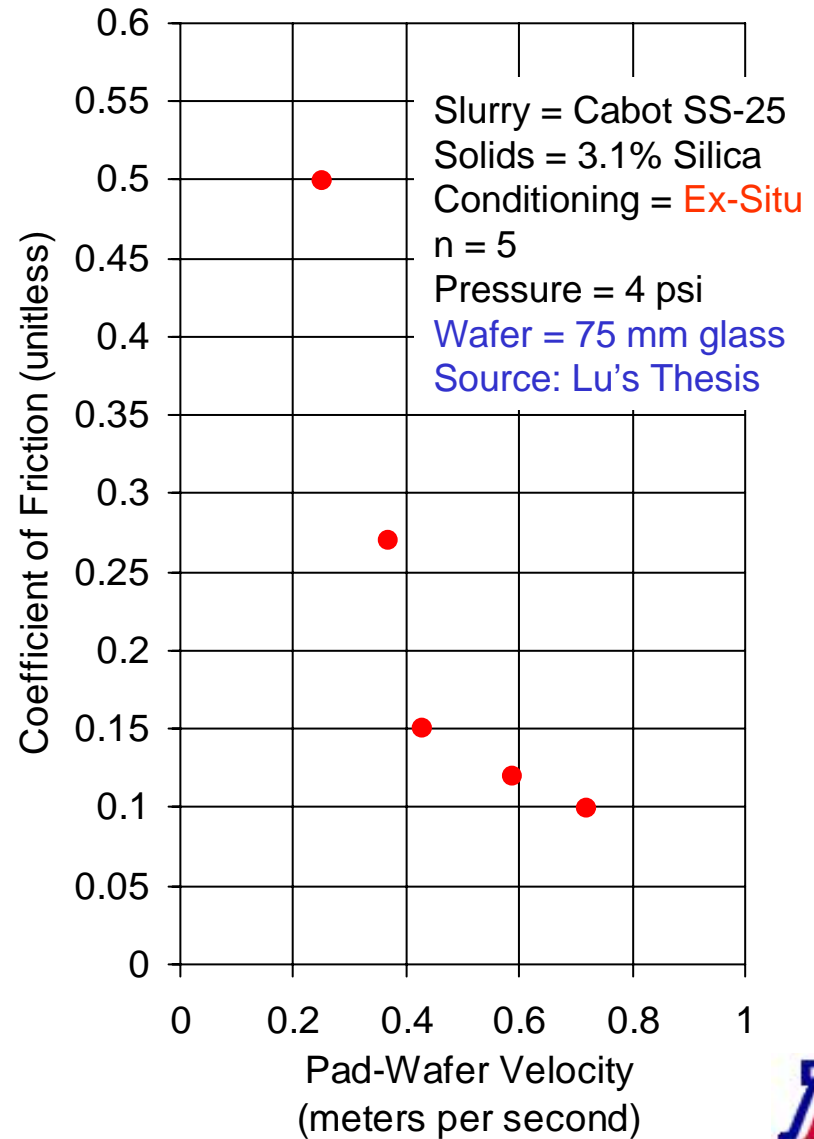
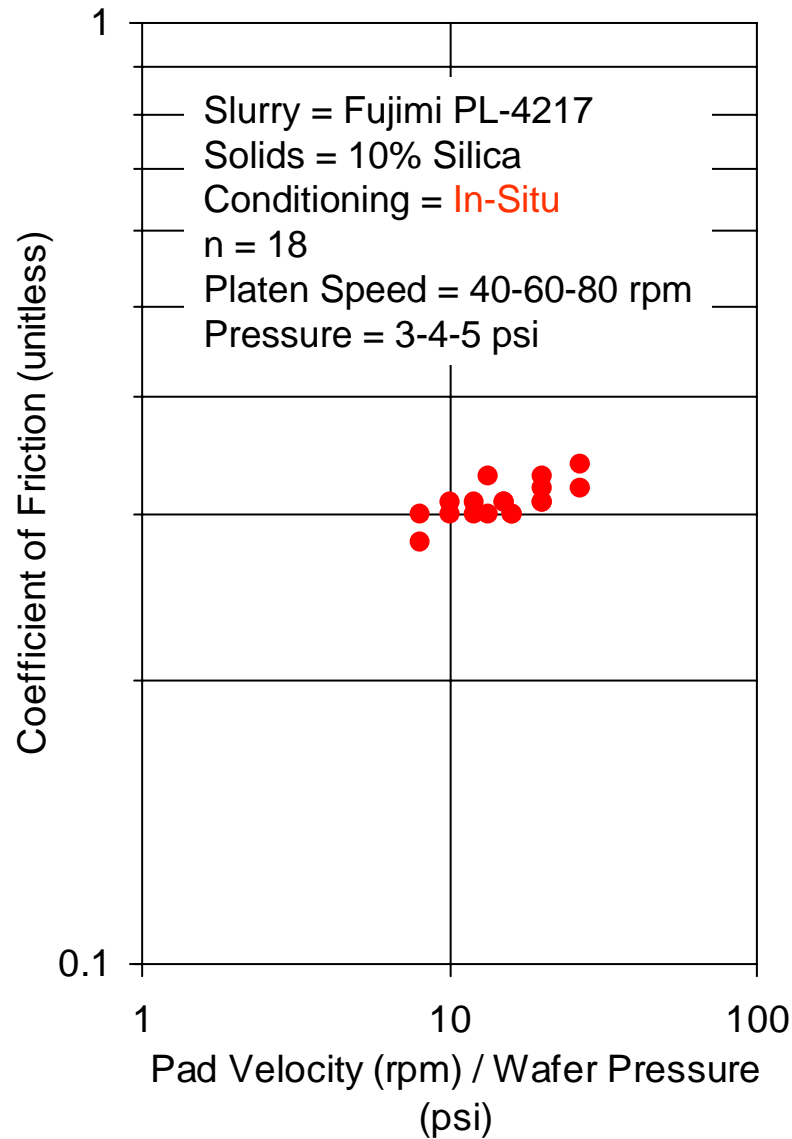
- Pad:
 - Rodel IC-1000 perforated (no sub-pad)
 - 30 minute conditioning followed by 1 minute wafer break-in
- Conditioning:
 - In-situ and ex-situ conditioning with 100 grit diamond disk
 - Disk speed ... 30 rpm
 - Sweep frequency 20 times per minute
- Polisher conditions:
 - Platen speed ... 40, 60 and 80 rpm (matched to wafer speed)
 - Wafer pressure ... 3, 4 and 5 psi
 - Slurry flow rate ... 35 cc per minute
- Slurries:
 - Fujimi PL-4217 (fumed silica)
 - Experimental colloidal slurries from DuPont Air Products Nanomaterials, LLC



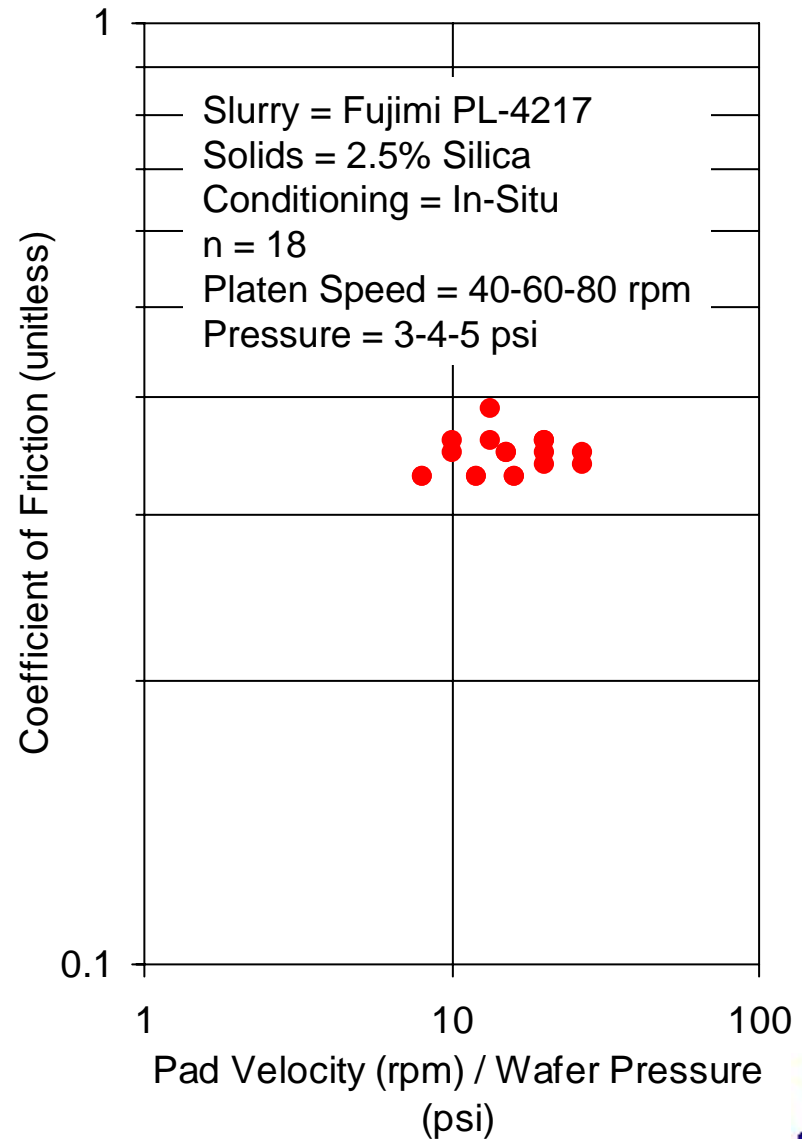
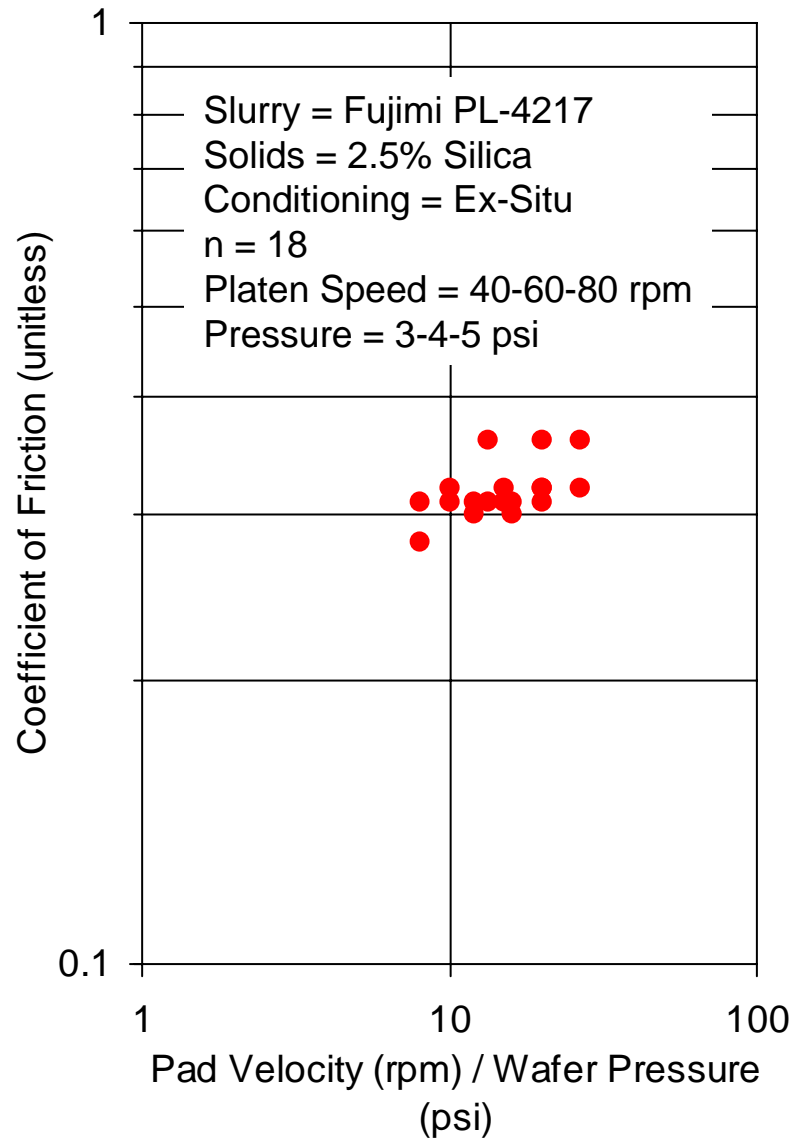
Stribeck Curve & Effect of Slurry Dilution



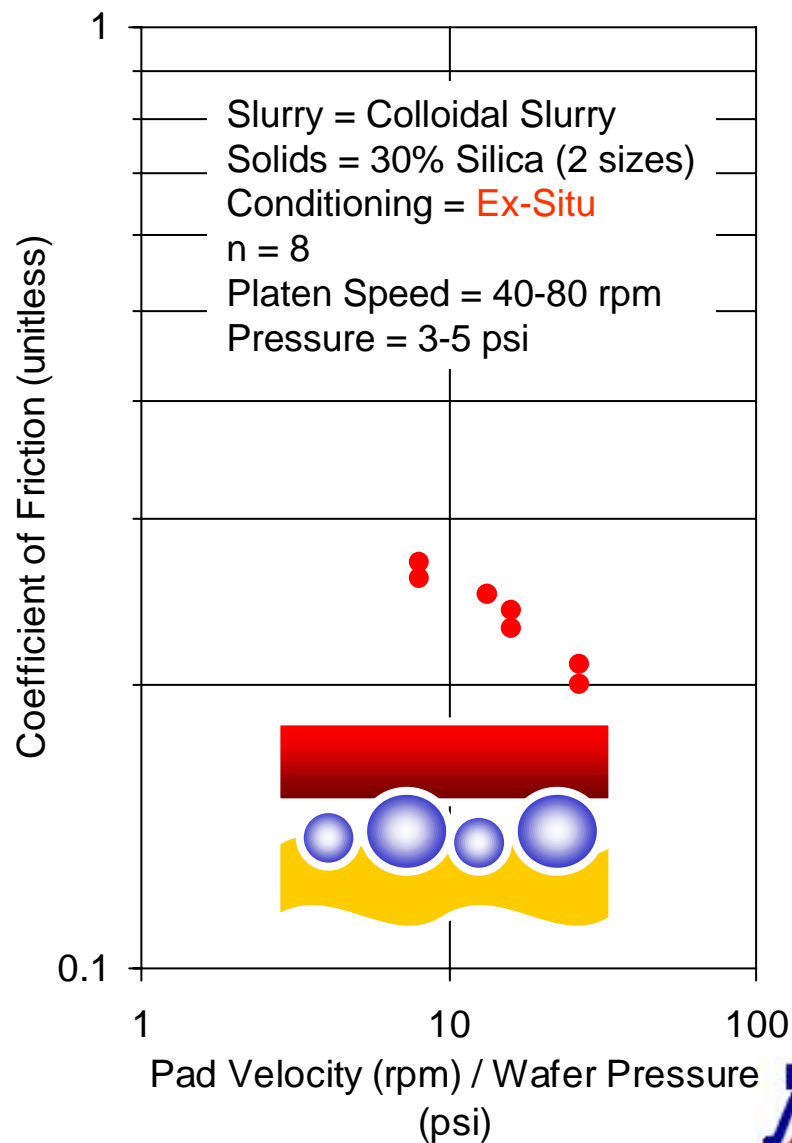
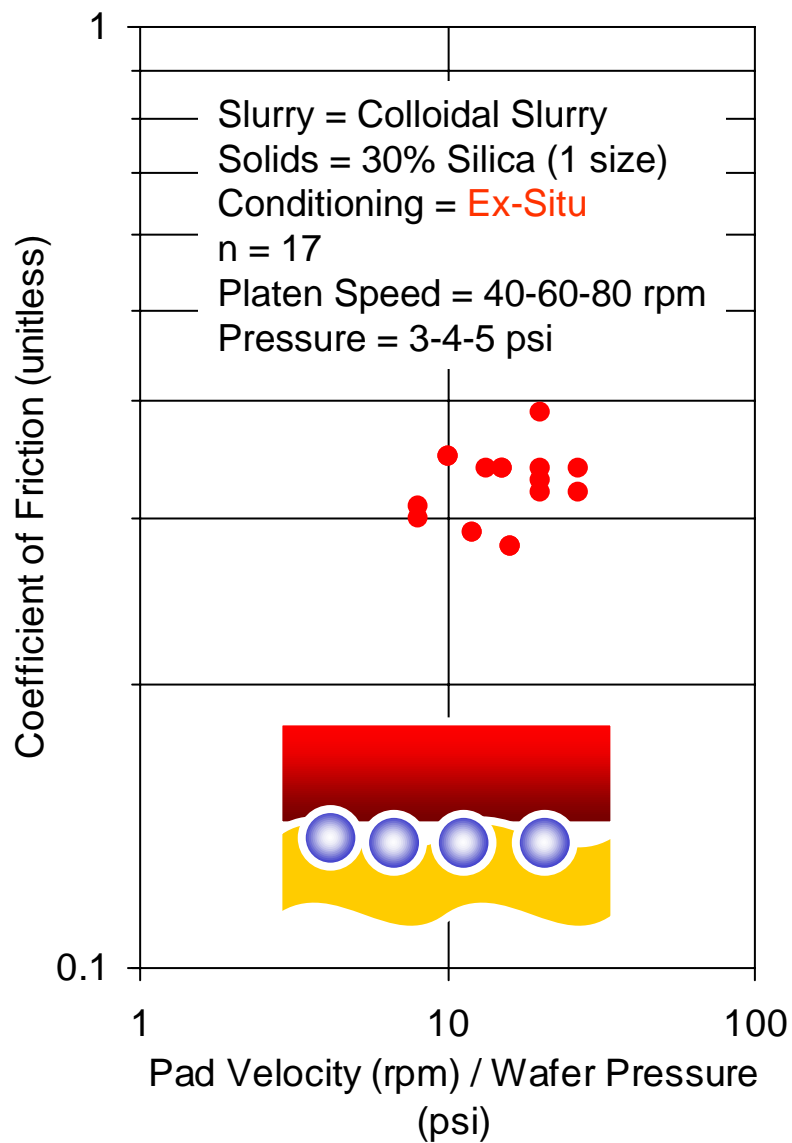
Comparing Results from Univ. of Arizona & Tufts



Effect of Conditioning Scheme



Mono-modal & Bi-modal Colloidal Abrasive Systems



Future Plans

- Verify that there is no difference between in-situ and ex-situ conditioning methods
- Study effect on COF of various:
 - Slurries
 - Pads
 - Pad groove shapes
 - Diamond grit sizes
 - Conditioning recipes
- Develop comprehensive tribological model which describes the above observations

