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Sandia National Laboratories

Tribochemically-Induced PDMS Crosslinking and Impact on Electrical Contact Resistance

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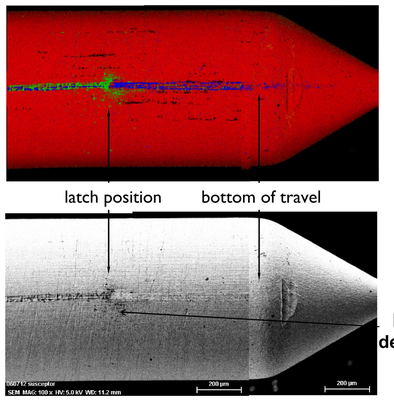
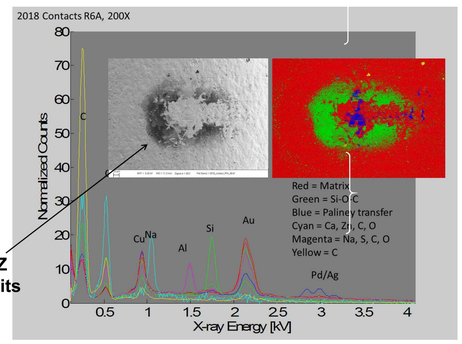
Problem

- Abnormal electrical contact resistance (ECR) behavior was exhibited during centrifuge testing of fluid-filled accelerometers
- SEM imaging indicated a low atomic number material on pins and contacts





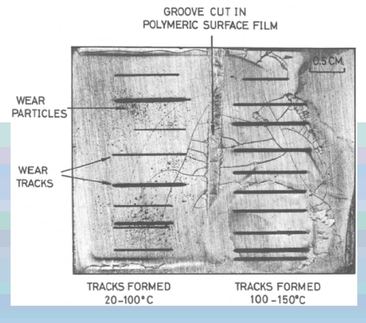
low Z deposits

atomic %

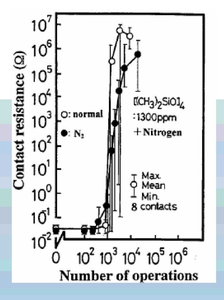
		Pd	Ag	Cu	Pt	Ni	Zn	Au
Pins	Paliney-6	39.8	33.9	24.2	0.5	1.6	0.01	NA
	Paliney-7	34.8	29.4	23.3	5.4	NA	1.6	5.4
Contacts	Neyoro-G	NA	6.0	33	6.3	NA	2.2	52.5

Approach

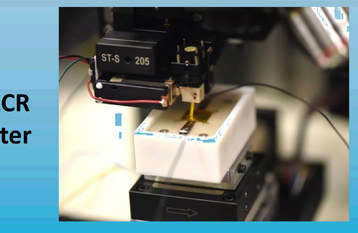
- Prior work indicated crosslinking on metal surfaces at T >100°C
- Thermal decomposition observed due to arcs in electrical switches
- Developed unique electrical contact nanotribometer to study material interactions under relevant conditions in the laboratory
- *Room temperature PDMS degradation was previously unknown*



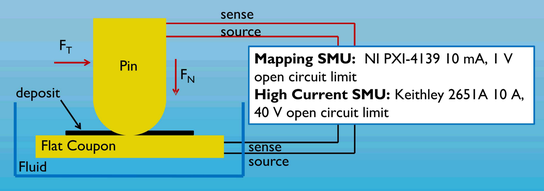
D. Tabor and R.F. Willis, *Wear* **13** (1969) p413



T. Tamai, *Proc. IEEE Holm Conference*, 2006



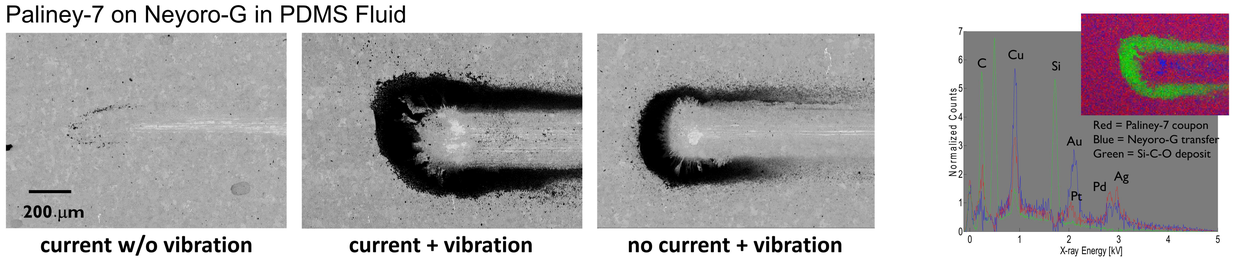
Sandia ECR Tribometer

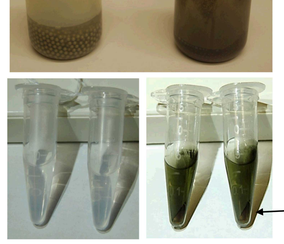


Results

- Discovered that electric current is not required for deposit formation
- Isolated a sample of deposit for characterization by Nuclear Magnetic Resonance (NMR); led to identification of the reaction sequence
- Identified an alternative fluid resistant to degradation and crosslinking

Paliney-7 on Neyoro-G in PDMS Fluid

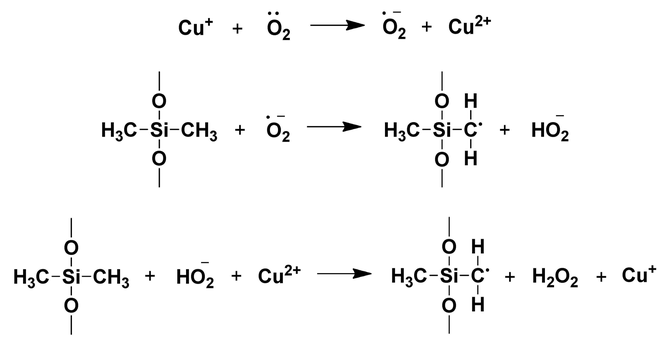


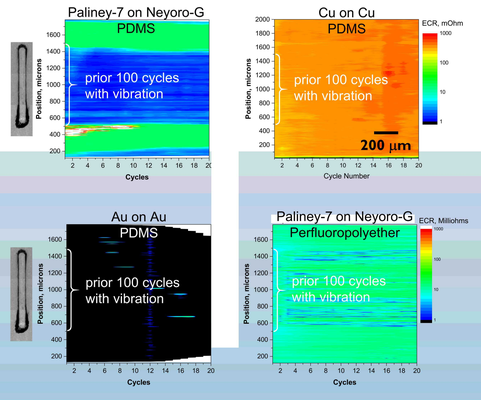


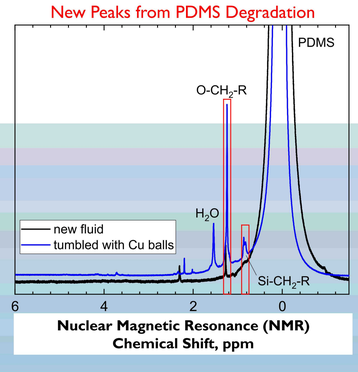
"Tumble Test" to generate sufficient product for analysis by NMR

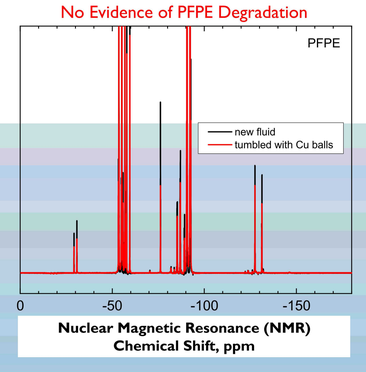
Concentrated Reaction Product

Reaction Sequence









Summary

- A previously unknown material incompatibility was discovered
- Sliding of Cu-containing contacts in PDMS fluid catalyzes the formation of an insulating deposit at room temperature
- Damping fluids with alternative chemistry prevent deposit formation

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