

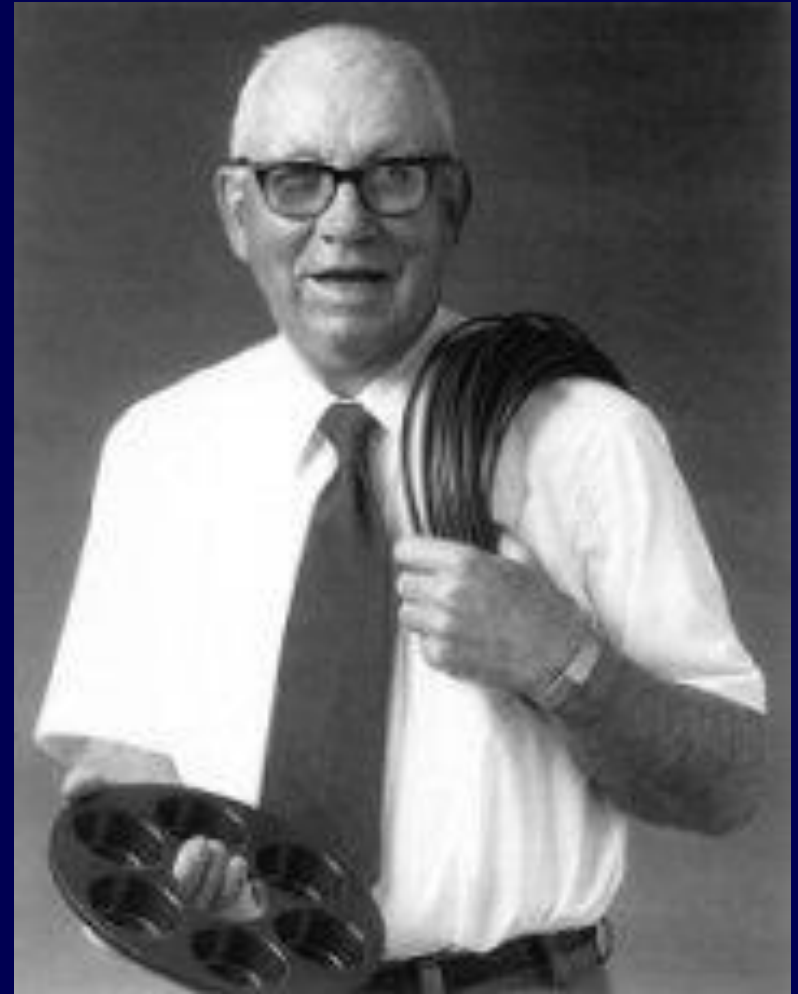
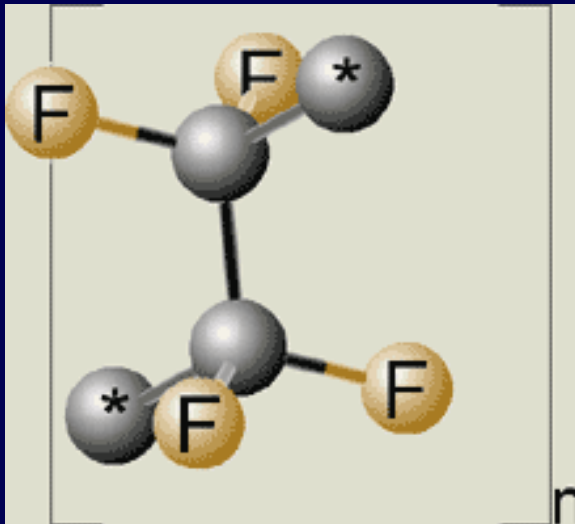
Teflon

Can we do better?

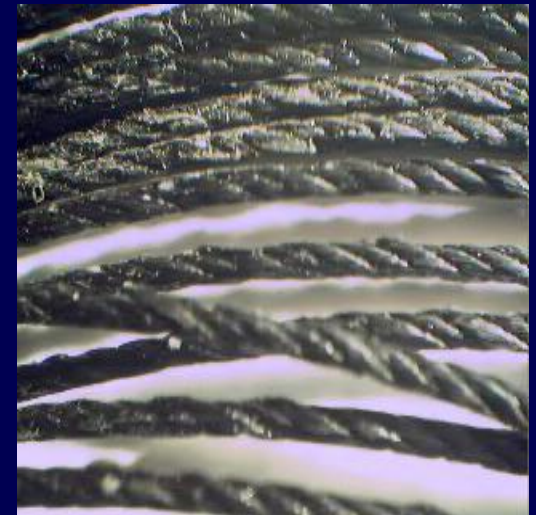
에코융합섬유연구원
이수진

1938: Dupont Research Labs

- Dr. Roy Plunkett —————> accidentally discovers Teflon.
- A.K.A. PTFE -
Polytetrafluoroethylene



Uses of Teflon

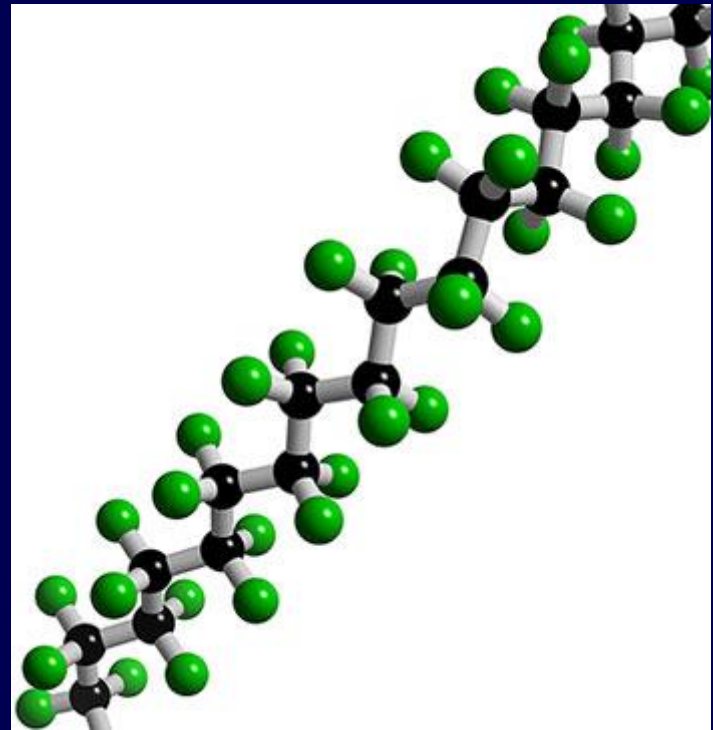


Benefits of Teflon

- Non-stick, **hydrophobic** (water-repellant) surface
- Efficiently, commercially manufactured
- Chemically inert
- Extremely versatile; can be used in numerous applications

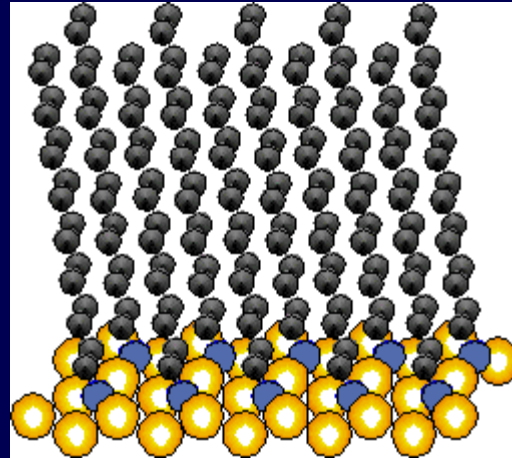
Problems with Teflon

- Only forms **physical** bonds
- Wears away over time
- Is a **Carcinogen**



Our Alternative: ODPA

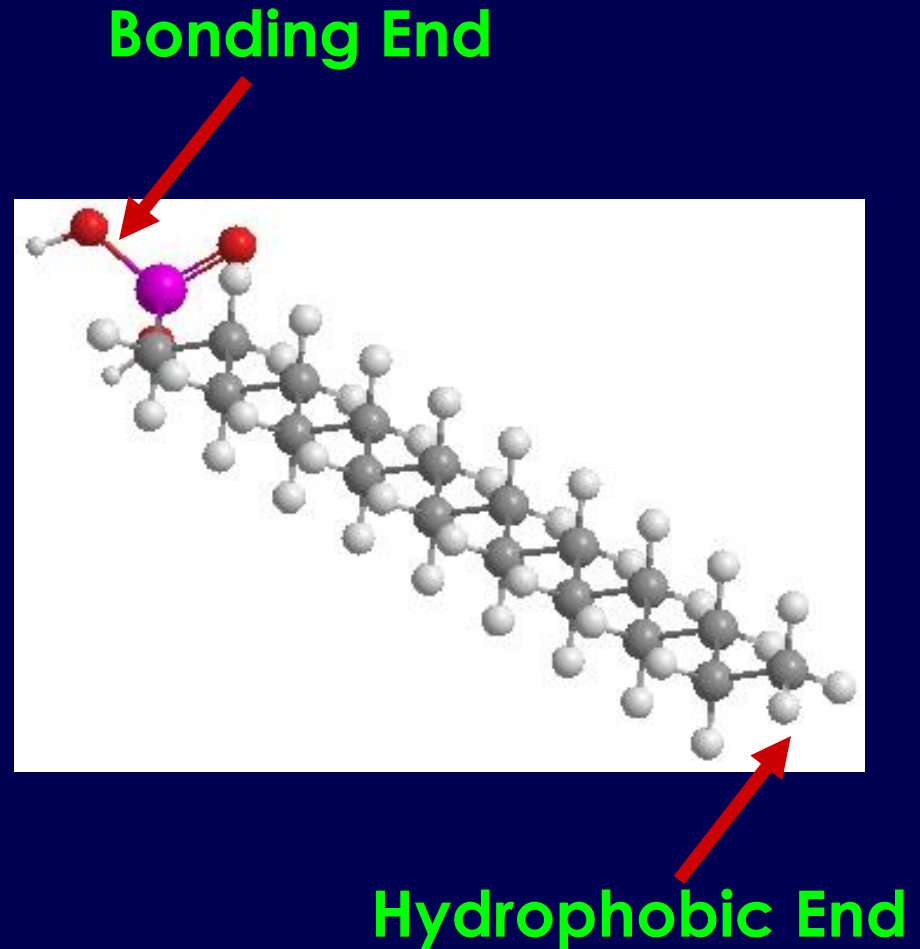
- Self-assembled monolayer (SAM)



- Chemically bonded
- Stays on indefinitely
- Environmentally friendly (non-carcinogenic)

Octadecylphosphonic Acid

- ODPA is an excellent substitute for Teflon
- Has all of benefits and none of the drawbacks.



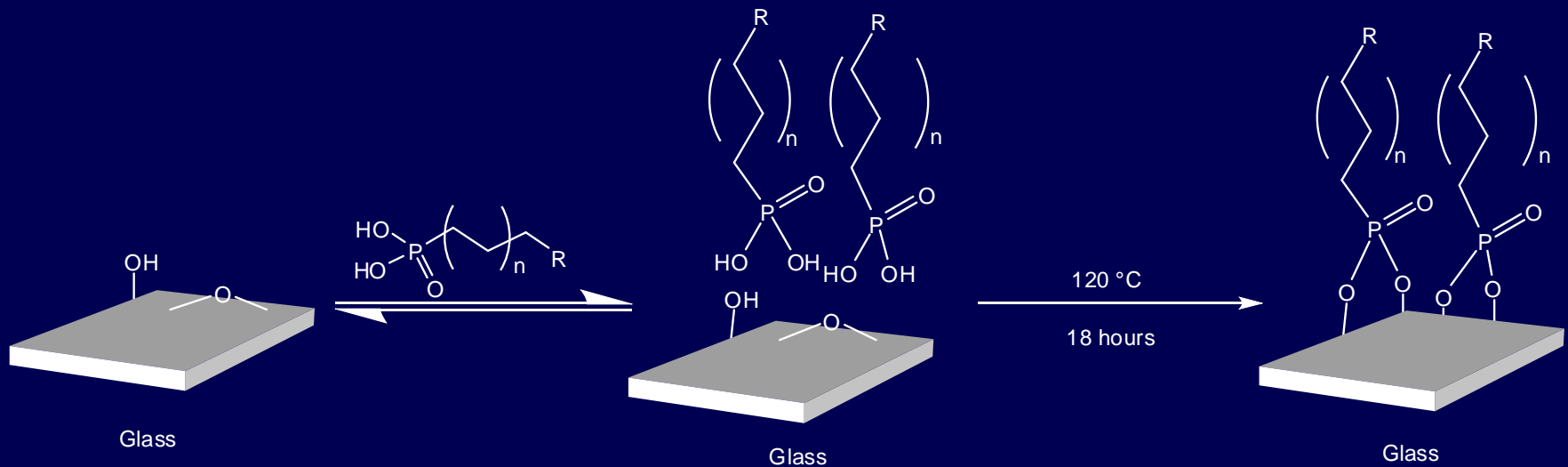
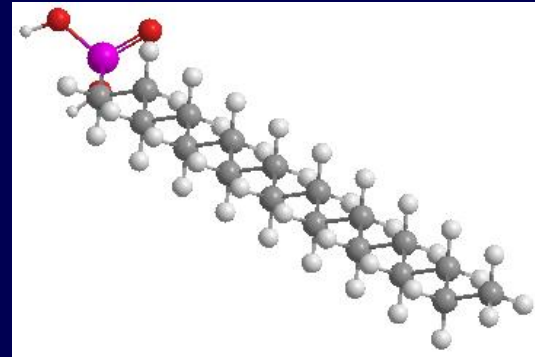
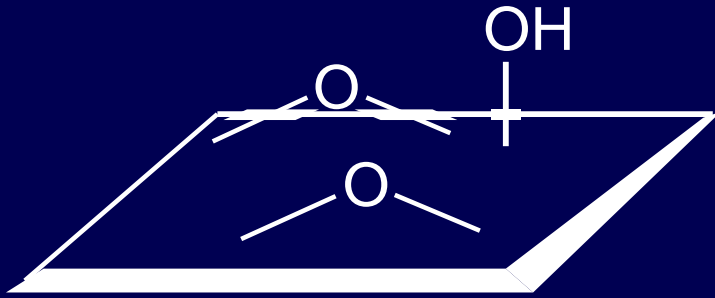
Our Goal

- Develop a viable Teflon substitute (ODPA)
- **Improve** efficiency of application of ODPA to an oxide surface

Physical vs. Chemical Bonding

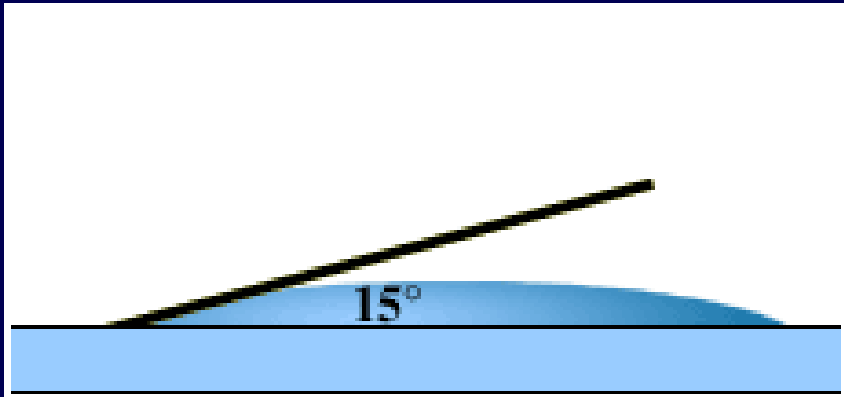
- Physical bond:
 - Electrostatic attraction to surface
 - Can be removed
- Chemical bond:
 - Actual covalent bond to surface
 - Cannot be removed

Bonding of ODPA to Oxide Surface

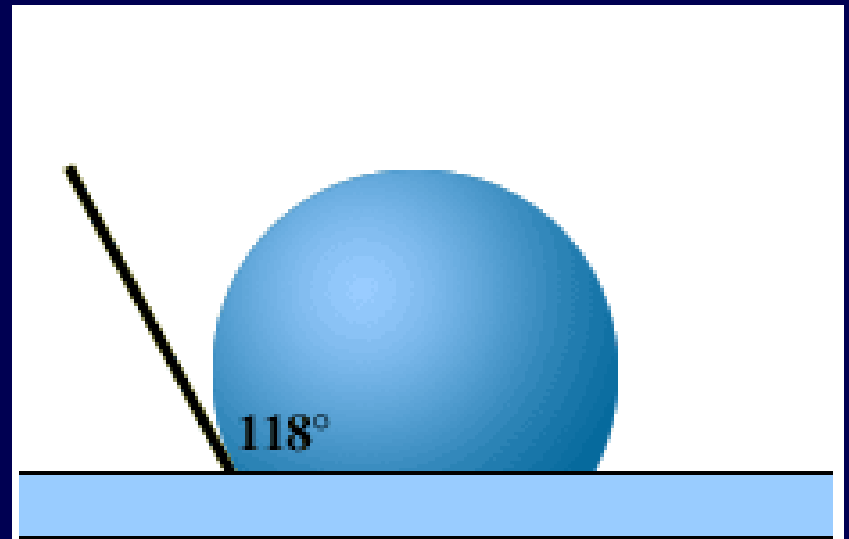


What is Contact Angle?

Highly Hydrophilic:



Highly Hydrophobic:



Our goal

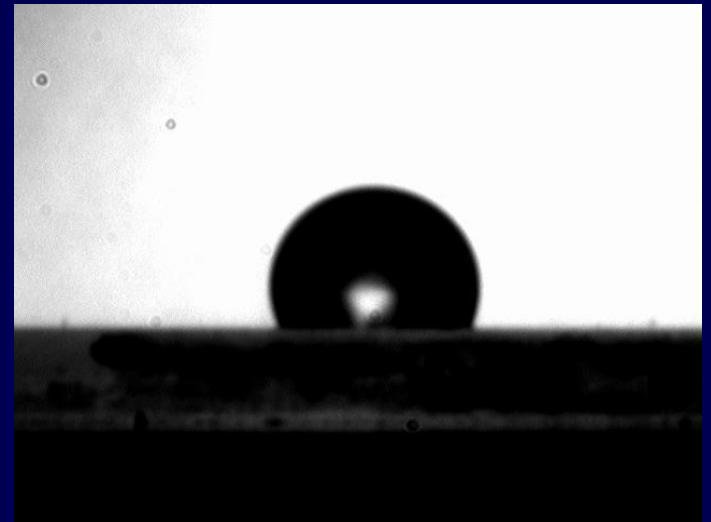


Measuring Contact Angle



<http://www.ramehart.com/goniometers/>

Contact Angle Goniometer



Large contact angle we observed

“The Gold Standard”

- **T-BAG** (Tethering by Aggregation and Growth)
 - Substrate immersed in ODPA solution
 - Evaporate for 24 hrs
- Oven for dehydration
 - 48 hrs at 120 degrees C
- What's the problem? It takes **too long**

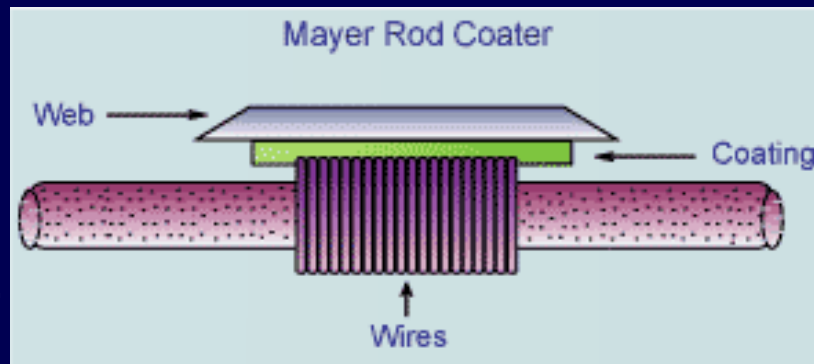
Alternate Coating Methods



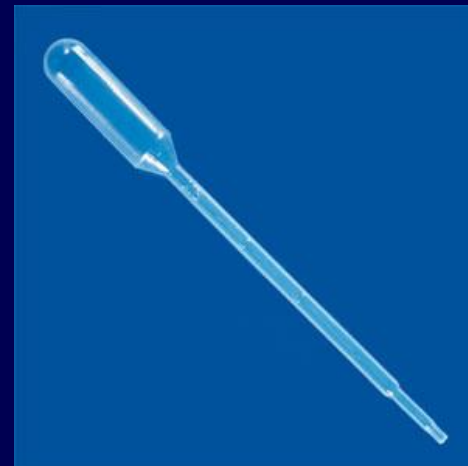
Spray



Drain



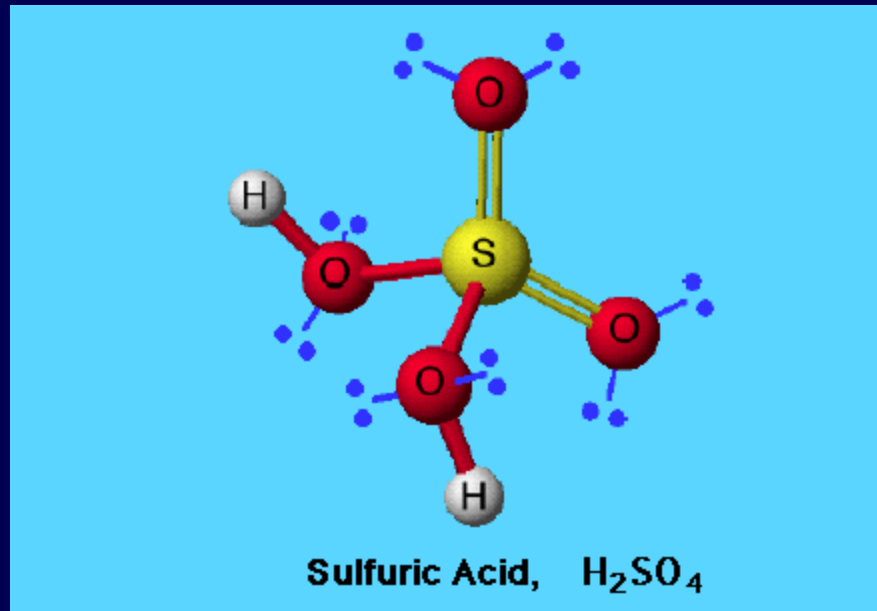
Mayer Rod



Pipet

Acid Pre-Treatment

- Hypothesized that it might corrode the surface
- Increases number of ODPA bonding sites



Dehydration Methods

<http://www.ogormans.co.uk>



Microwave

www.androv-medical.com



Infrared



Ultraviolet

www.sks-bottle.com



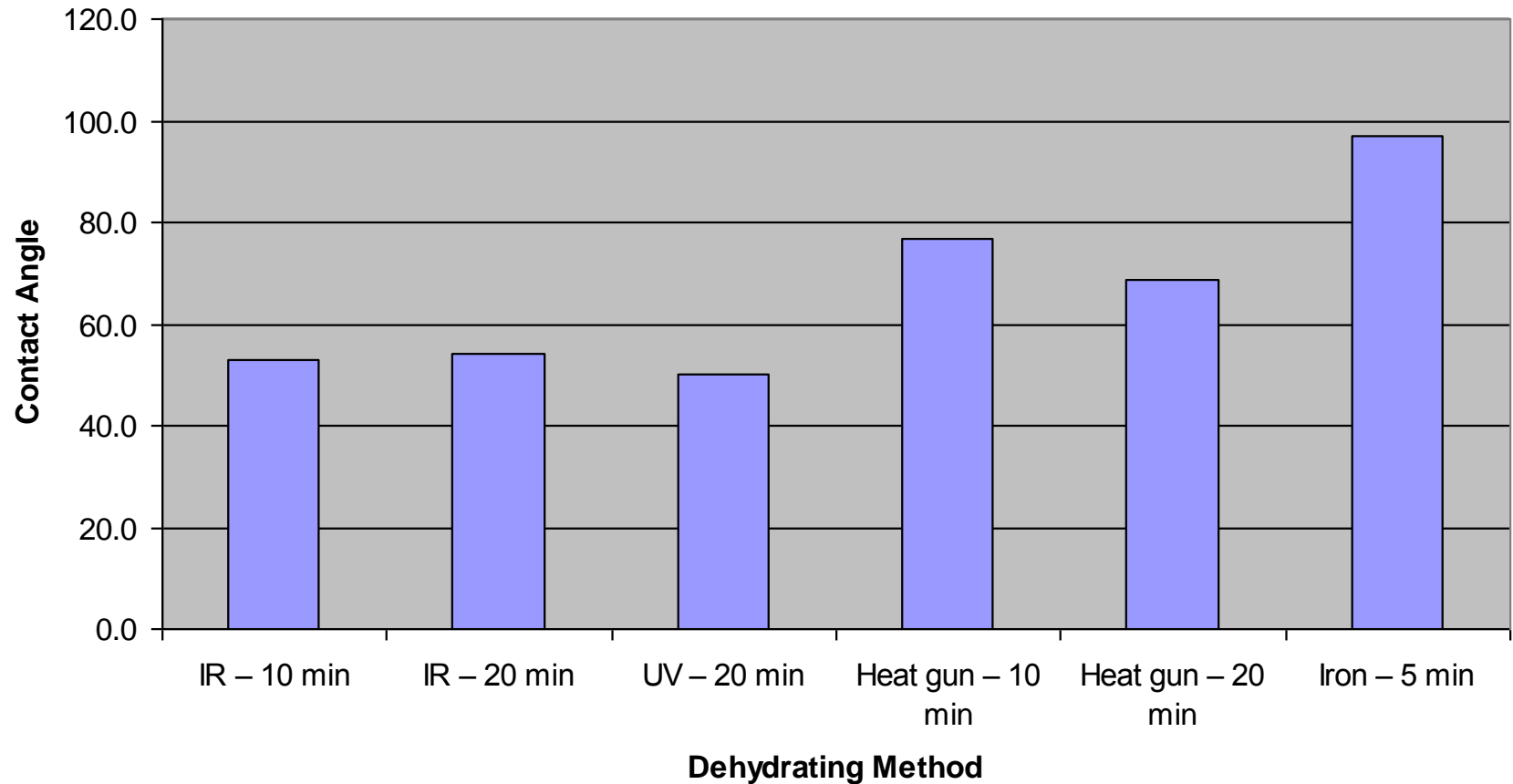
Heat Gun



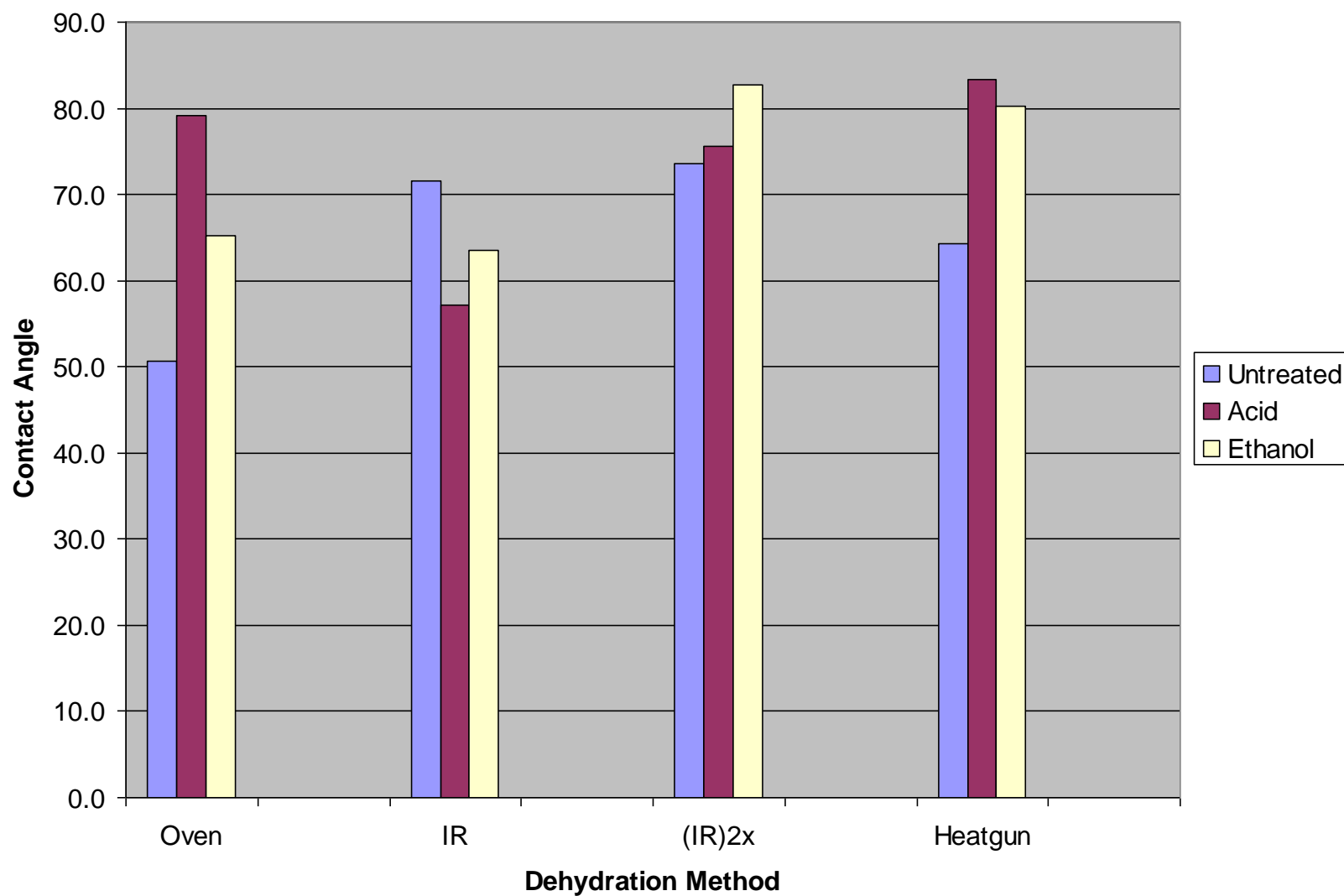
Iron

Our Results Say...

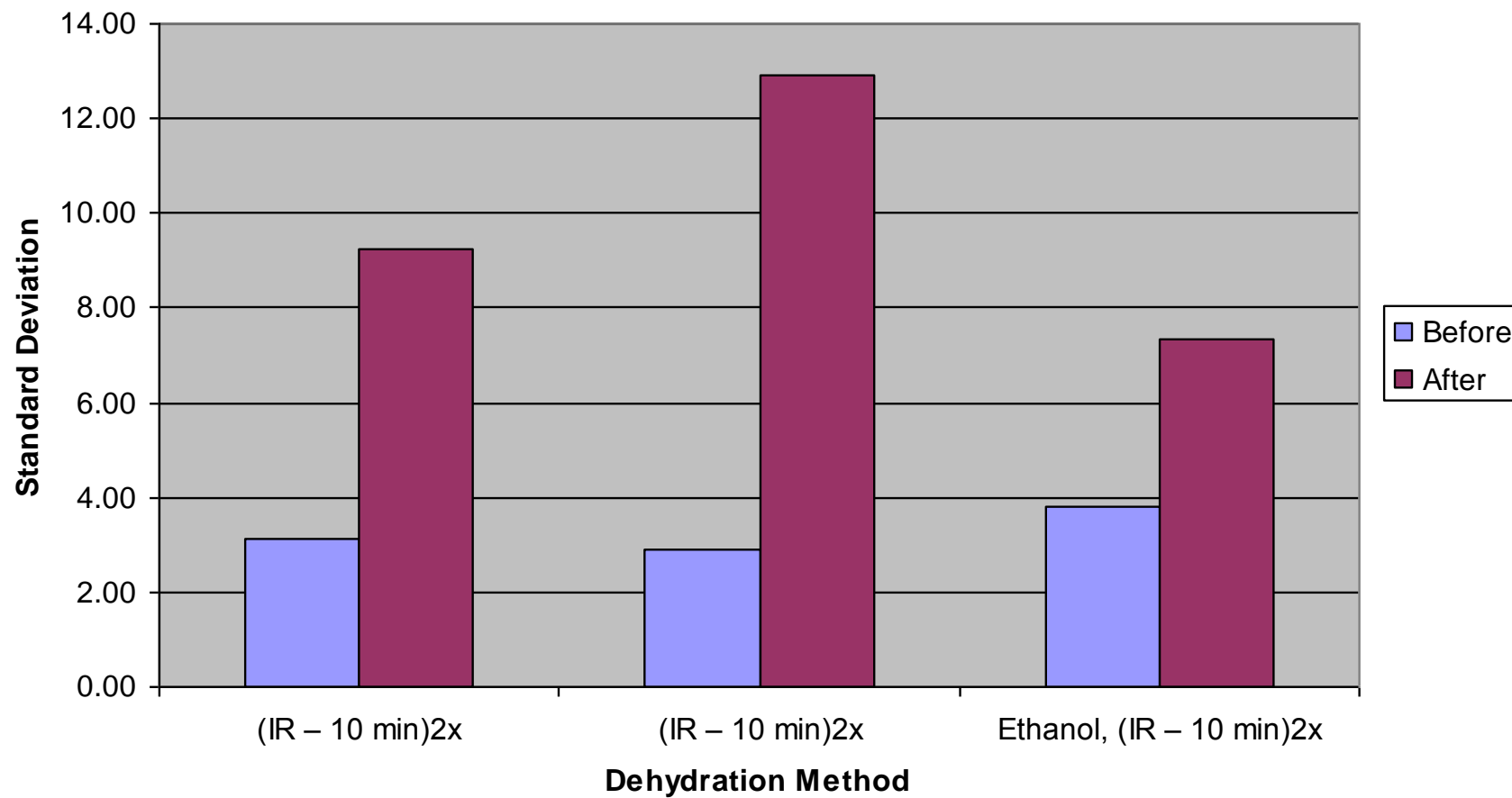
Contact Angle vs. Dehydrating Methods: Drain (15 min)



Average Contact Angle: Mayer Rod



Inconsistency of Coating Before and After Soaking



Discussion/Conclusions

- Application method
 - Drain, Drop, Mayer Rod
- Chemical bonding method – Iron
- Pre-treatments inconsistent
- Multiple repetitions good
- Sample size and consistency

What's in Store for the Future?

- Continue work with ODPA to coat glass, plastics, and metals (e.g. Ti replacements)
- Try fluoronating the phosphonic acid
- Used **VMD** (Visual Molecular Dynamics) to simulate SAMs

The Bottom Line...

Our results offered potential promise
as an industrially plausible
replacement for Teflon, with low
toxicity and high hydrophobicity.

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We'd like to thank...

NJGSS

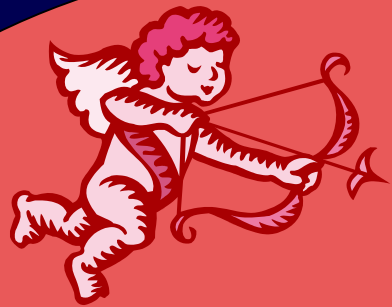
Dr. David Miyamoto

Dr. Paul Quinn

Dr. Michael Avaltroni

Dr. Gloria Anderle

Mr. and Mrs. John Overdeck



Jeremy
Tang



And who can forget..