

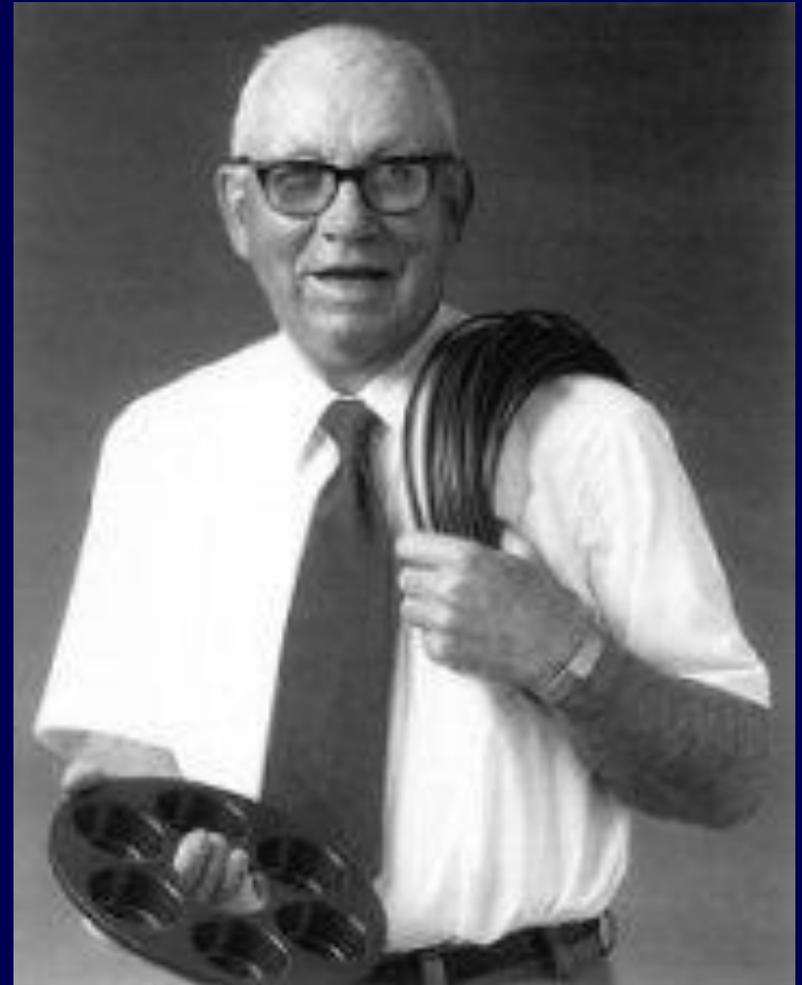
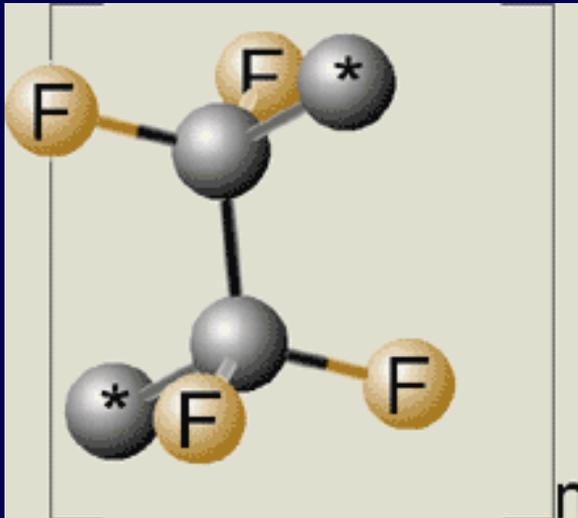
# Teflon

Can we do better?

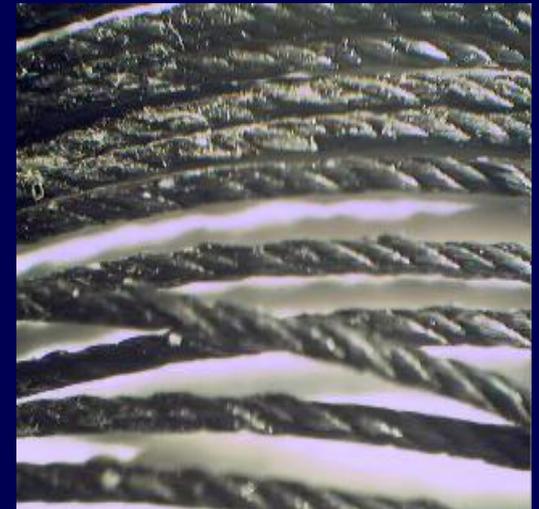
에코융합섬유연구원  
이수진

# 1938: Dupont Research Labs

- Dr. Roy Plunkett → accidentally discovers Teflon.
- A.K.A. PTFE - **Polytetrafluoroethylene**



# Uses of Teflon

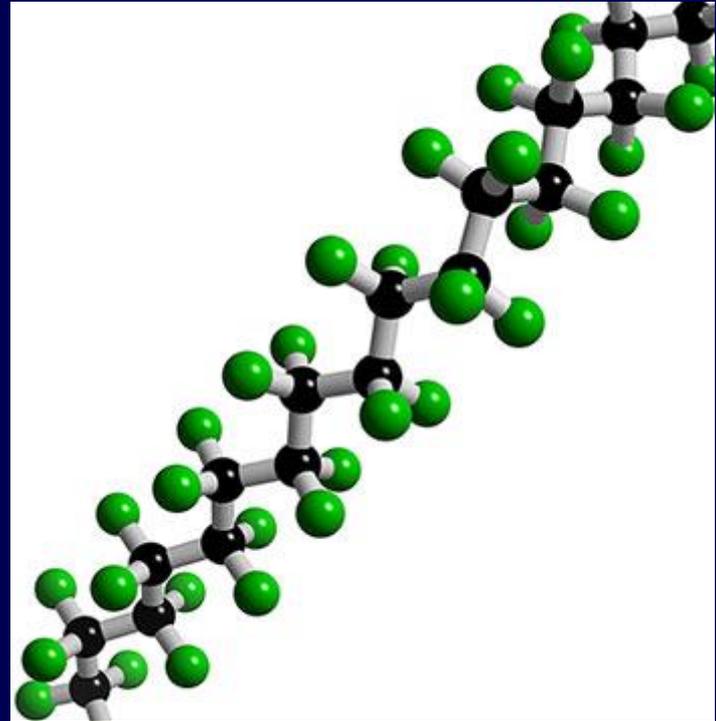


# Benefits of Teflon

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

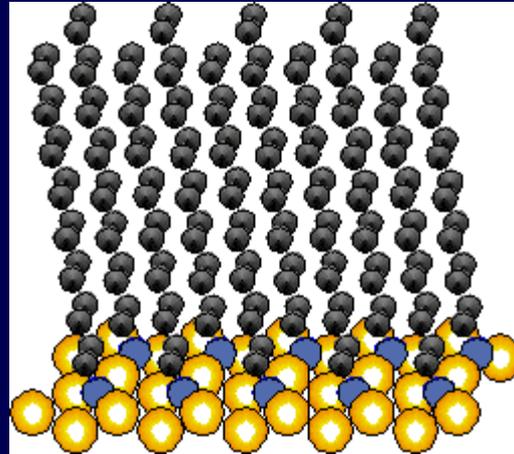
# Problems with Teflon

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



# Our Alternative: ODPA

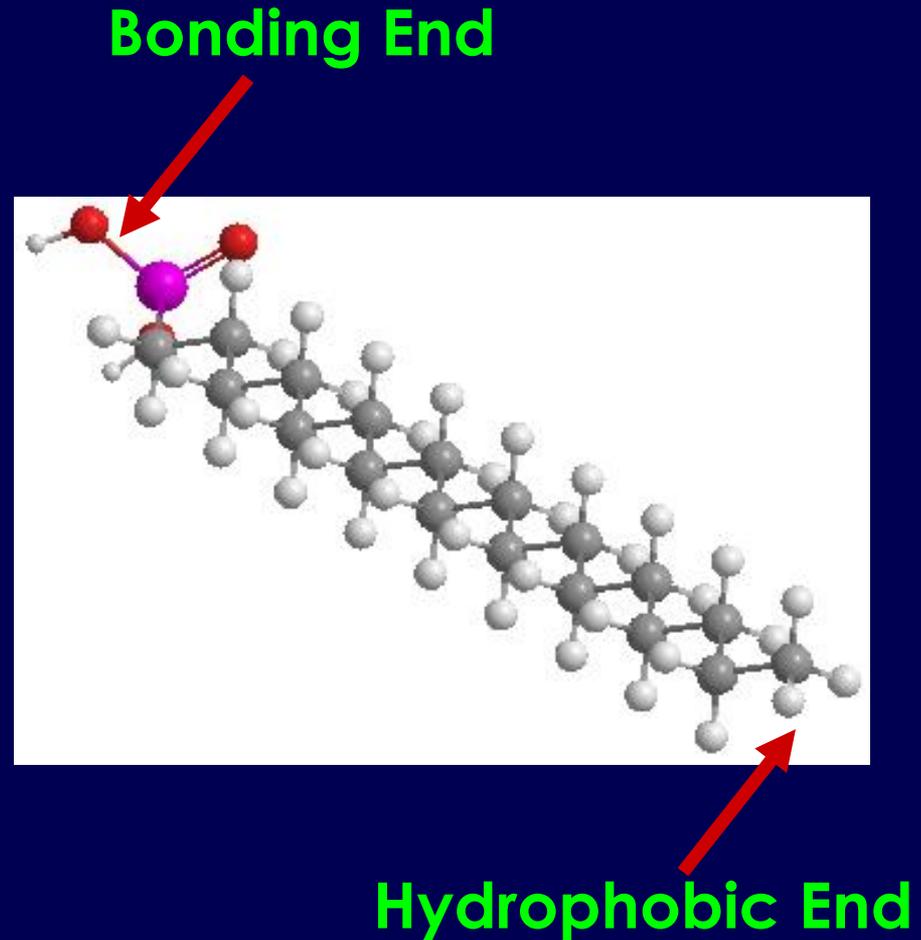
- Self-assembled monolayer (SAM)



- 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.



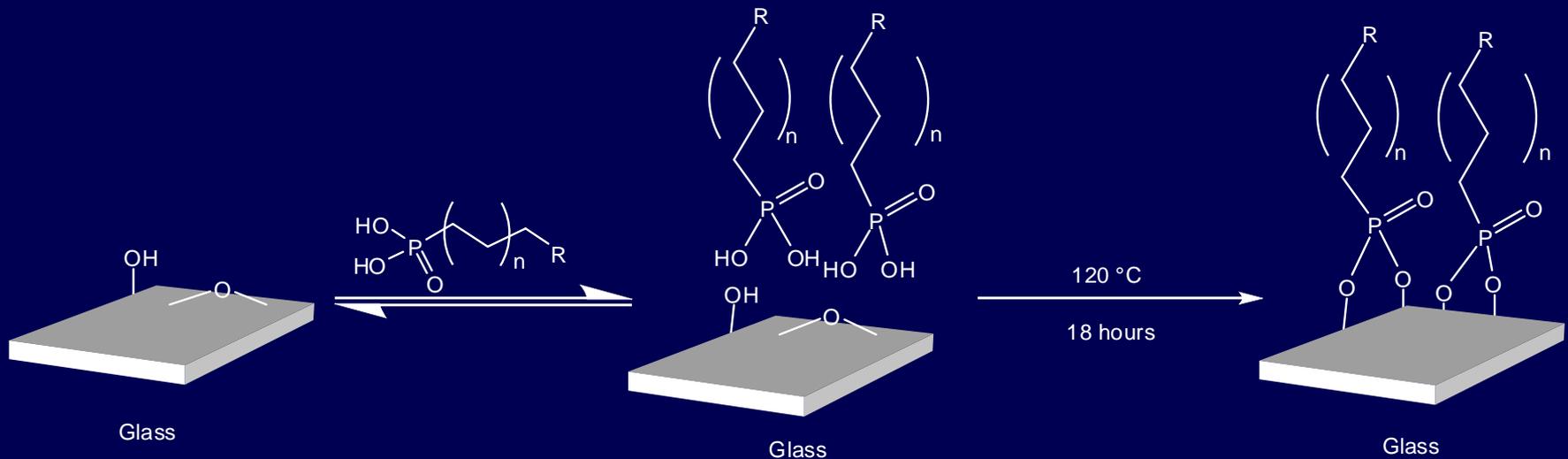
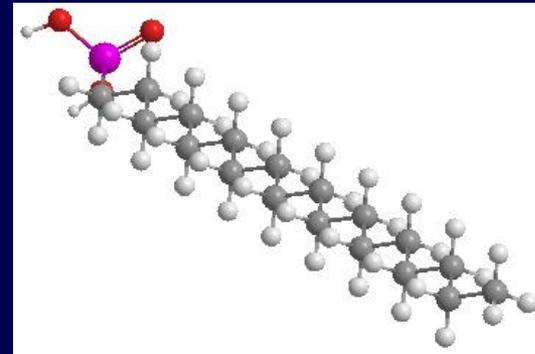
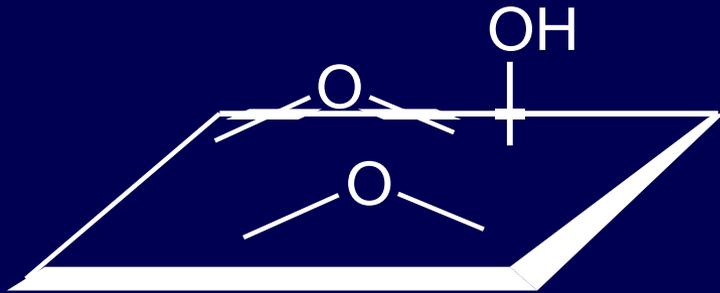
# Our Goal

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

# Physical vs. Chemical Bonding

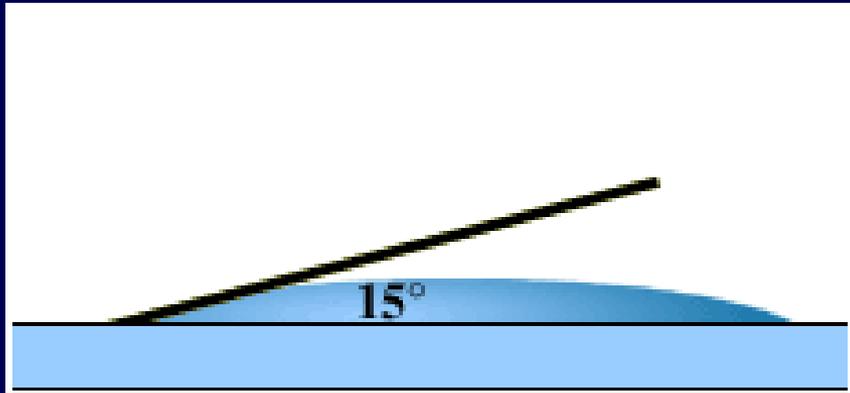
- **Physical bond:**
  - Electrostatic attraction to surface
  - Can be removed
- **Chemical bond:**
  - Actual covalent bond to surface
  - Cannot be removed

# Bonding of ODPA to Oxide Surface

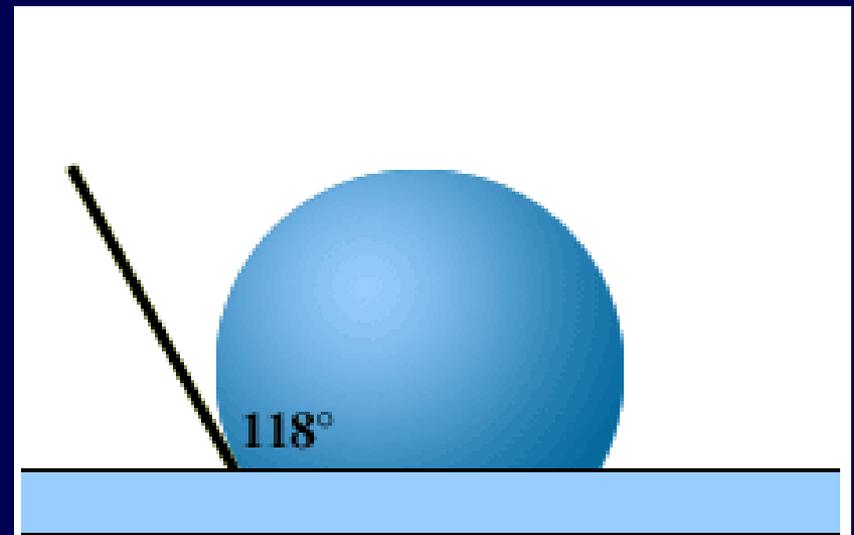


# What is Contact Angle?

Highly Hydrophilic:



Highly Hydrophobic:



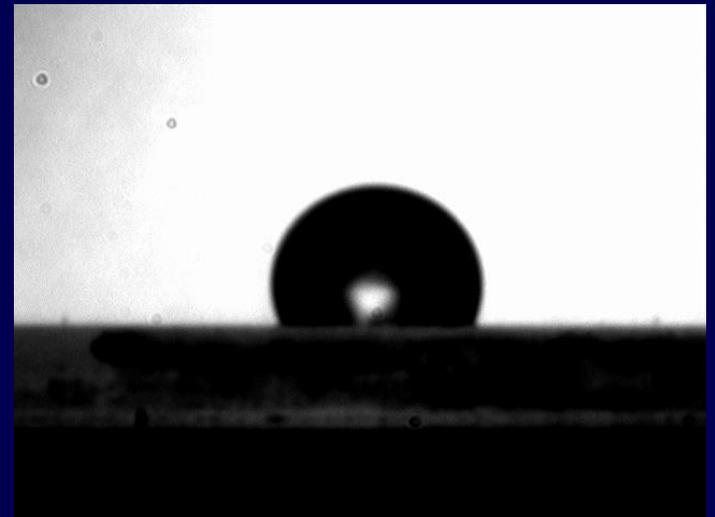
Our goal  $\longrightarrow$

# 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**

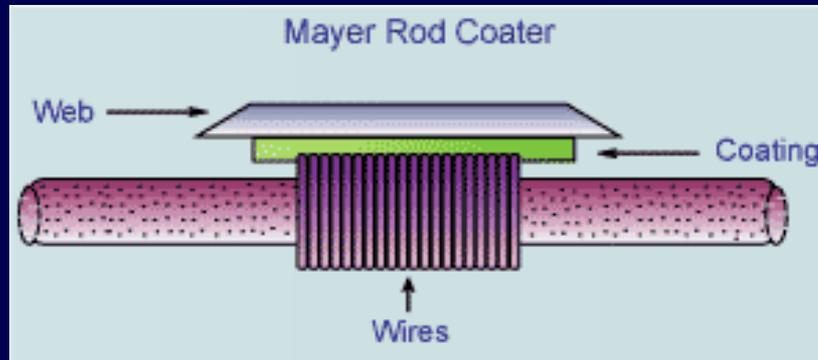
# Alternate Coating Methods



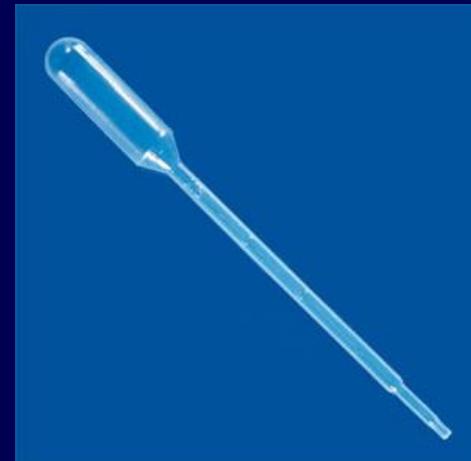
Spray



Drain



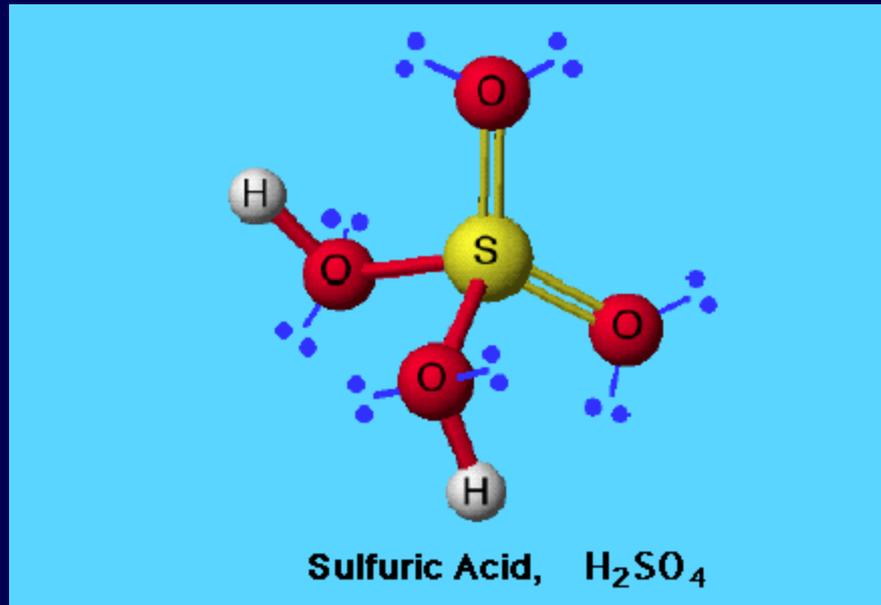
Mayer Rod



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](http://www.androv-medical.com)



Infrared



Ultraviolet

[www.sks-bottle.com](http://www.sks-bottle.com)



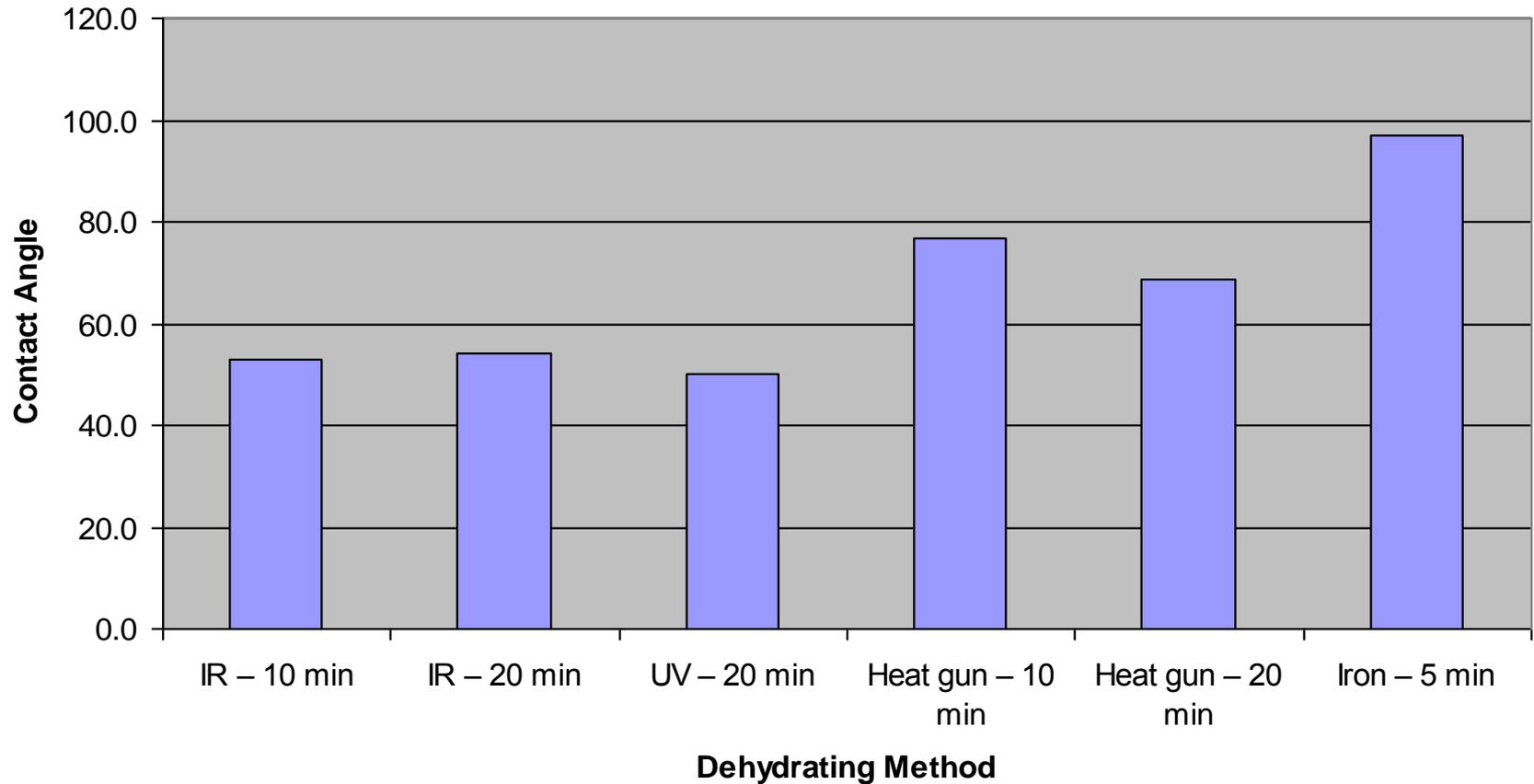
Heat Gun



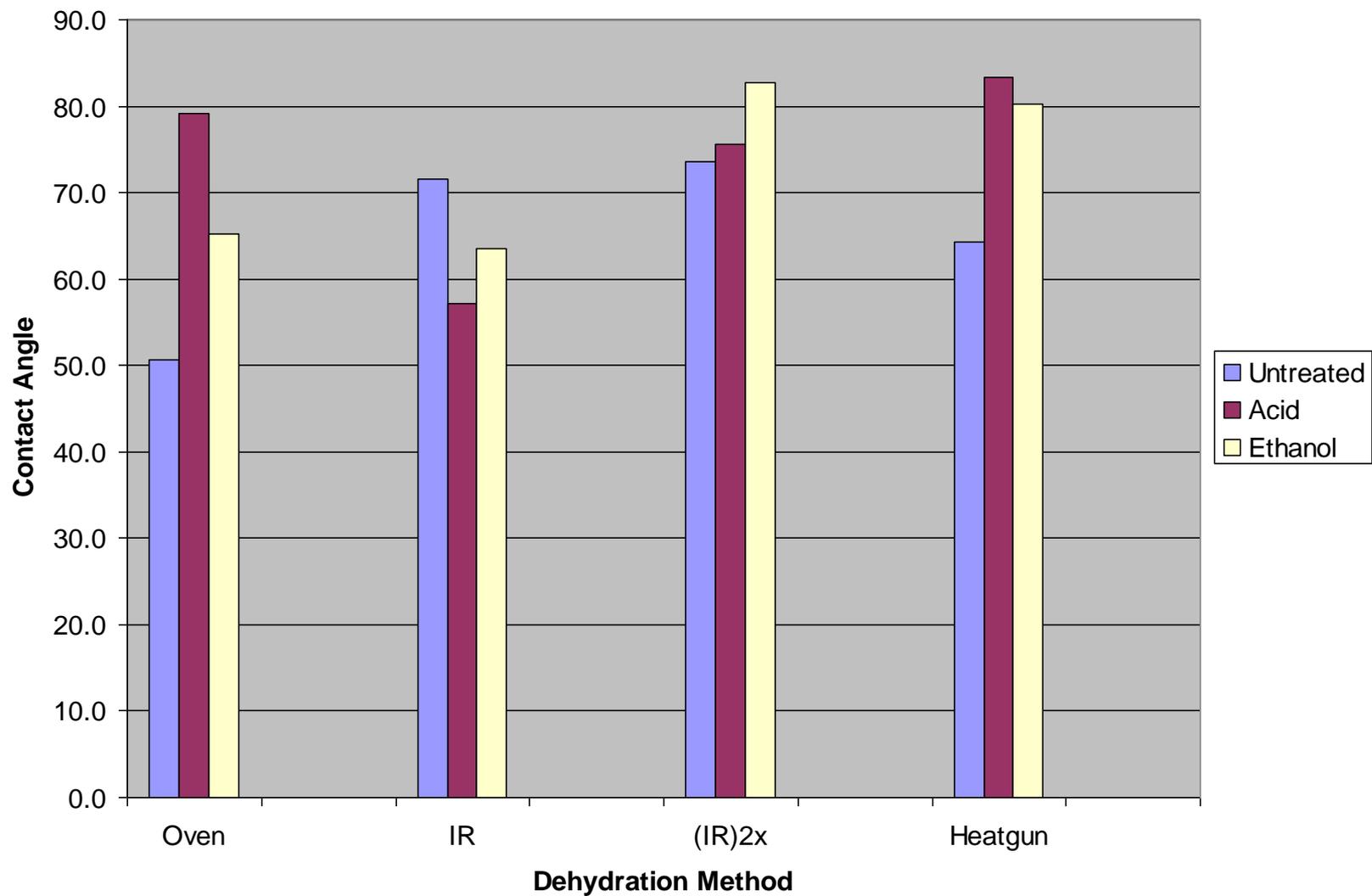
Iron

# Our Results Say...

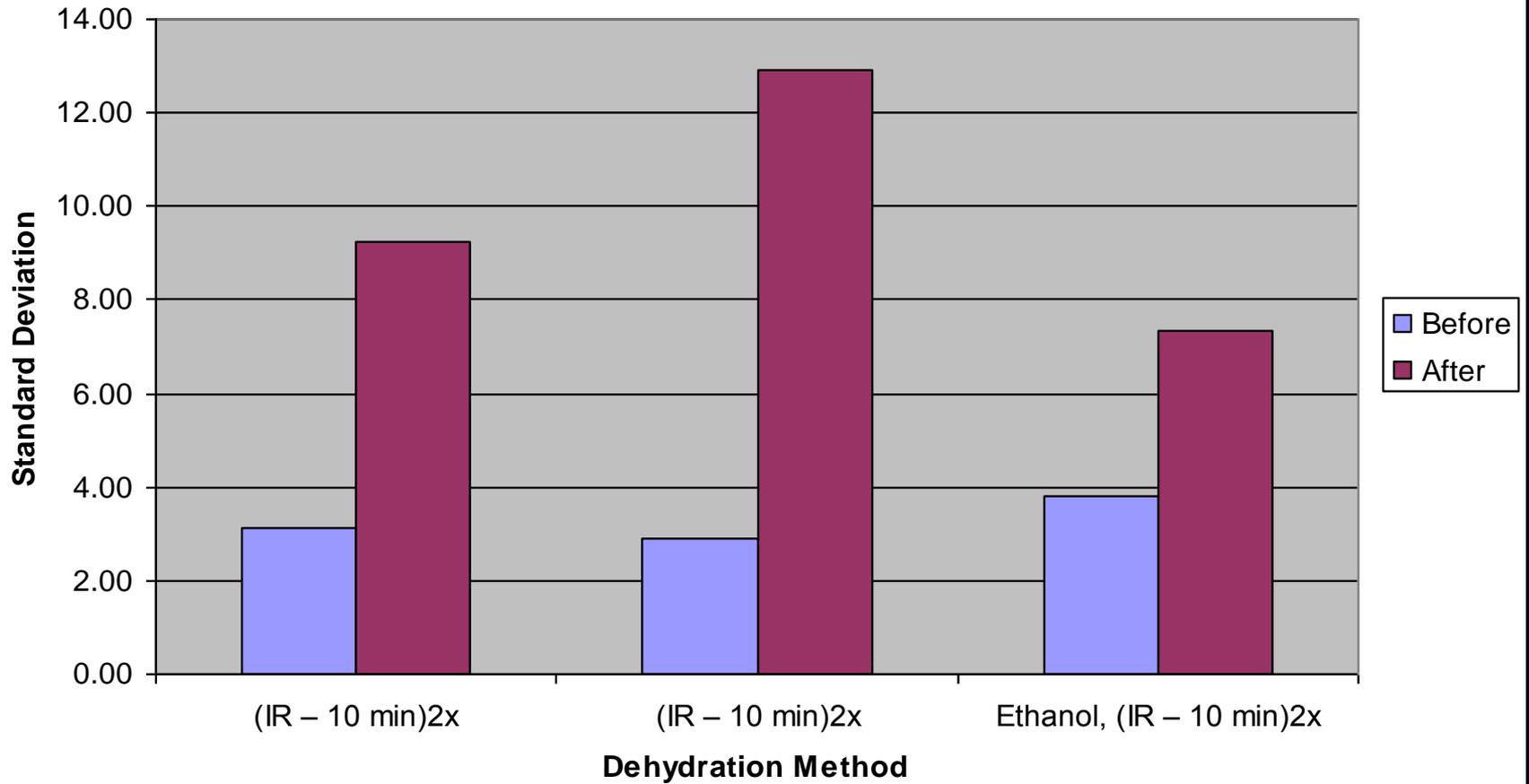
Contact Angle vs. Dehydrating Methods: Drain (15 min)



## 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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Jeremy  
Tang



And who can forget..