

Effect of Hydrophobic Pretreatment on Type III Aluminum Anodized Surfaces

Caroline Houston, Dean Yost, Young Jo Kim

Department of Chemical Engineering,
University of New Hampshire, Durham NH, 03824

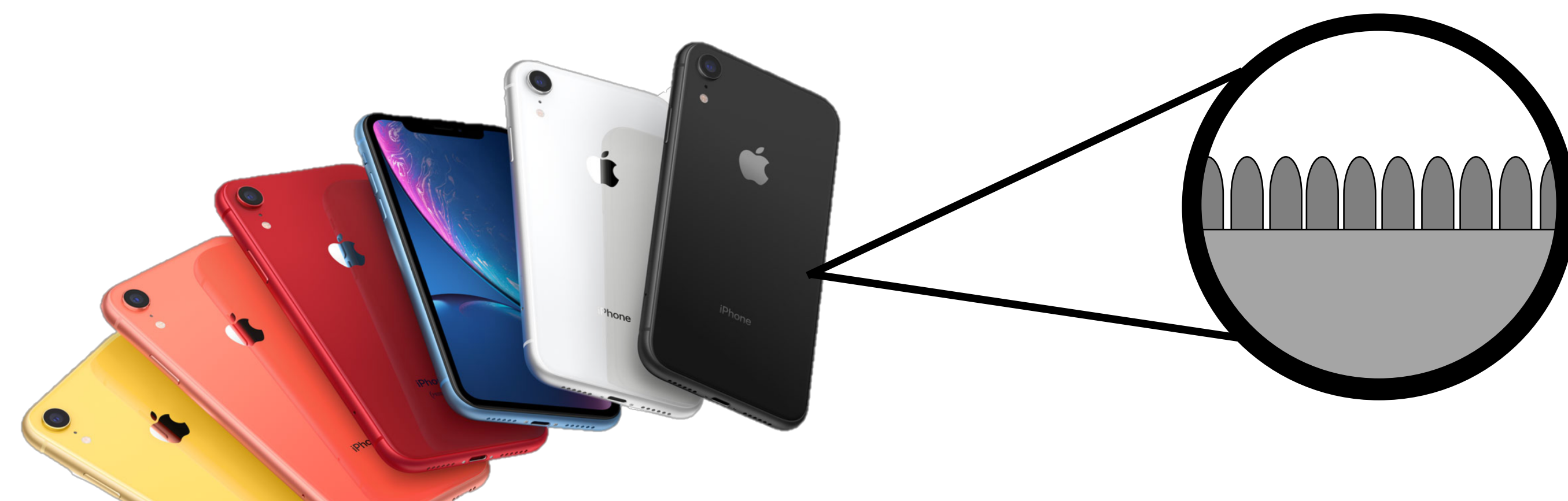


Abstract

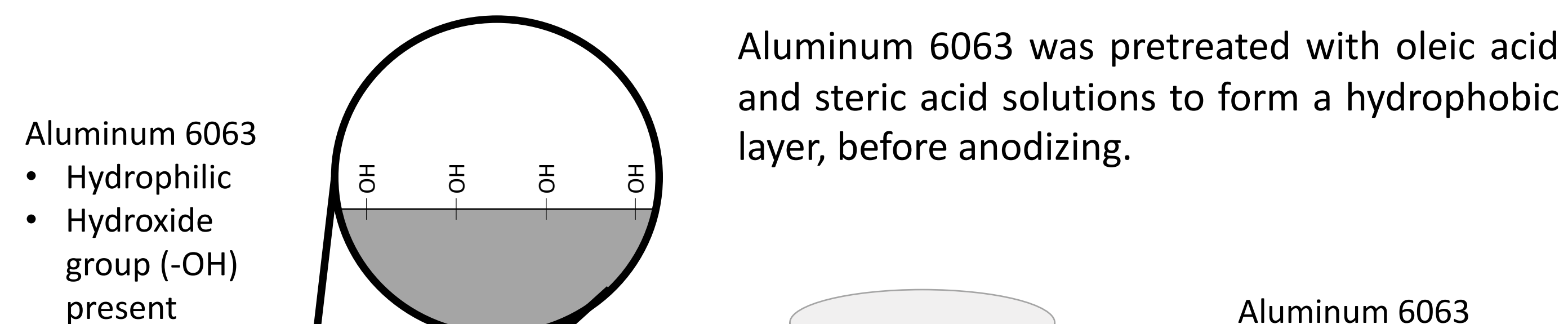
Anodizing has become a very popular method to make corrosive resistance and durable coatings on metals. Among much research, hydrophobic pretreated alumina has shown positive results towards creating corrosive resistant alumina coatings. Hydrophobic pretreated alumina T6-6063 were anodized in sulfuric acid at low temperatures and constant current density. Steric acid and oleic acid were utilized as pretreatments due to their hydrophobic abilities- improving corrosion resistance and durability of hard-anodized alumina. Initial tests showed positive results for anodized coatings pretreated with oleic acid and steric acid. The corrosion properties for the T6-6063 samples were observed with Tafel plots. Hydrophobic properties of the anodized layer was confirmed with contact angle measurements. Mechanical tests were carried out to determine durability of the anodized layer. Additional research in this field could improve products with high wear and tear and/or harsh environmental exposure such as hand-held devices as well as cooking and cleaning products.

Aluminum Anodizing

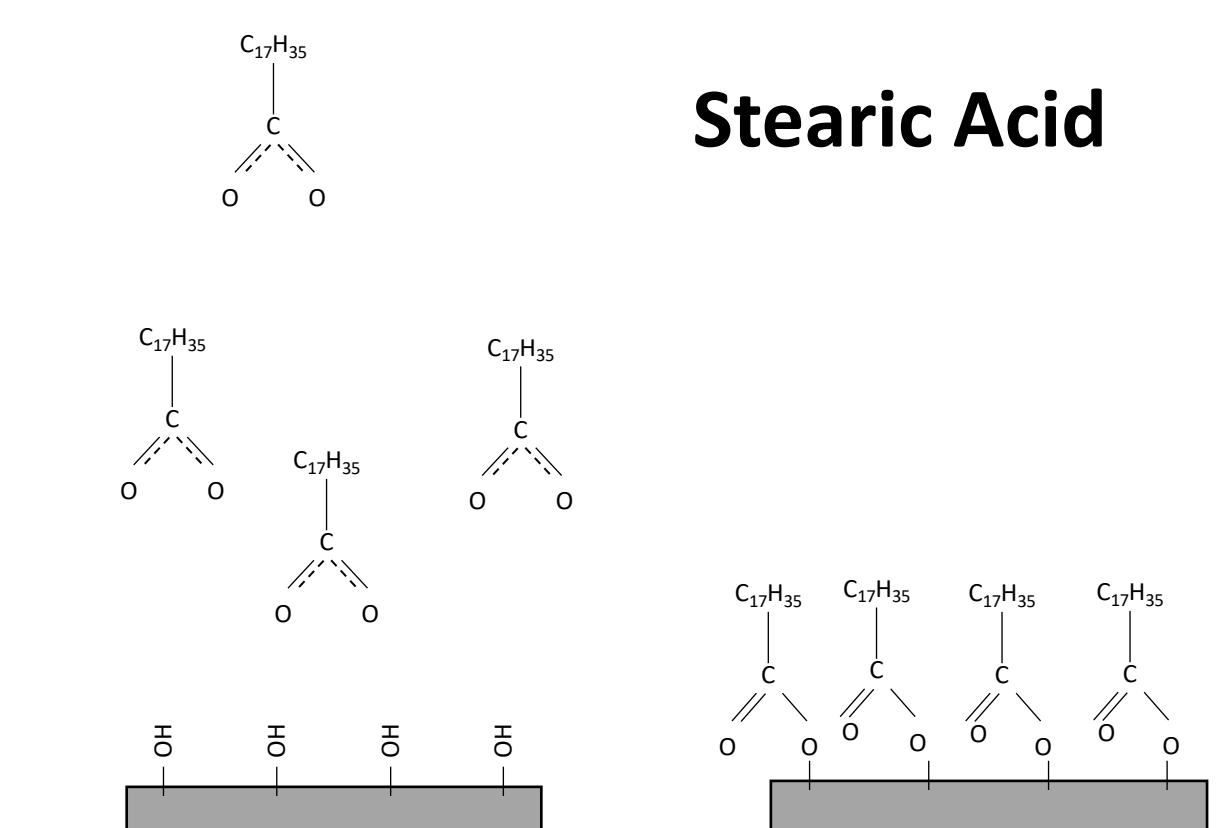
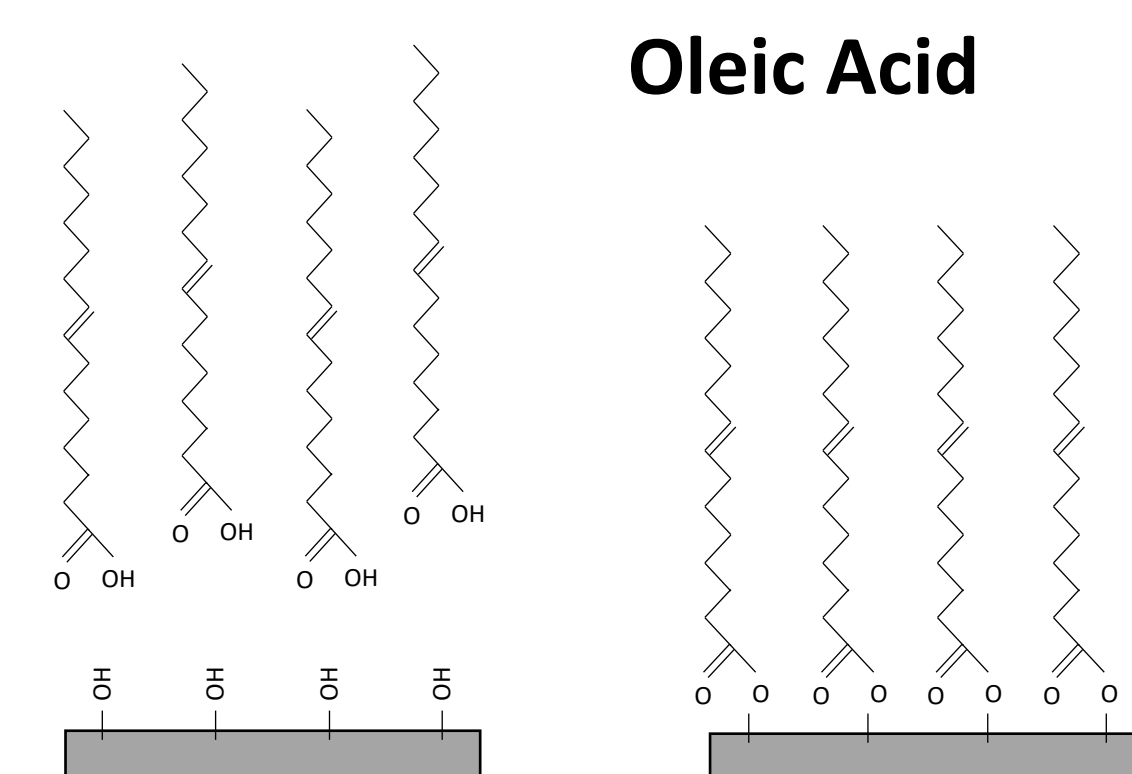
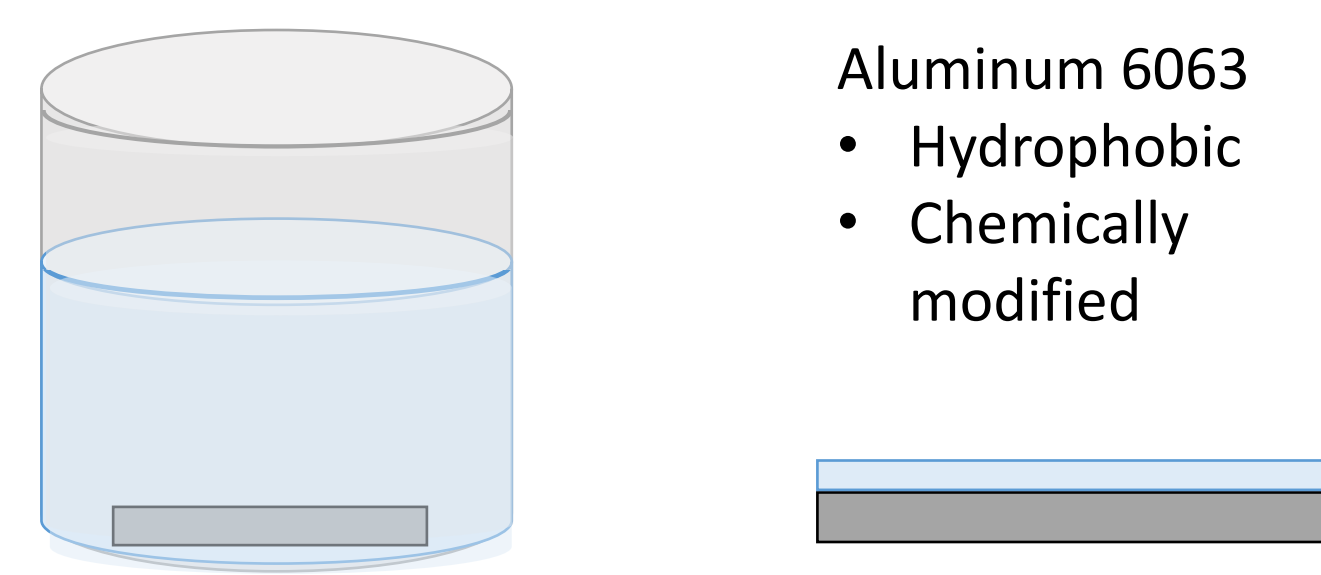
Anodization of aluminum provides mechanical and chemical protection to aluminum metal alloys by forming a porous aluminum oxide layer. Structure parameters include pore size, pore wall thickness, and pore length. These parameters depend on: anodization time, current density, temperature, agitation, electrolyte concentration, and more.



Corrosion Resistance



Aluminum 6063 was pretreated with oleic acid and steric acid solutions to form a hydrophobic layer, before anodizing.

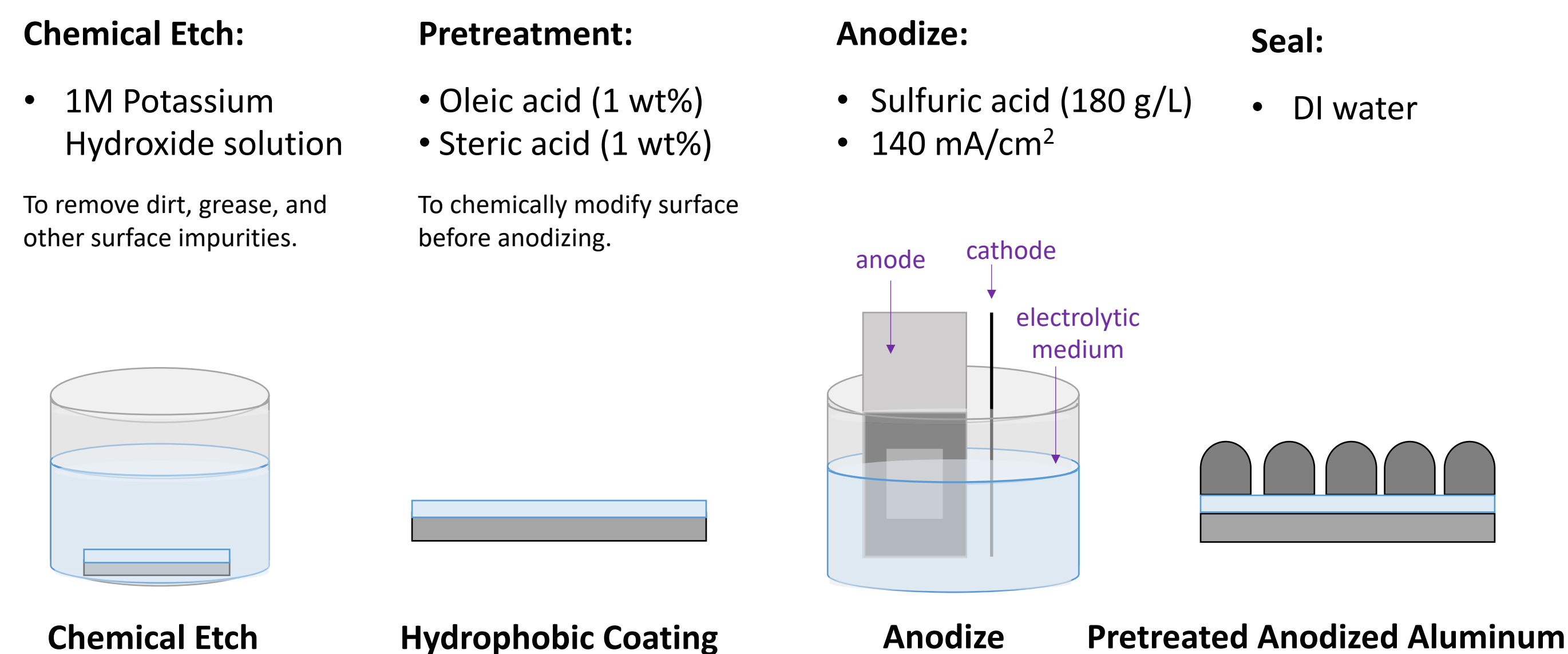


Oleic acid orients the -COOH group which is hydrophilic to react with the -OH group on the oxide layer. The presence of alkyl chain on the surface of anodized Al surface contributes to the hydrophobic property.

Stearic acid orients the -COOH group which is hydrophilic to react with -OH group on the oxide layer. The long tail (-C17H35), opposite of the -COOH group gives the surface hydrophobic properties.

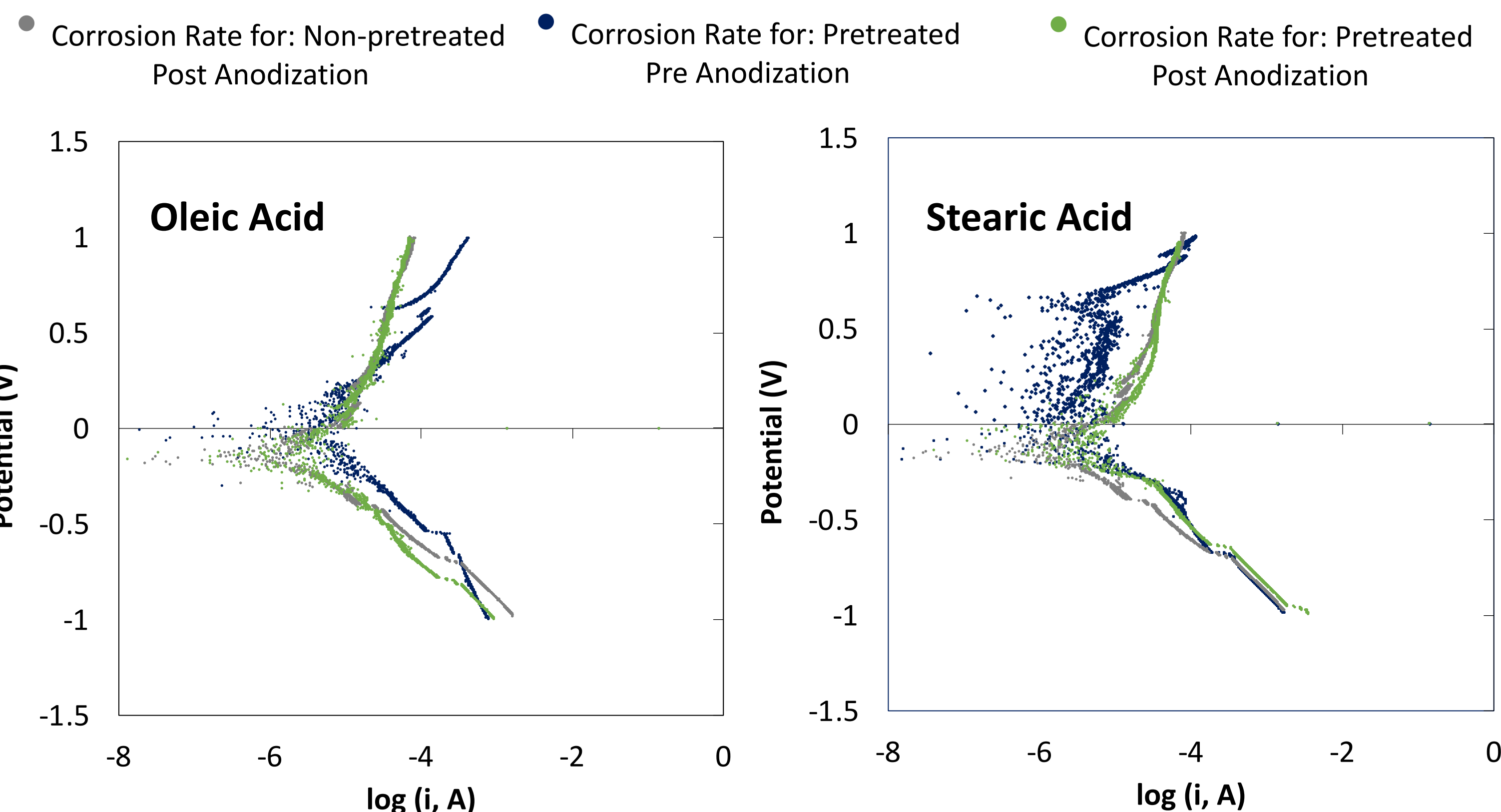
Research Objectives

- Pretreat aluminum 6063 plates with oleic acid and steric acid
- Determine contact angles, corrosion properties, and mechanical strength



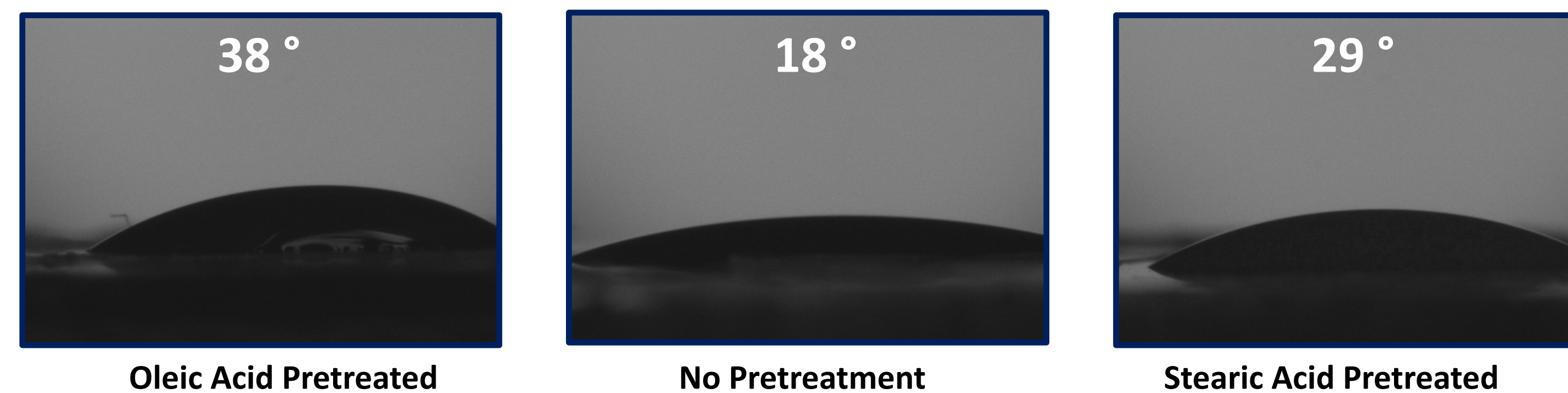
Results

Tafel Plot



Contact Angle

* All measurements taken after anodizing



Mechanical Testing



Conclusions

- Hydrophobic pretreated aluminum was formed with oleic acid and steric acid treatments. Surface properties were confirmed by contact angle measurements, Tafel plots, and mechanical testing.
- Contact angles for anodized samples pretreated with oleic and steric acid showed higher angles than non pretreated anodized samples.
- Tafel Plots show a change in potential for both the steric and oleic acid pretreated samples.
- Additional mechanical testing was carried out by scratching each sample and all anodized samples showed scratch marks.

Areas for Further Study

Change anodizing solution:

- Oxalic (3-5 wt%)- works well for materials with Zn impurities, or other inhibiting additives; guarding against delamination.
- Phosphoric (10-12 wt%)- aluminum films can be more soluble in phosphoric acid than in sulfuric acid; leading to films will dissolving faster.

Different etch techniques:

- Physical- etch a specific pattern into the aluminum before any pretreatment or anodization to provide structural strength.

Different pre/post treatments:

- Pre UV resistant treatments- use UV resistant molecules to pretreat the aluminum, possibly increasing the longevity of dyed aluminum anodized.
- Explore post sealing solutions.

Compare aluminum alloys:

- Look at the effects of the pretreatment with different alloys.
- Use SEM to look at morphology of surface.

References

[1] Y. L. S. C. L. L. M. Y. Meirong Song*, "Fabrication and icing property of superhydrophilic and superhydrophobic aluminum surfaces derived from anodizing aluminum foil in a sodium chloride aqueous solution," Applied Surface Science, vol. 283, pp. 19-24, 2013.

[2] O. C. P. J., W. T. Pat Sooksaena*, "Chemical treatment on aluminum alloy for hydrophobic surfaces," Materials Today: Proceedings, vol. 4, no. 5, pp. 6528-6533, 2017.

Acknowledgements

Dr. Dale Barkey, UNH Chemical Engineering

John Thornton, Apple Inc.

University of New Hampshire, Chemical Engineering Department

