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Poster Instructions

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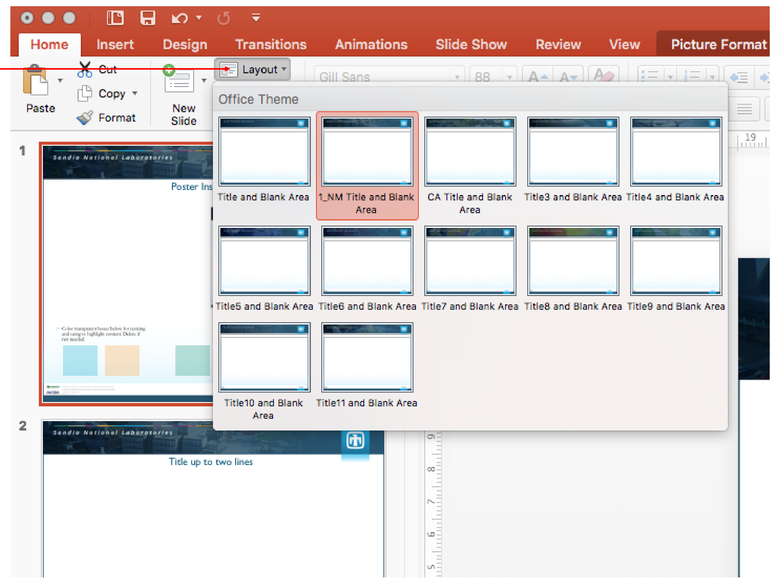

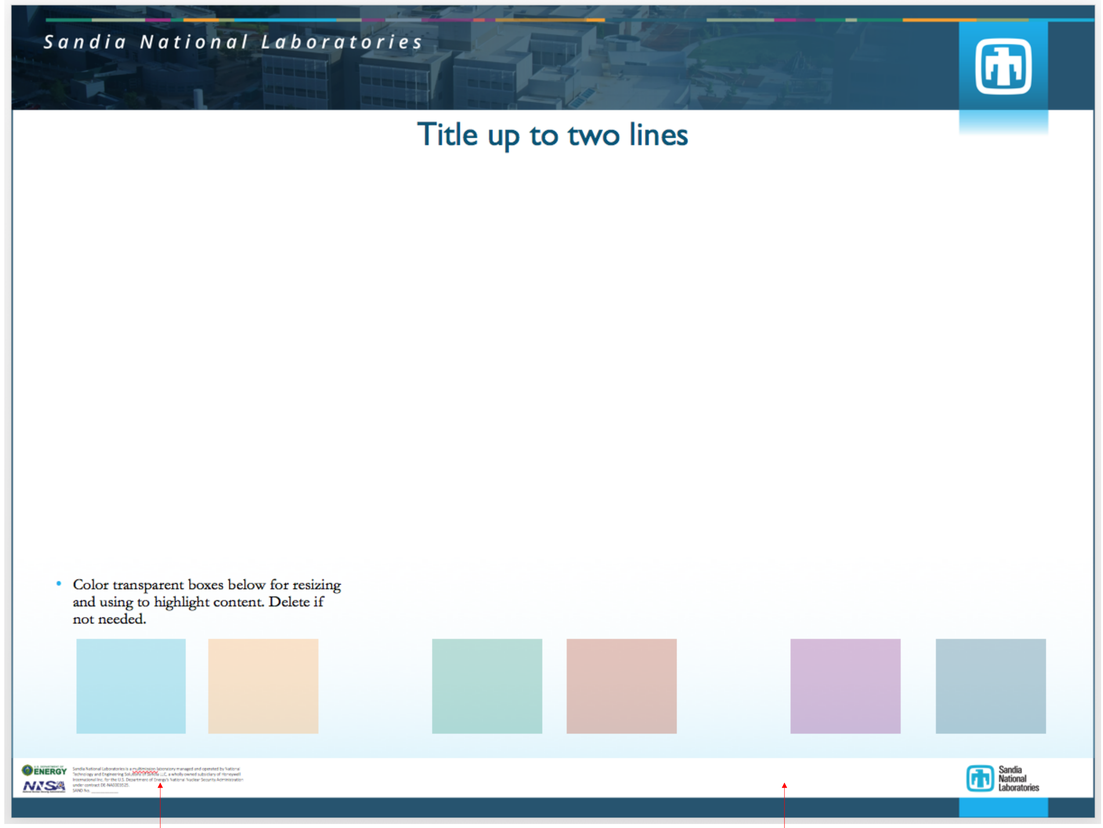

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Anti-Icing Coatings using Ionomer Films

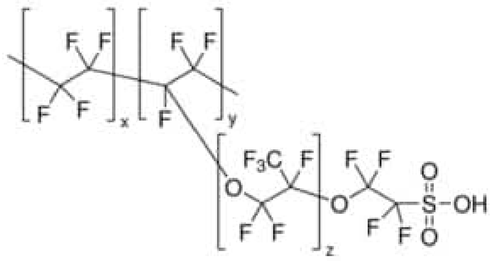
1. Background

Ice buildup and accumulation on machinery, makes operation difficult and dangerous. Thus, the need for a durable anti-icing coating solution.

Current Solutions have drawbacks, our approach is to utilize fluoropolymer-based ionomer films [1].

2. Materials and Methods

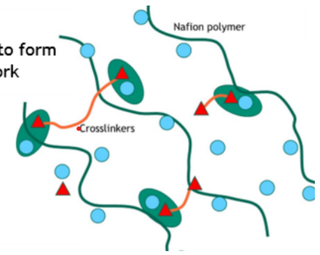
Nafion (hydrophilic polymer) has demonstrated to prevent nucleation and ice crystal adhesion to a coating [1,3].



- Use electrostatic attraction between molecular species to form a reformable polymer network

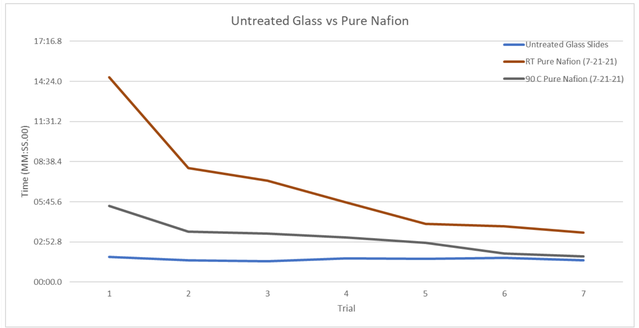
Cation (+) (-) Anion

The bond strength is critical for macroscopic properties.

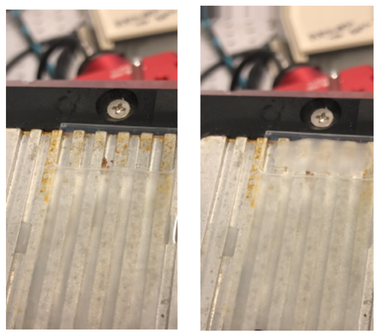


The chemical variations to be tested involve the choice of additives that create the anti-icing properties of the surface including ionic salt compounds and hydrophilic polymer. Coatings are measured for their physical, thermal, and surface wetting properties [1].

3. Baseline Nafion



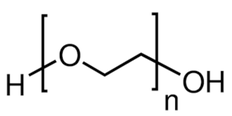
Onset of frost formation on the Nafion film can be visually observed by formation of opaque/hazy ice surface layer.

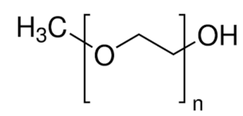


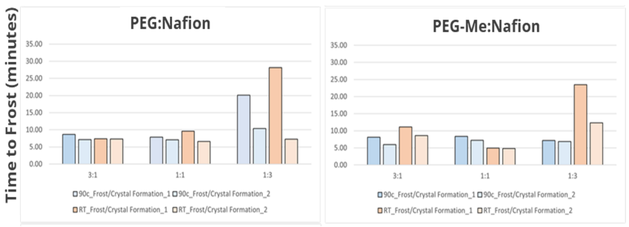
4. Glycol Additive

Polyethylene glycol surfactants were used to lower the freezing temperature of water inside the film [1,2].

Poly(ethylene glycol) Poly(ethylene glycol) methyl ether





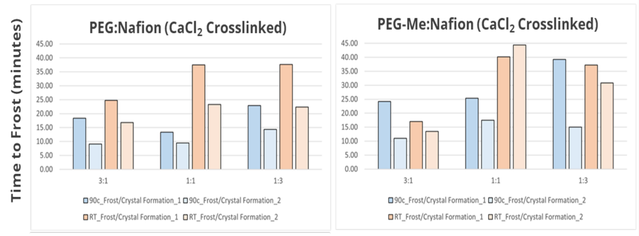


Glycols added at loading levels of 1:3 showed substantial improvement. However, in all cases the TTF was still observed to decrease with subsequent freeze/thaw cycles [1].

5. Ionic Crosslinkers

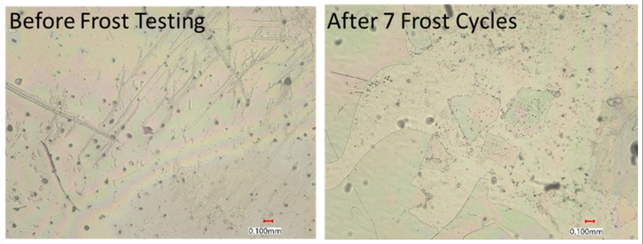
Ionic salt compound were used for their intrinsic freezing point depression effect [1,4].

Calcium Chloride



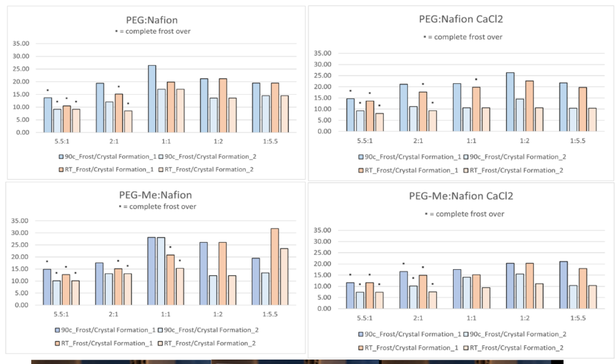
The reduction in TTF between trials 1 and 2 was the lowest of any observed previously. However, film cracking/fracturing was observed.

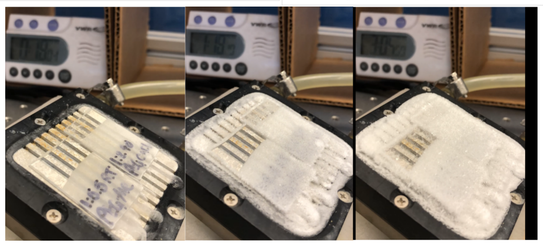
1:1 PEG:Nafion Film



6. Nafion Concentrations

Higher concentration of Nafion dispersion (20 wt.% instead of 5 wt.%) was prepared with the hopes of coating thicker more robust films [1].





Results demonstrate a dramatic improvement over the performance of both untreated glass and neat dip-coated Nafion films dried at RT or 90 °C

7. Conclusions

Best preforming mixtures:

- Higher concentrations of Nafion

Next Steps:

- Test air spray applications onto substrates

8.References & Acknowledgments

(1)Bell, N.; Narcross, H.; Bowman, A.; Jansen, A.; Grest, G.; Thurston, B. Anti-Icing Coatings Using Ionomer Film Layer Structuring. **2021**.

(2)Durability Enhancement of Low Ice Adhesion Polymeric Coatings Elsevier Enhanced Reader.Pdf.

(3)Morphology Study of Nafion Membranes Prepared by Solutions Casting.Pdf.

(4)Room Temperature Characteristics of Polymer-Based Low Ice Adhesion Surfaces - Srep42181.Pdf.

I would like to thank my mentor Hannah Narcross, Ashley Bowman, and Nelson Bell for their guidance throughout this project.