

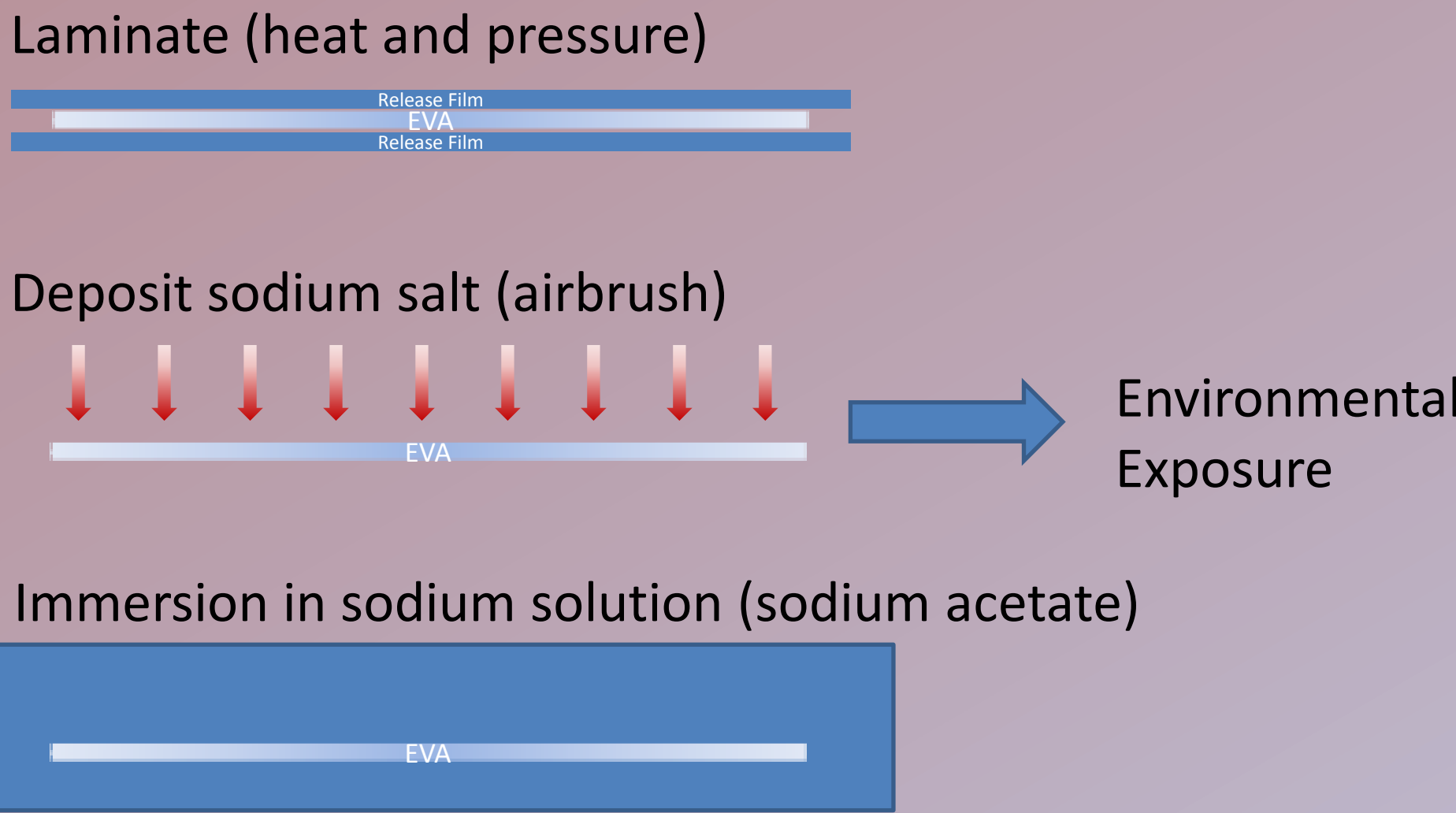
The Effect of Na on the Electrical Breakdown of EVA

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Test Plan

This study will develop an understanding of the changes in dielectric properties that occur in EVA as a function of age and exposure to different environments. The study can take several paths.

- Creating an accelerated test to validate the model(s).
- Validation efforts that test dielectric strength of samples.
- Modules with >5 years service in humid climates could be brought back for validation efforts.
- Ultimately use this information to
 - develop standardized accelerated test protocols
 - study safety/reliability issues



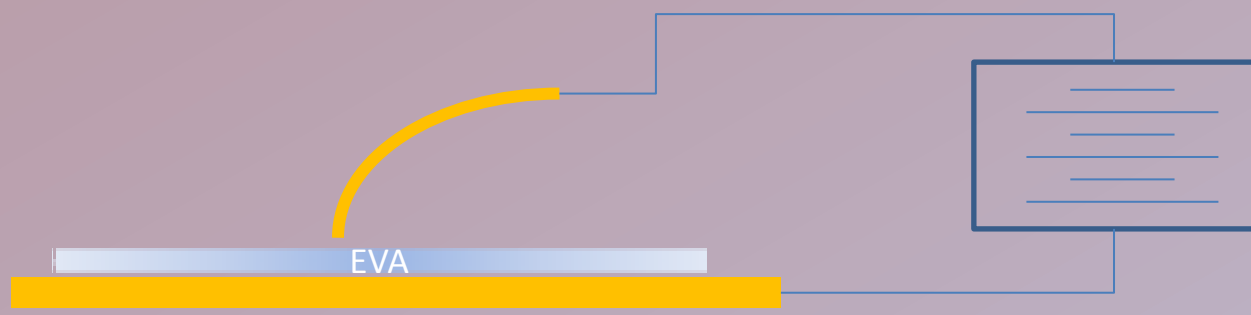
Proof Test
EVA in solution of NaAcetate - 3 days.
Rinse in DI water & dry.
Measure Na on surface.
Measure Na in bulk of EVA

Na (ug/cm2)	1	10	100
	Exposure (%RH) at 70C		
Time	20%	50%	85%
1 week	X	X	X
3 weeks	X	X	X
6 weeks	X	X	X

Voltage Breakdown Measurements

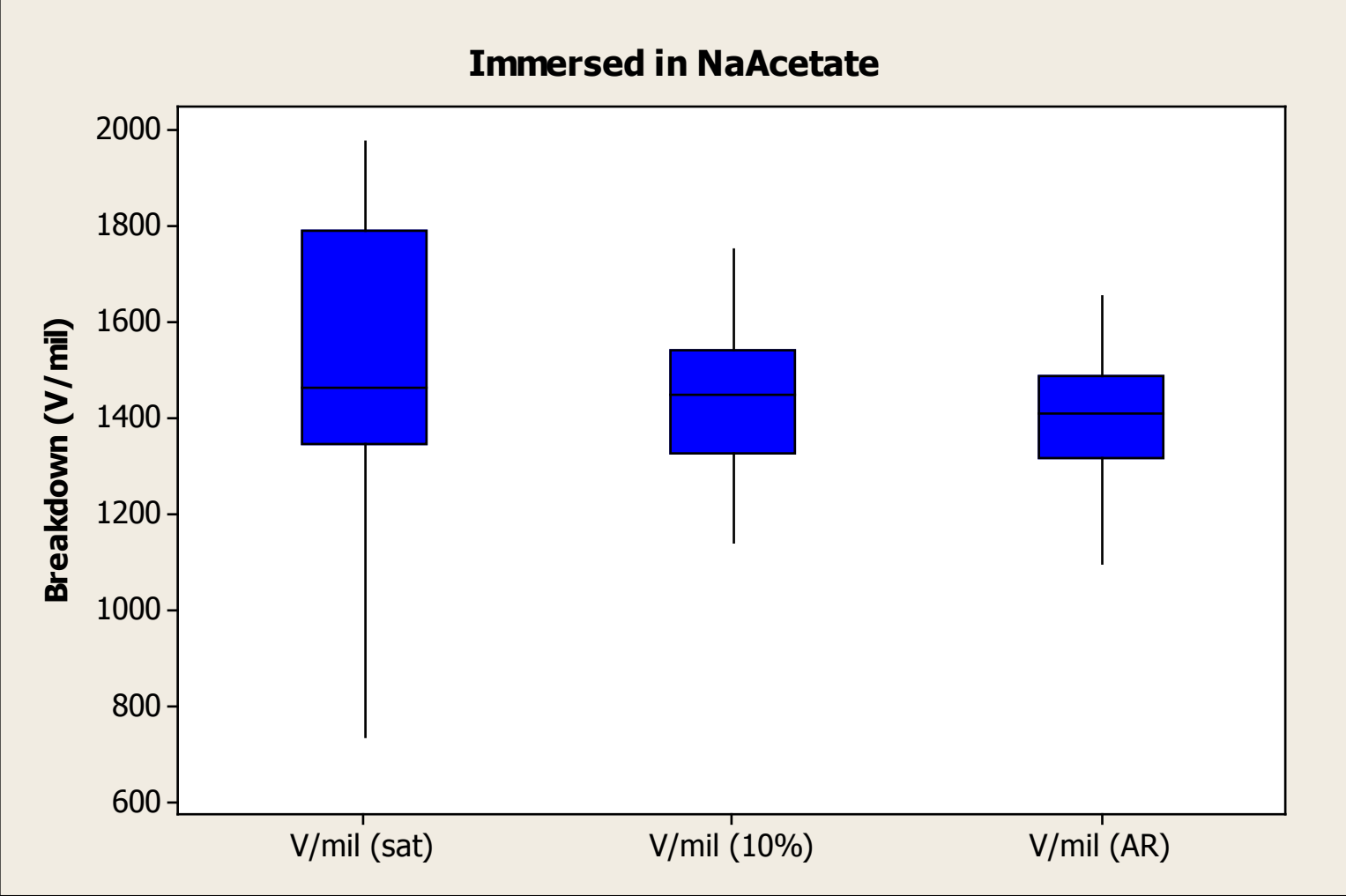
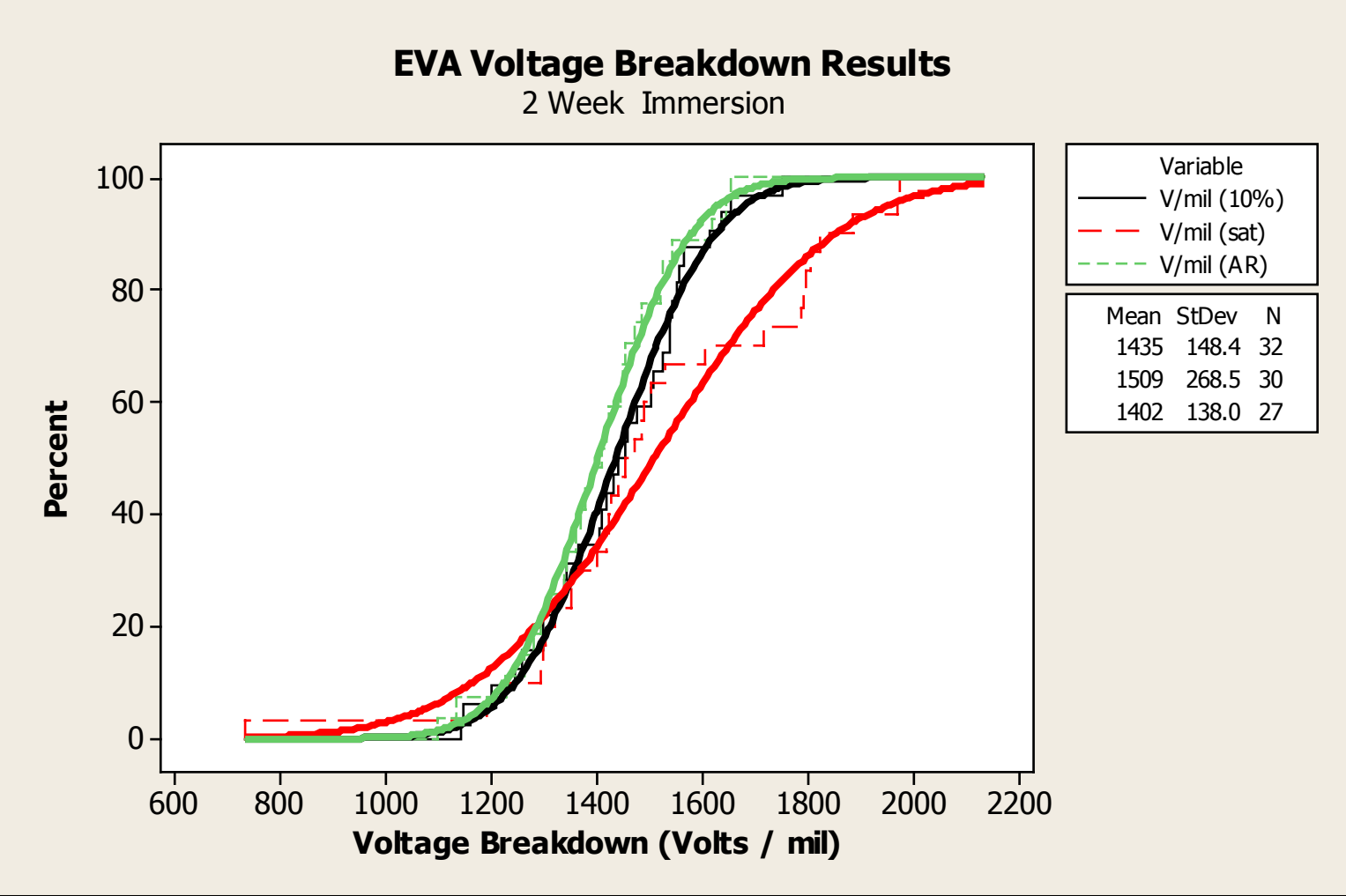
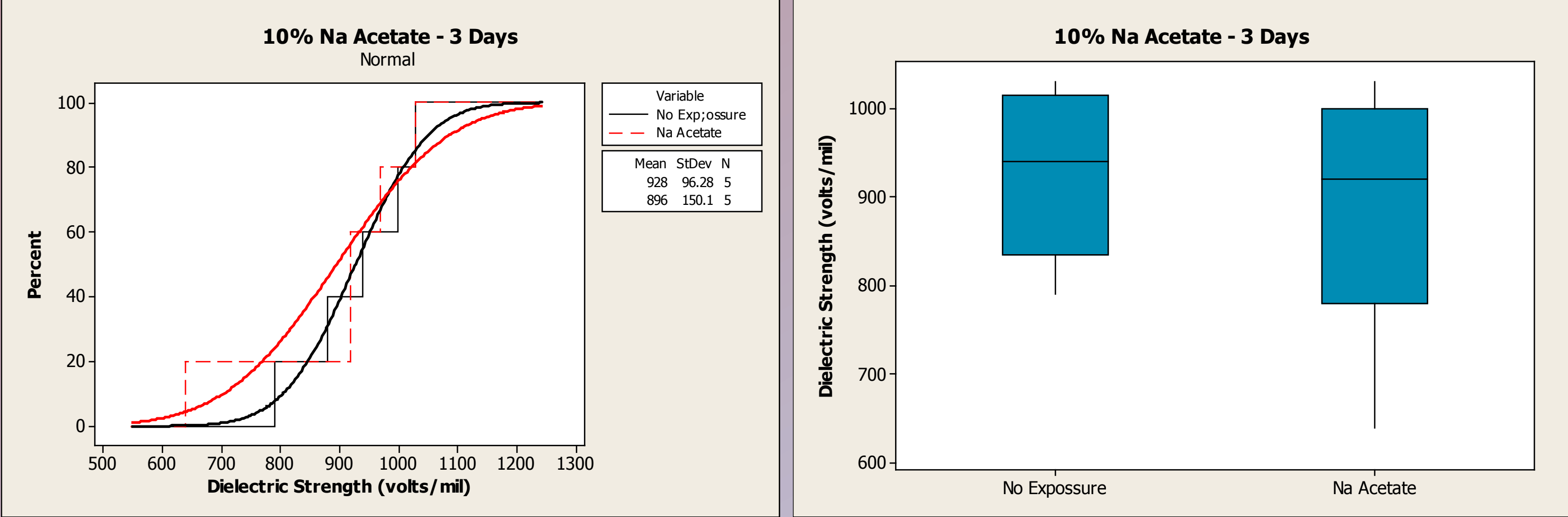
Initial Results (3 day immersion)

- No change in breakdown characteristics
- Measured at external lab

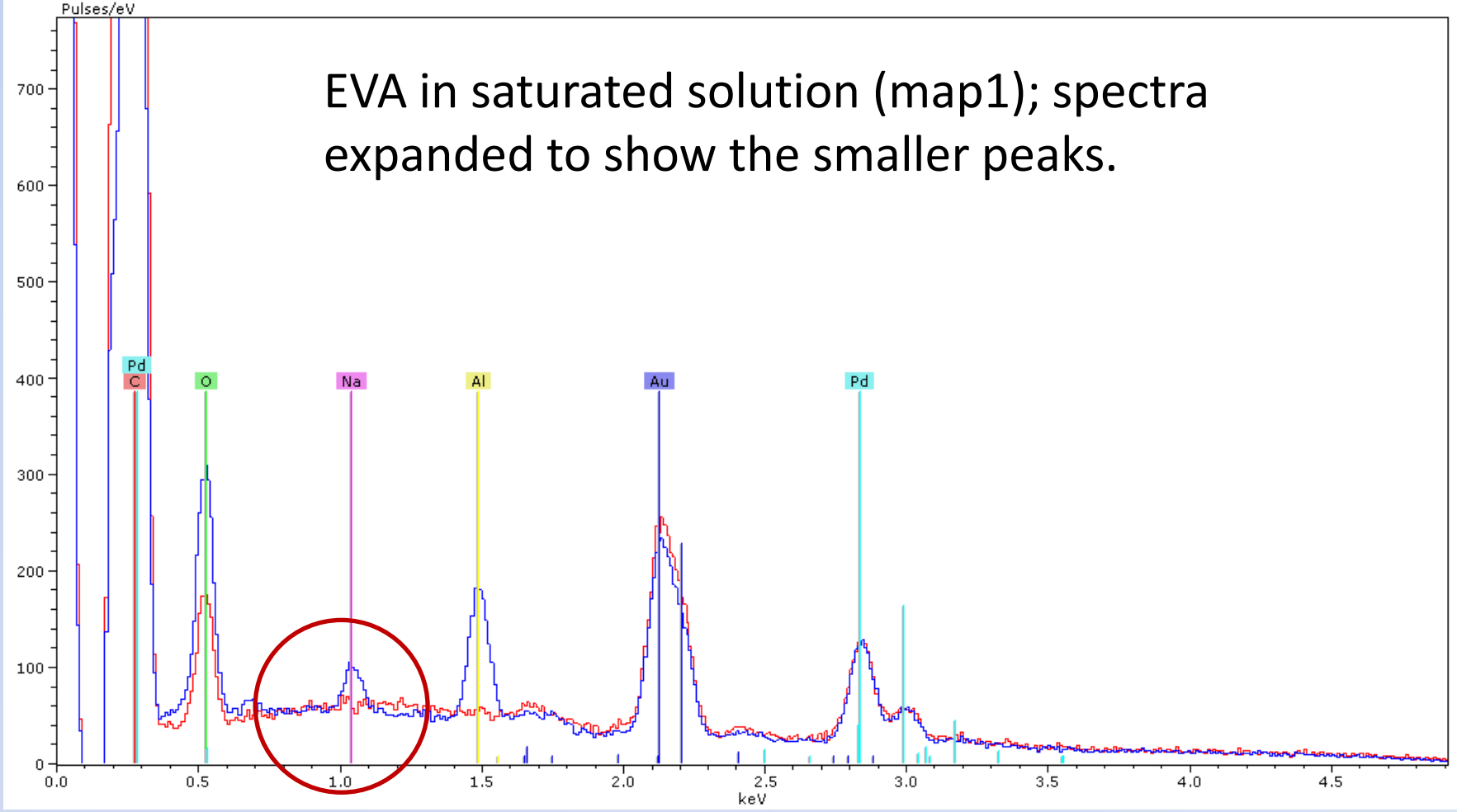
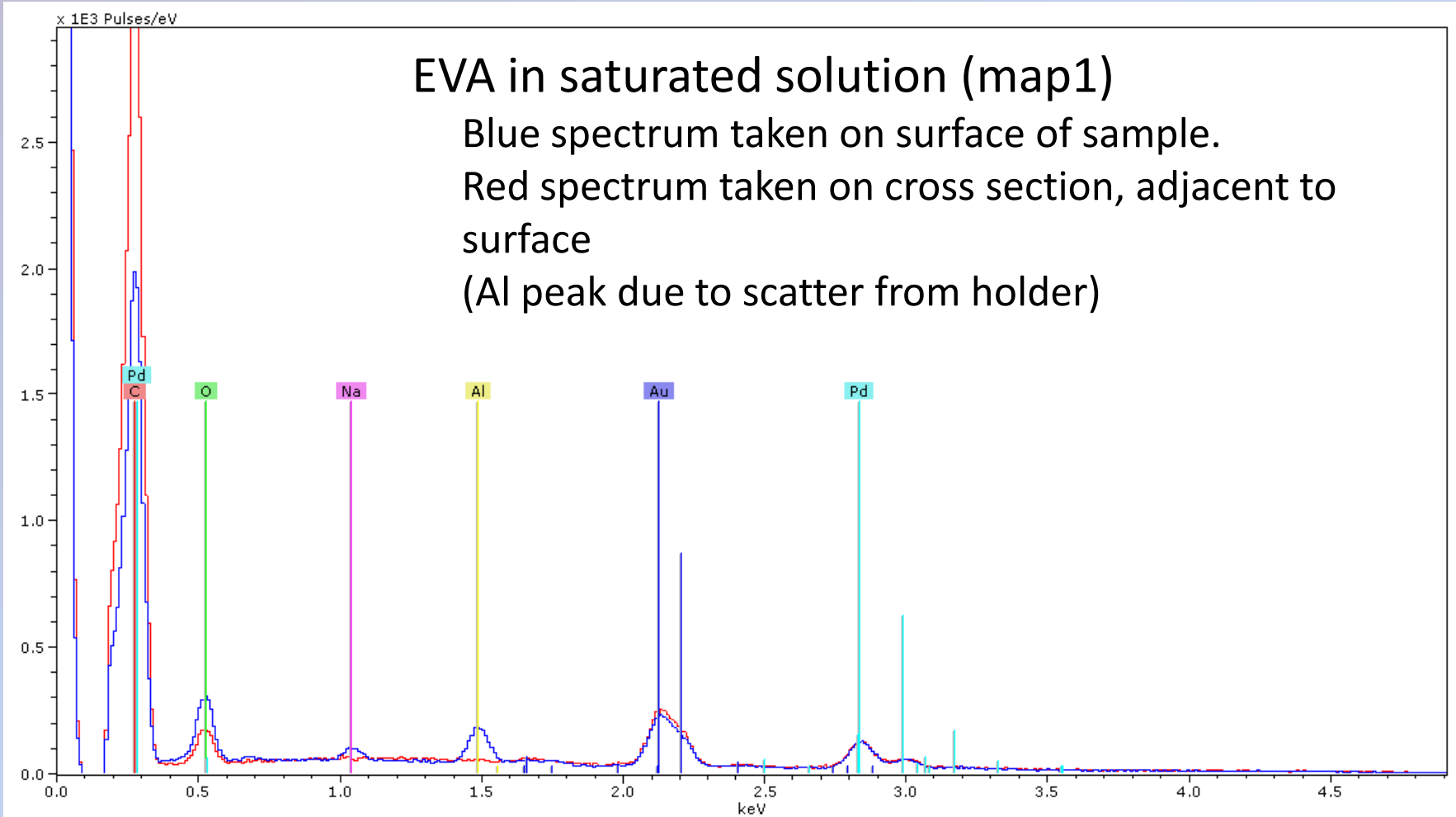
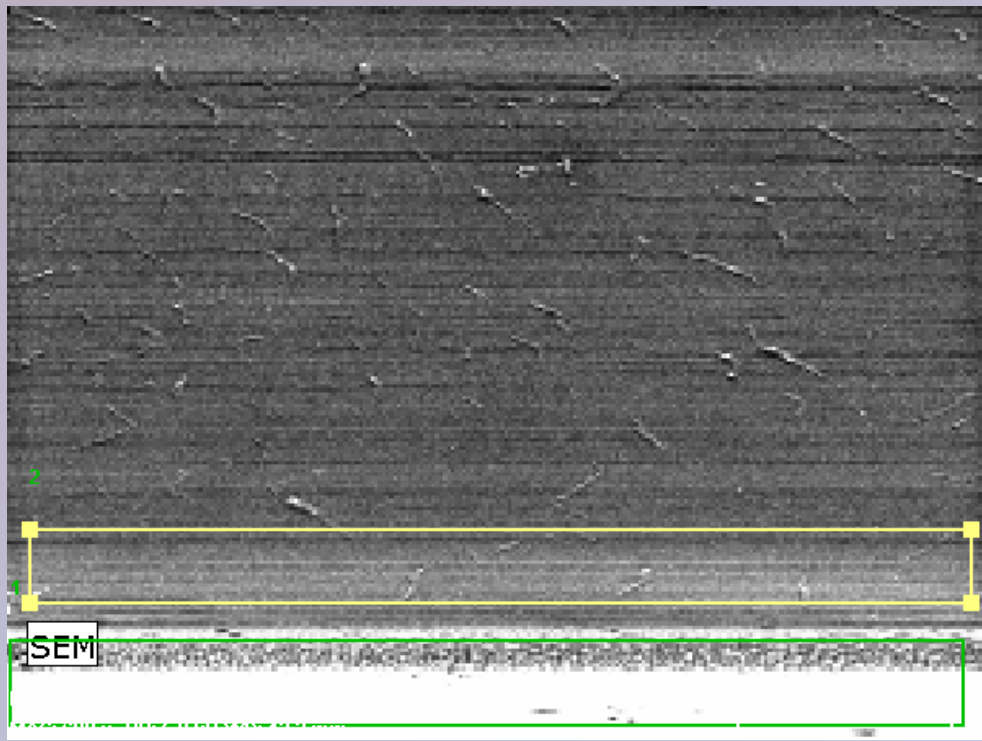


Round 2 (2 week immersion)

- No change in breakdown characteristics
- Measured internally
- No evidence of Na in the EVA



Compositional Analyses (SEM / EDS)



Sample cut to expose cross section. Spectra were taken that compare surface and internal composition (Na). Na was found on the surface, but not on the interior.

No evidence of Na diffusion into the EVA.

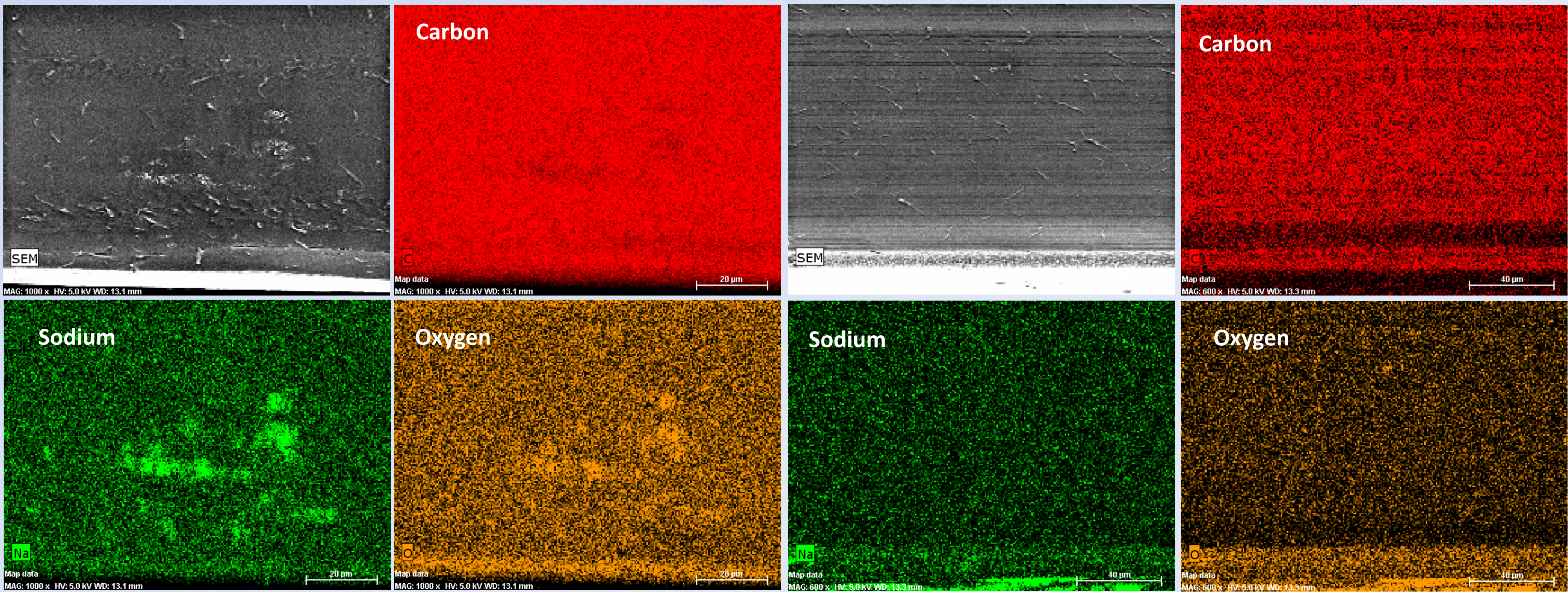
- Insufficient time?
- Wrong chemistry?

Elemental Maps:

Na found on surface. It is present as discrete deposits. Simple rinsing did not remove the Na.

Sodium was not seen on the cross section, indicating little or no diffusion had occurred.

EVA Surface



Summary

Status

With limited data, no evidence of Na effects

- No difference in breakdown (short exposures)
- No Na in the EVA

Ongoing Work

Continue immersion tests

- Longer time exposure
- Additional solutions

Harvest samples from modules

- New, good in the field, failed in the field.
- Use coring technique to obtain EVA
- Measure Na content
- Measure breakdown voltage

References

Neelkanth G. Dhere, Nachiket R. Ravavikar, Effect of Glass Na Content on Adhesion Strength of PV Modules, *Proc. 29th IEEE Photovoltaic Specialists' Conference, New Orleans, LA, May 2002*

Spooner, Edward D., Wilmot, Nigel, Safety Issues, Arcing and Fusing in PV Arrays, *ISES-AP - 3rd International Solar Energy Society Conference - Asia Pacific Region (ISES-AP-08)*.

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