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Localized Electrical Properties of Semi-Conductive Coating

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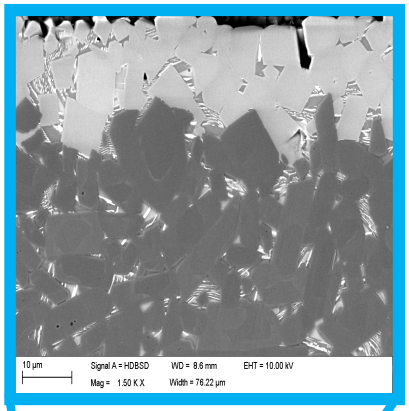
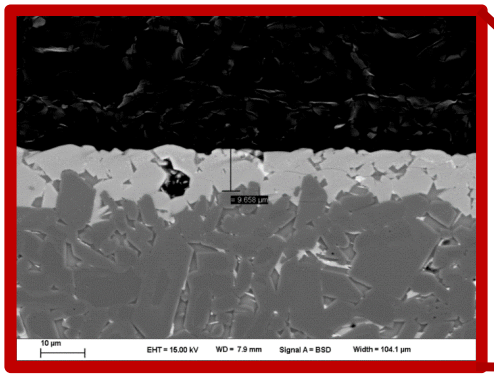
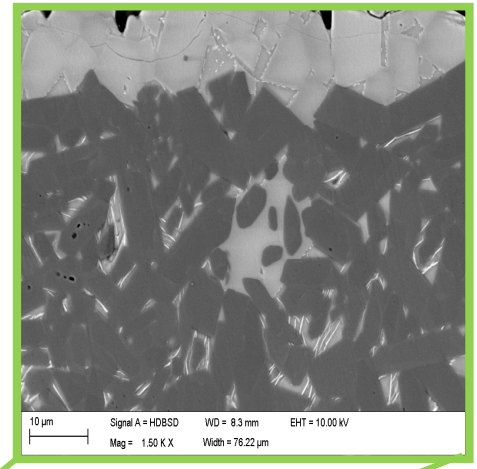
Structure

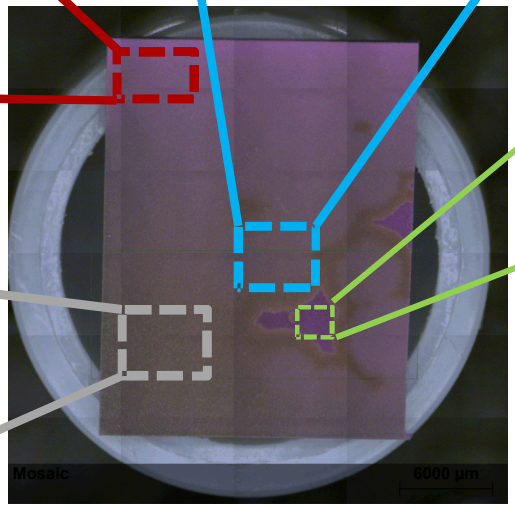
Inside Circles: More crystallites in intergranular region near surface (same thickness of spinel layer as outside circles)

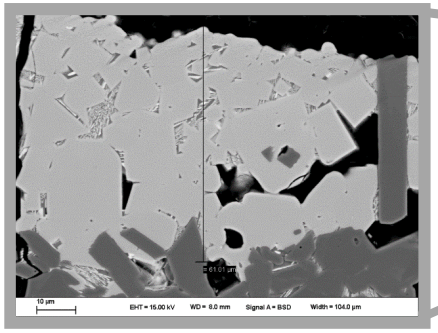




Pinker Region: Thinner spinel layer





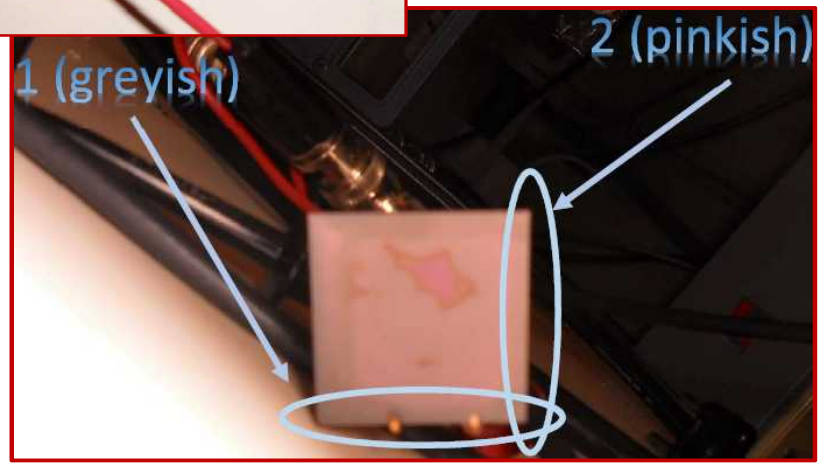


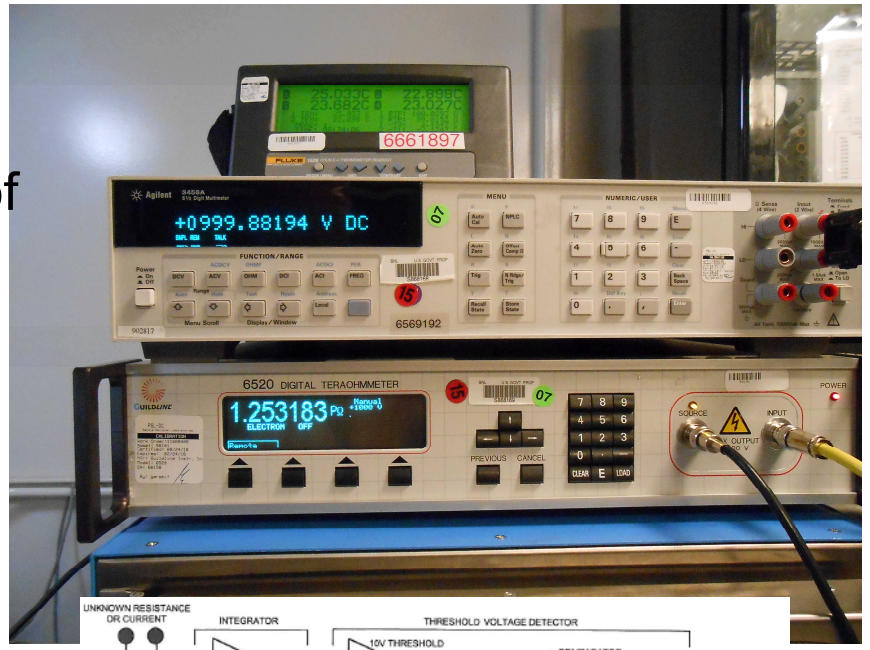
Greyer Region: Thicker spinel layer

Outside Circles: Fewer crystallites in intergranular region near surface (same thickness of spinel layer as inside circle)

Testing Configuration

- With the help of primary standards lab (Keith Morris and Hy Tran) we took preliminary resistance measurements of two color regions.





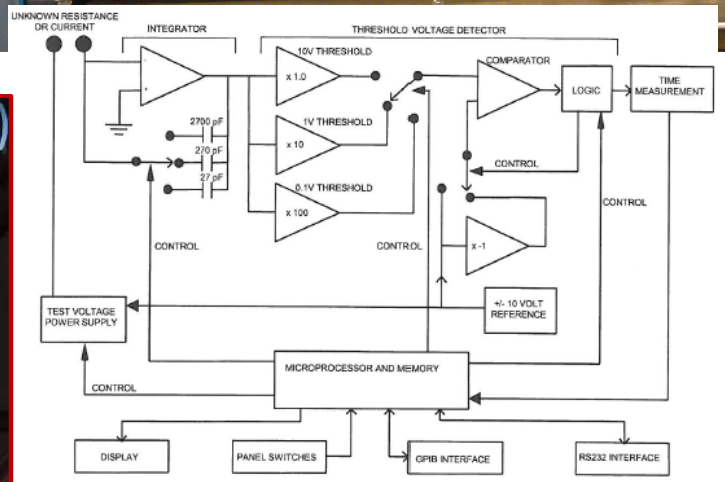
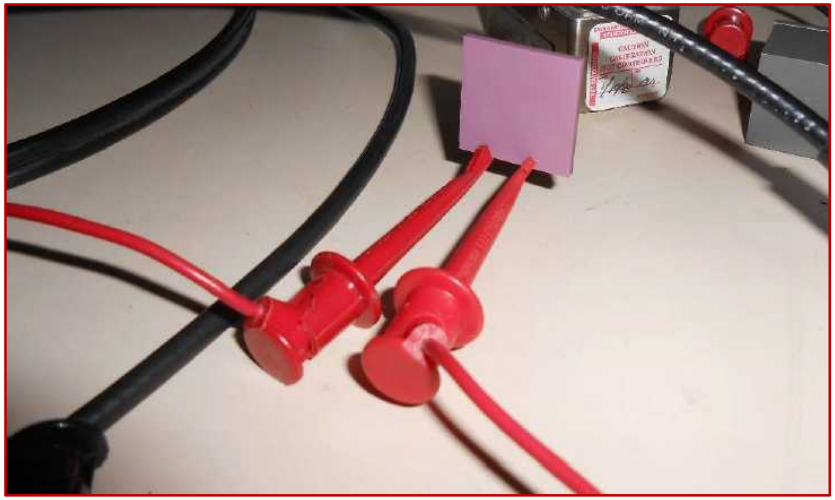
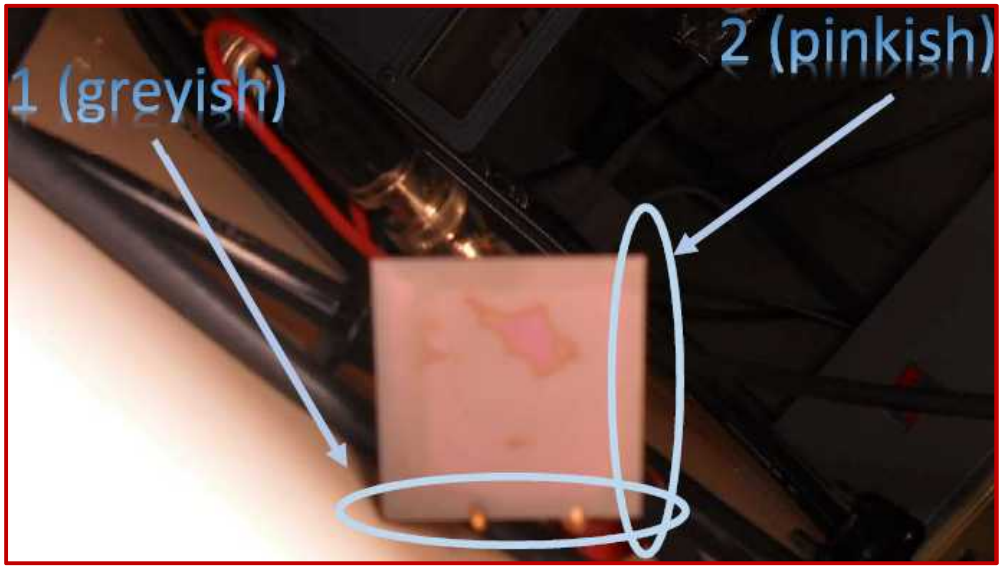


Figure 1-3: 6520 Simplified Block Diagram

Preliminary Testing





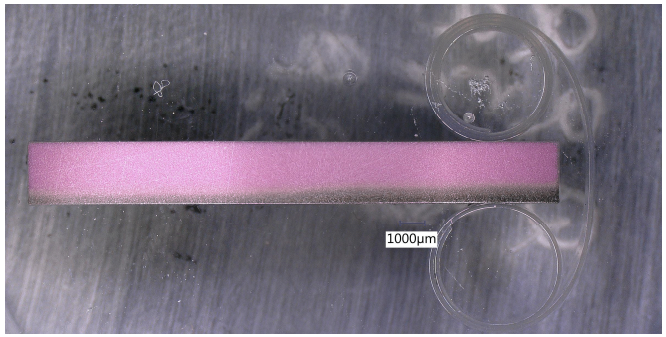
- Initial results show ~1.5 order of magnitude difference between “pink” and “grey”

Region	Trial	Resistance Ω	Uncertainty (%)
1	1	1.5 e+15	4.9101 %
	2	1.5 e+15	1.5030 %
2	1	3.1 e+13	1.2969 %
	2	5.5 e+13	2.9177 %

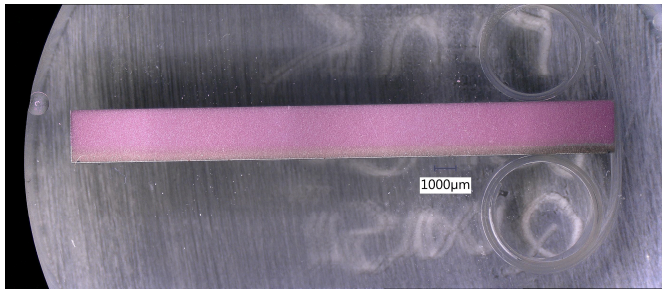
Preliminary Testing

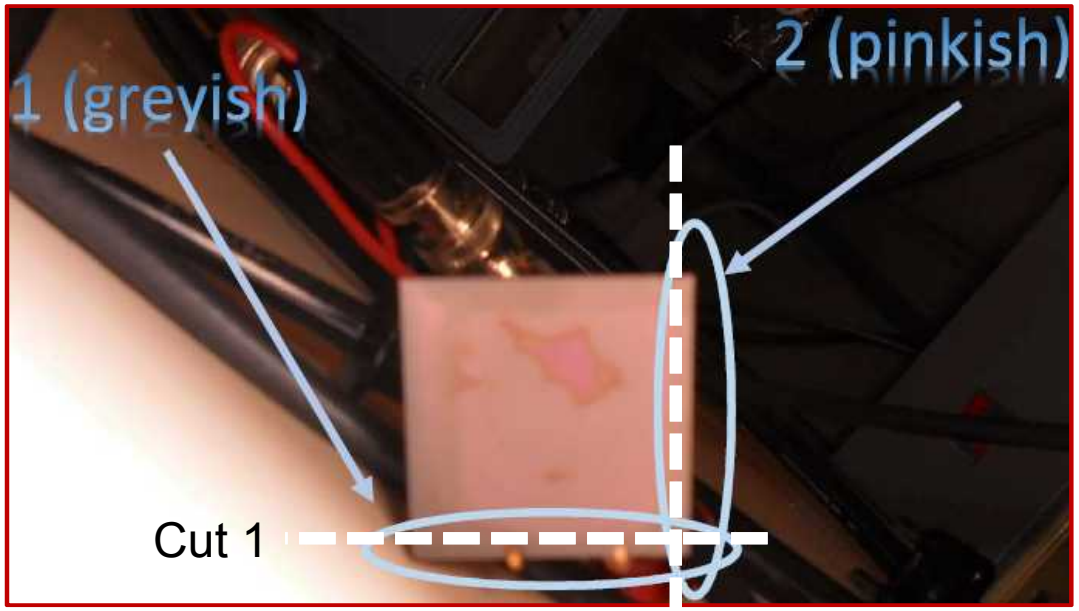
- To tie resistivity to microstructure, two cuts were made across measurements areas and polished to examine microstructure with scanning electron microscopy:

1



2

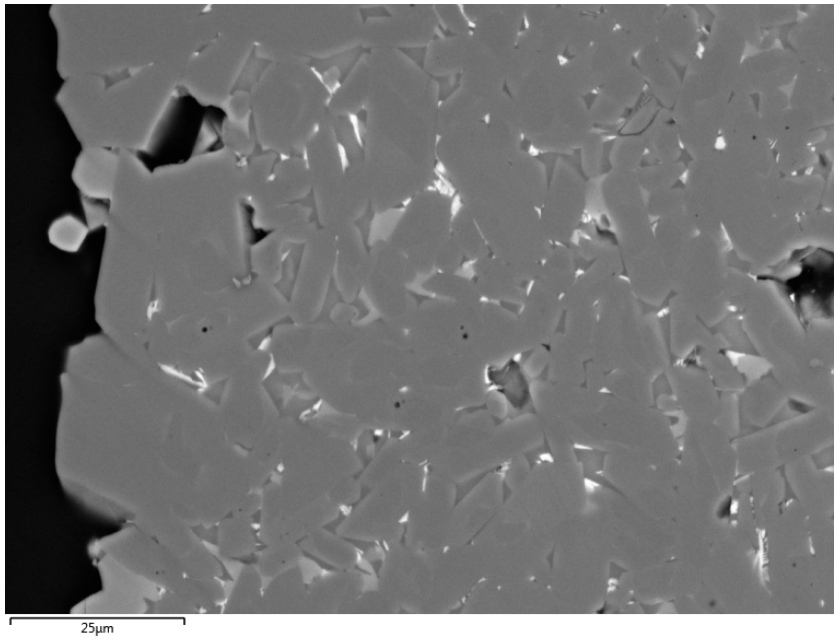


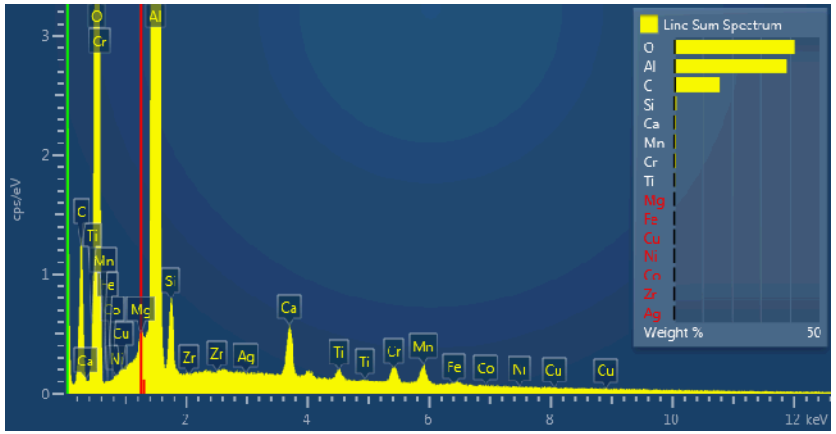


Cut 2

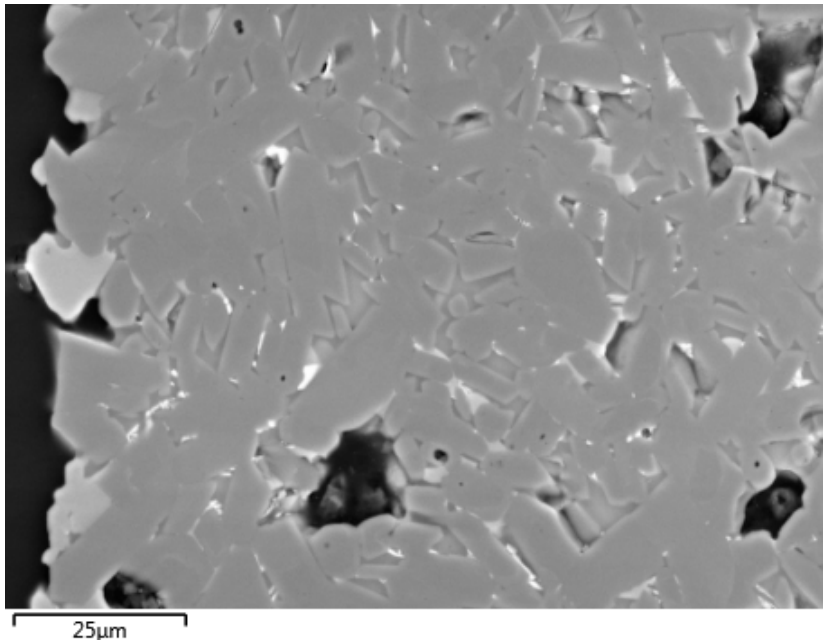
Chemical Mapping

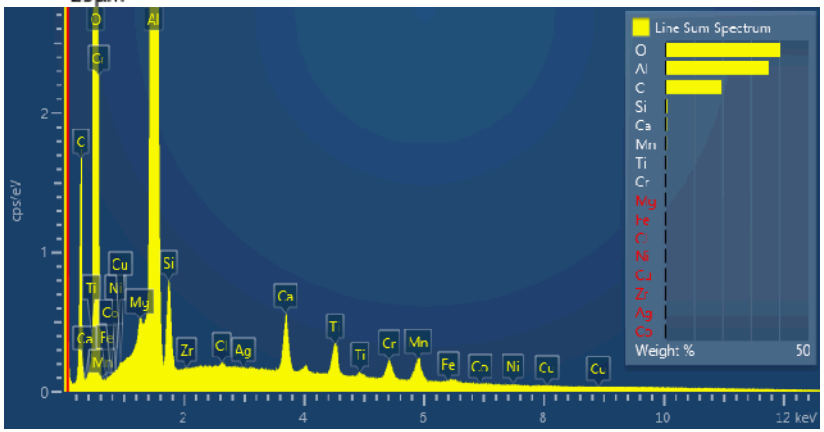
Greyish





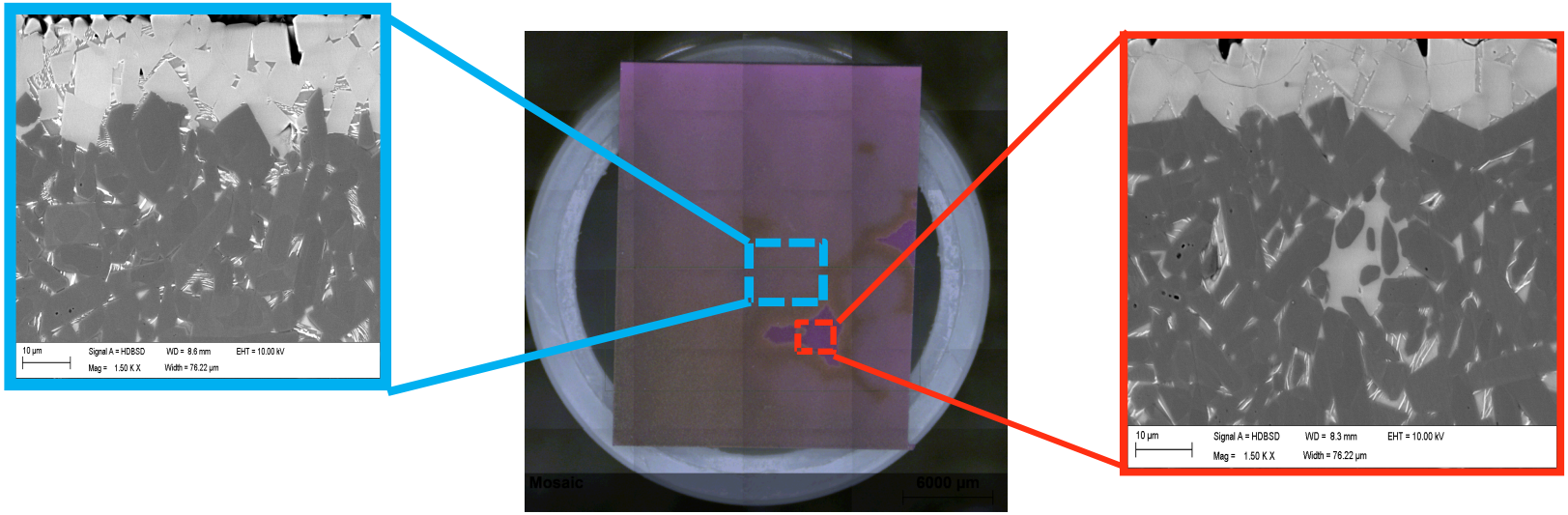
Pinkish



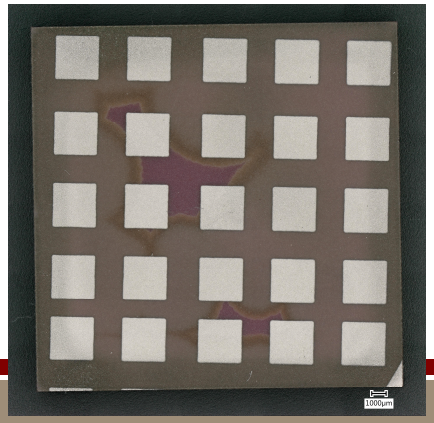


Increasing testing complexity and precision:

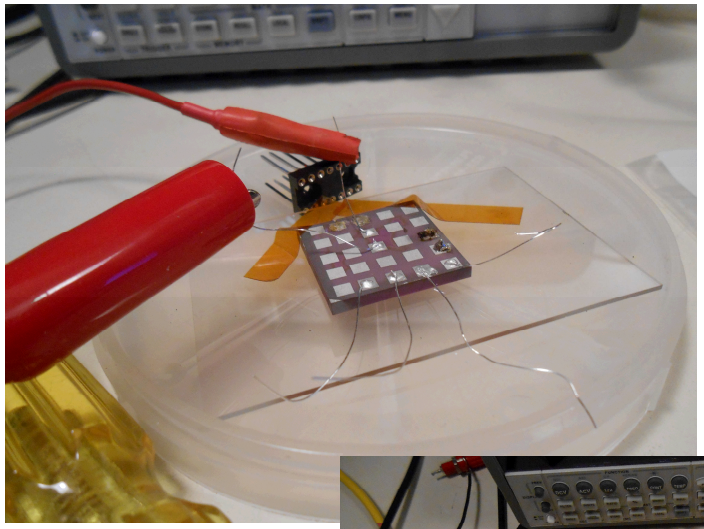
- Initial results served as a proof of purpose, but ultimately we would like to know if areas of similar coating thickness but different microstructure play a role in electrical performance:

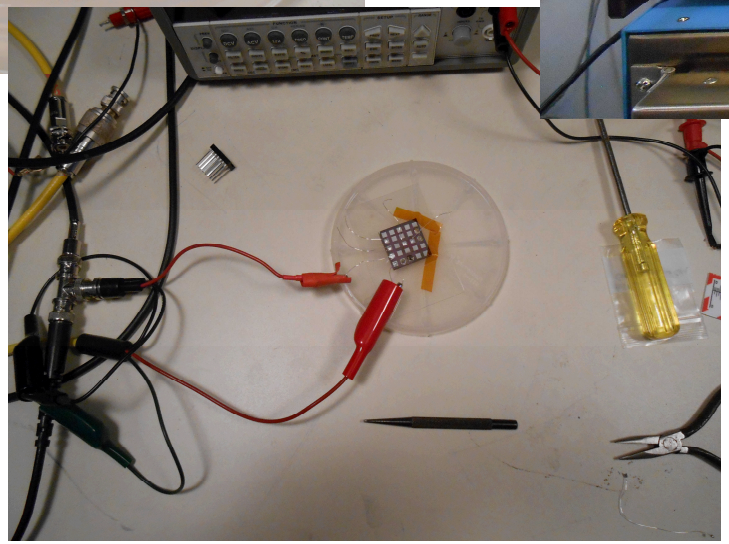


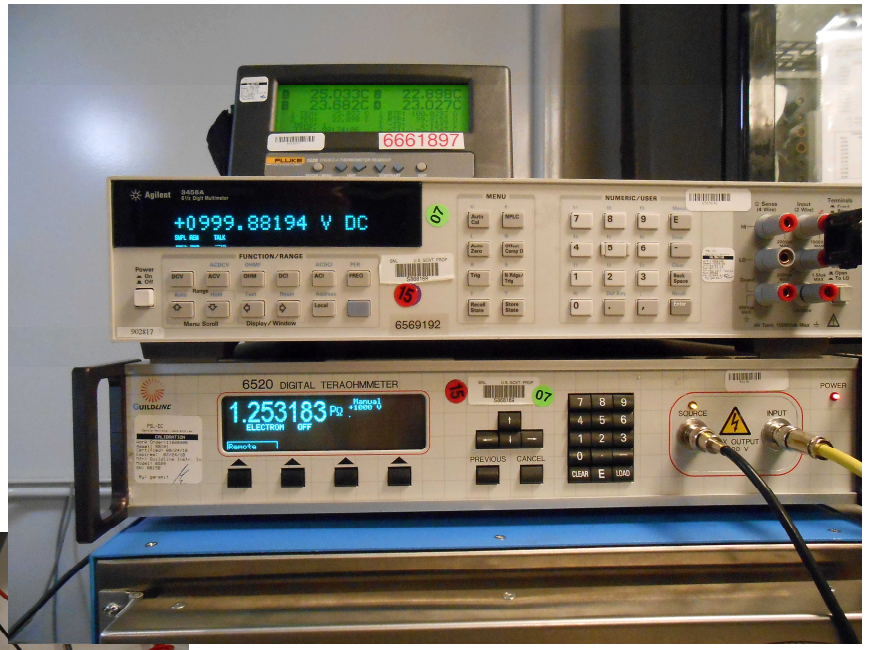
- We can test this, by sputtering Pt electrodes to the surface and taking precise localized measurements:



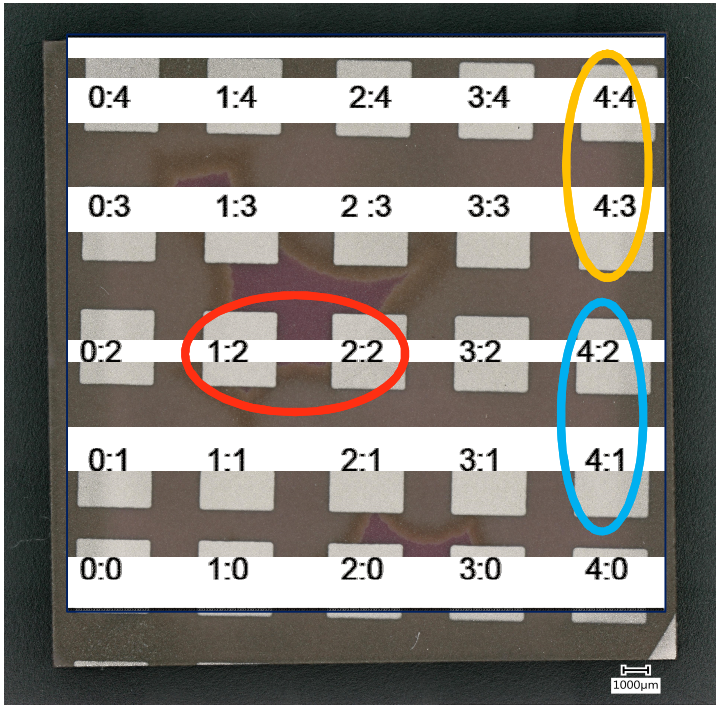
Testing Configuration





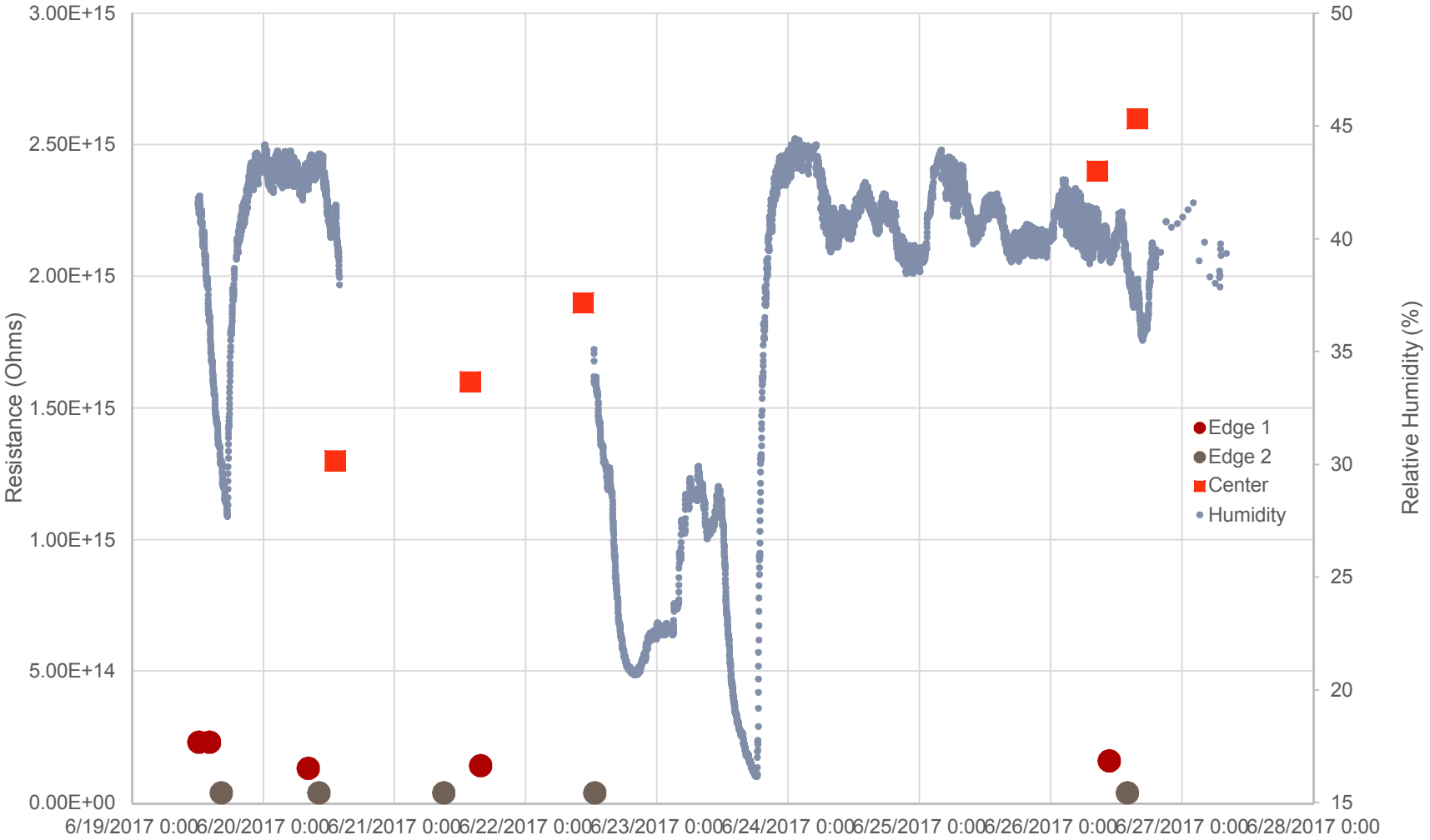


Data

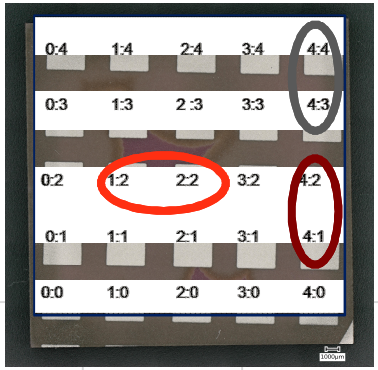


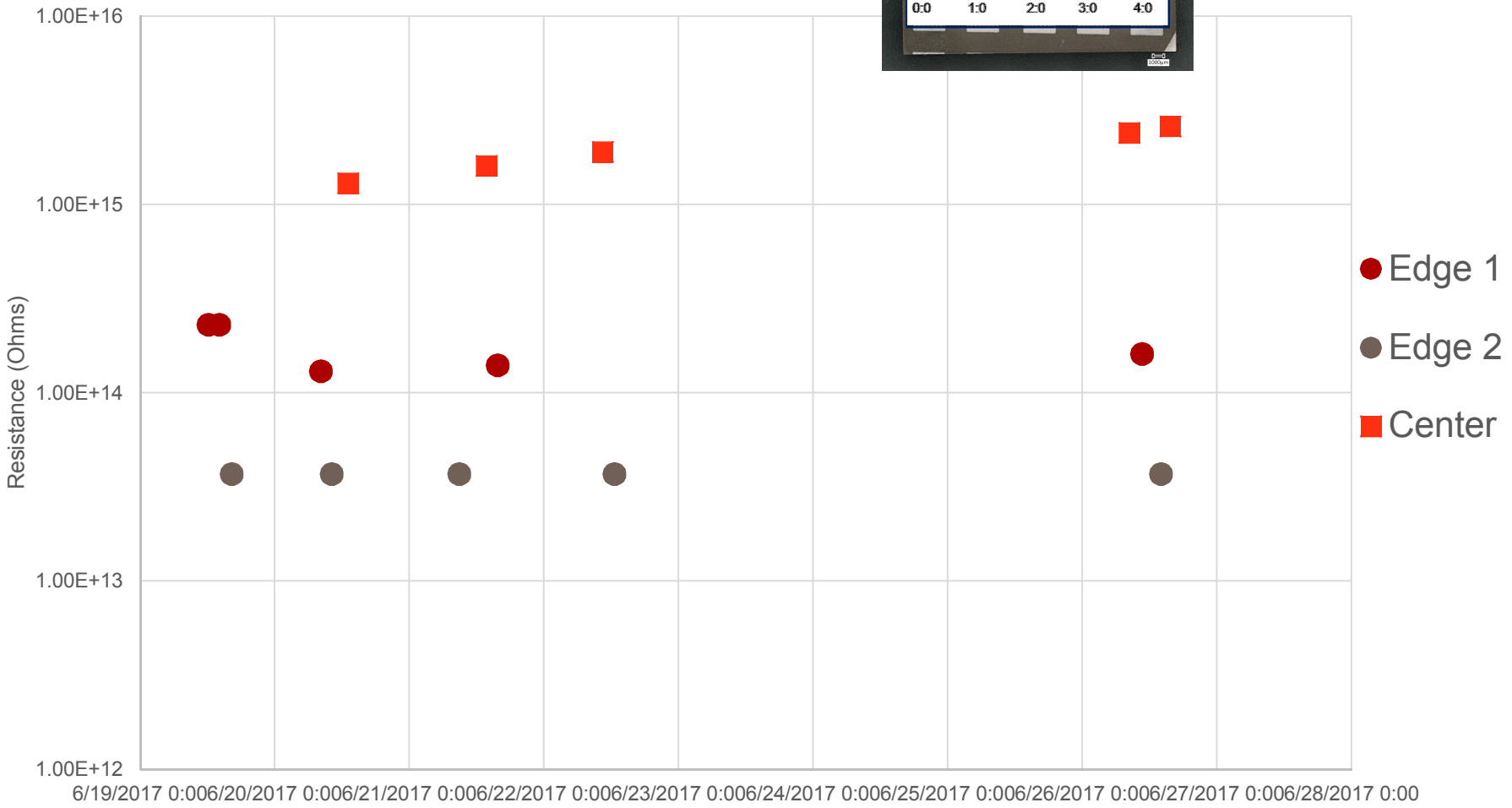
Point	4:2-4:1 Edge 1	4:4-4:3 Edge 2	1:2-2:2 Center
Trial 1	2.30E+14	3.70E+13	1.30E+15
Trial 2	2.30E+14	3.70E+13	1.60E+15
Trial 3	1.30E+14	3.70E+13	1.90E+15
Trial 4	1.40E+14	3.70E+13	2.40E+15
Trial 5	1.60E+14	3.70E+13	2.60E+15
Average	**1.78E+14**	**3.70E+13**	**1.96E+15**
Adjusted	**9.24E+13**	**1.67E+13**	**8.76E+14**

Humidity Data



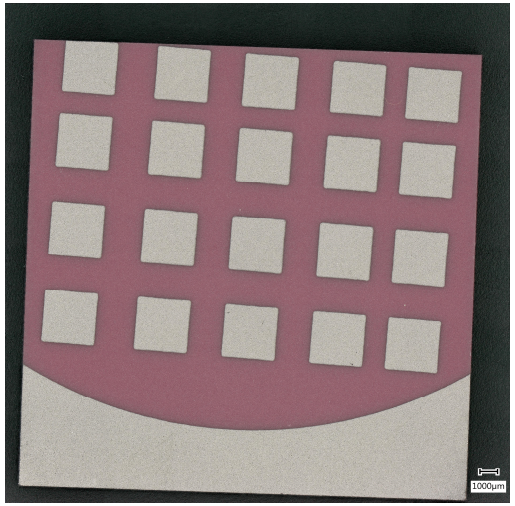
Humidity Removed





Conclusion

- Testing indicates distinct electrical properties corresponding to coating coloration
- Electrical properties may be attributed to differences in chemical structure
- Further research is required to quantify electrical properties by coloration
  - Increased Isolation in testing
  - Keithley 8009 Resistivity Test Fixture
    - Bulk resistivity measurement
    - Surface measurements



Acknowledgments

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