

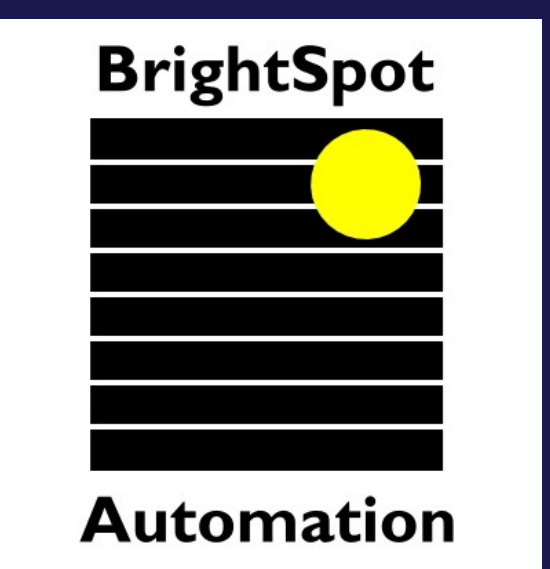


UV Fluorescence for Detection of Solar Panel Bill of Materials Variations

Andrew M. Gabor¹, Philip Knodel¹, Dylan Colvin², Kris Davis², and William Oltjen³

¹BrightSpot Automation LLC, Westford, MA, USA; ²University of Central Florida, Orlando, FL, USA;

³Case Western Reserve University, Cleveland, OH, USA



1. Challenge

- **Expectation:** A single solar panel system has a uniform design and bill of materials (BOM)
- **Reality:** Supply challenges often cause manufacturers to use different materials suppliers, including materials not verified in certification testing
- **Risks include:**
 - Higher than expected degradation rates
 - Safety concerns
 - Current mismatch losses between series-connected panels due to different degradation rates associated with different materials

2. Opportunity

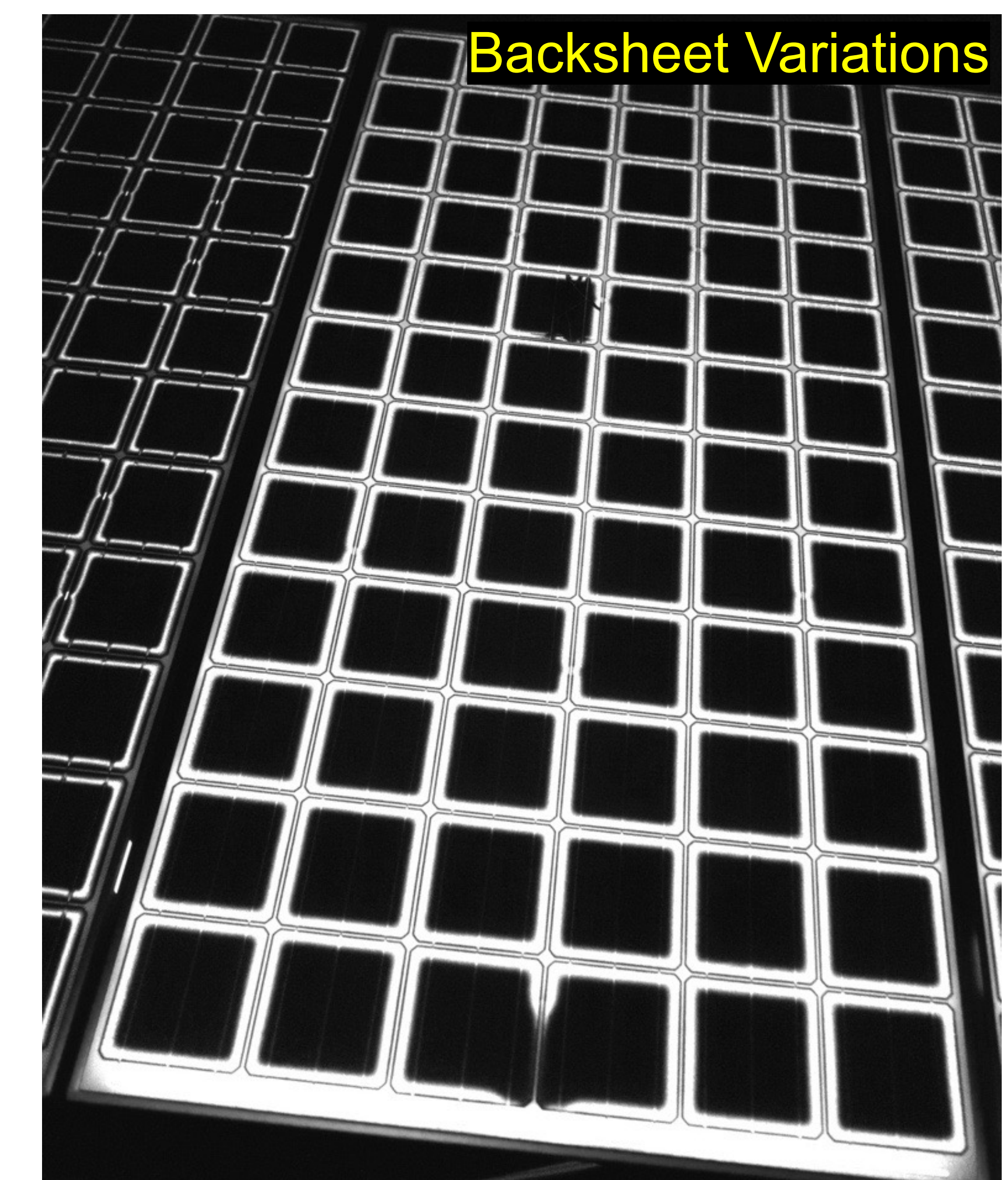
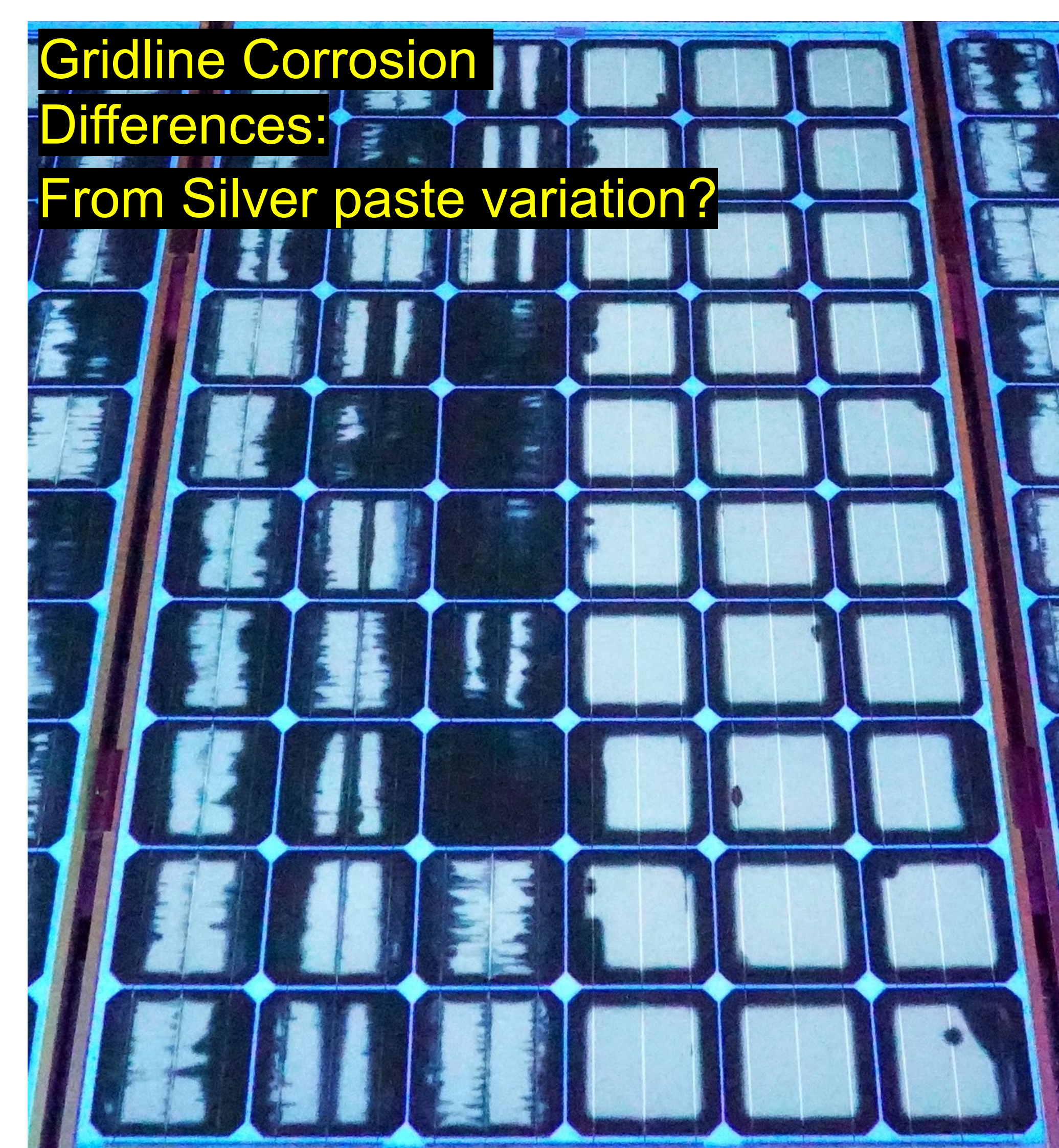
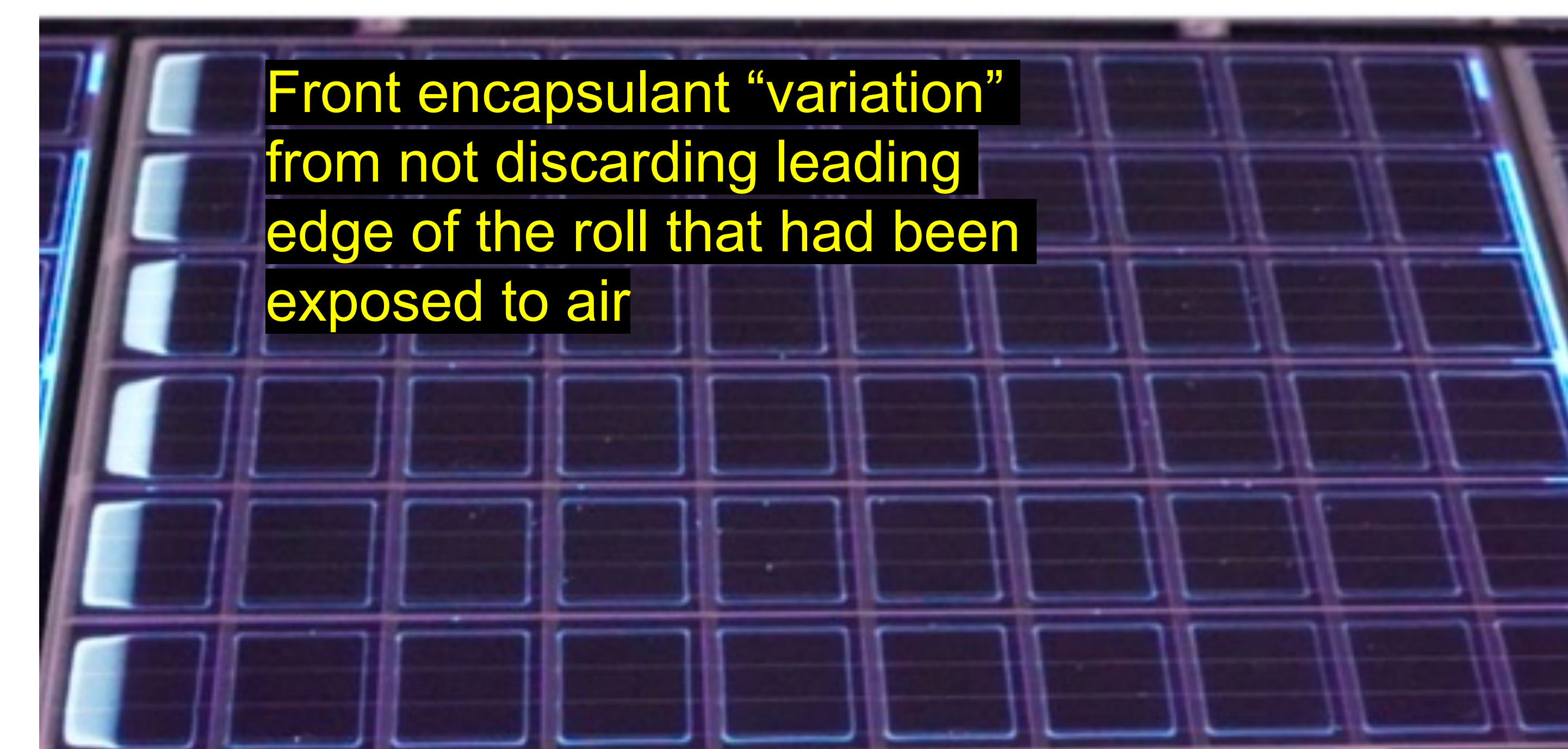
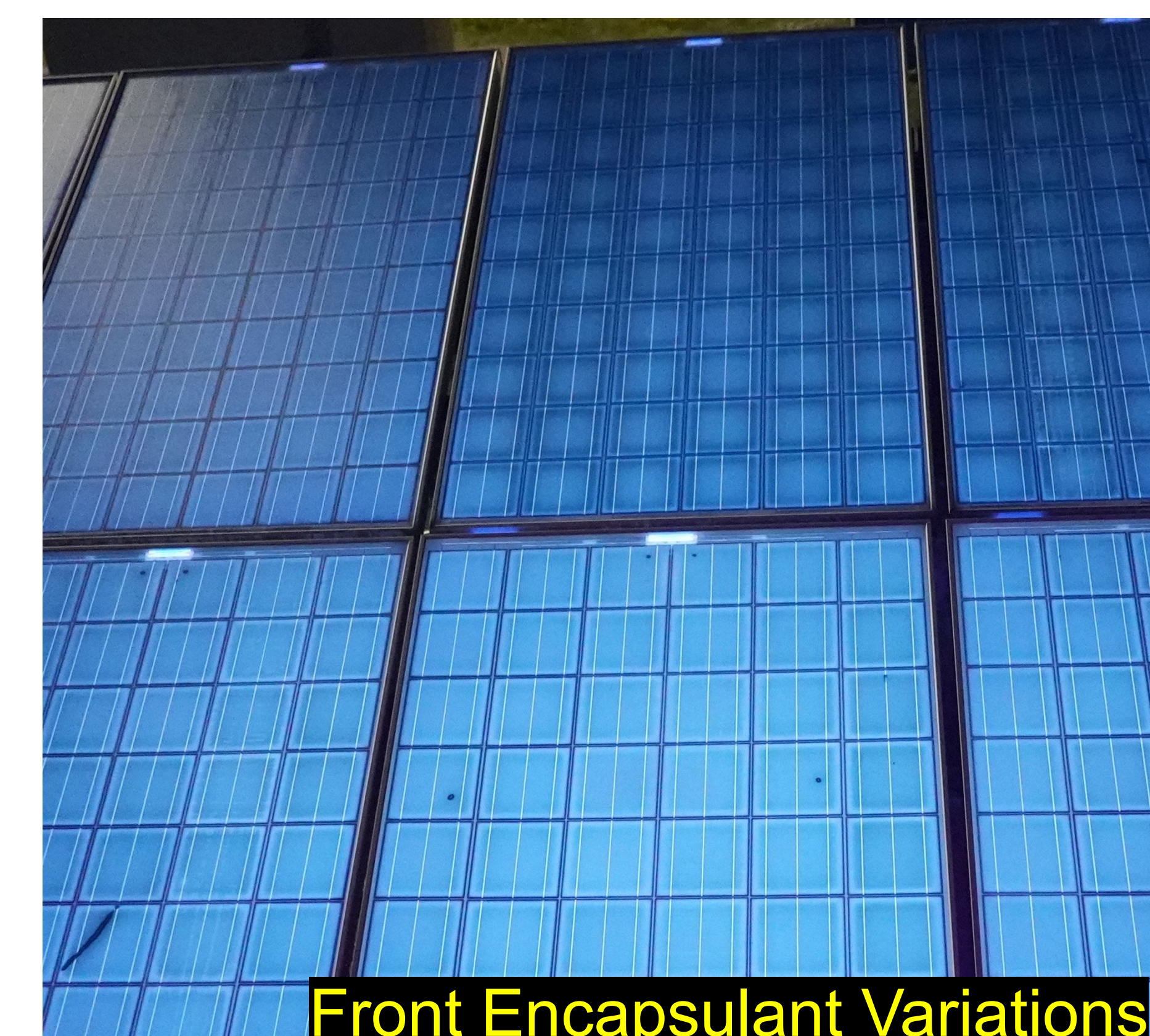
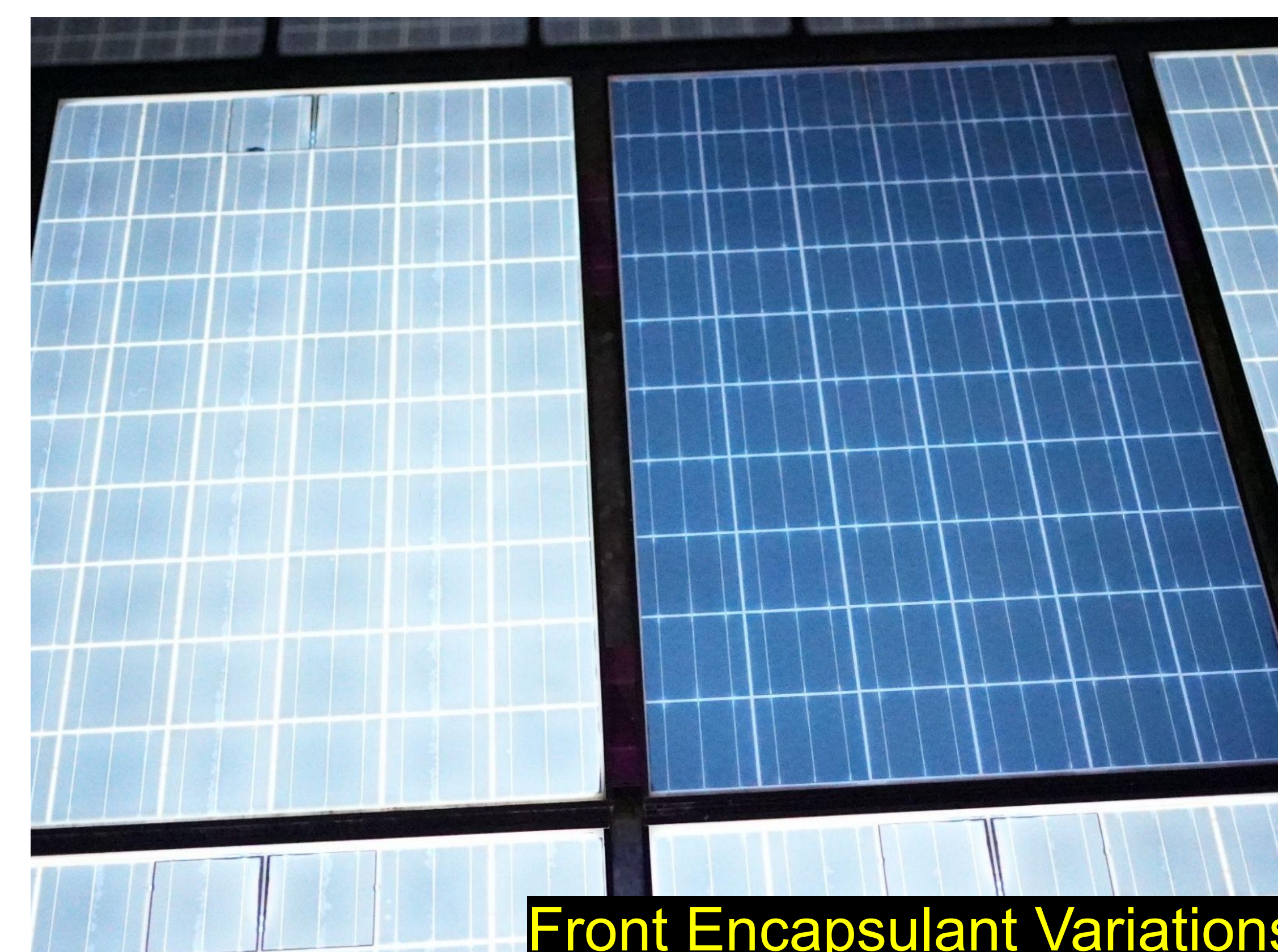
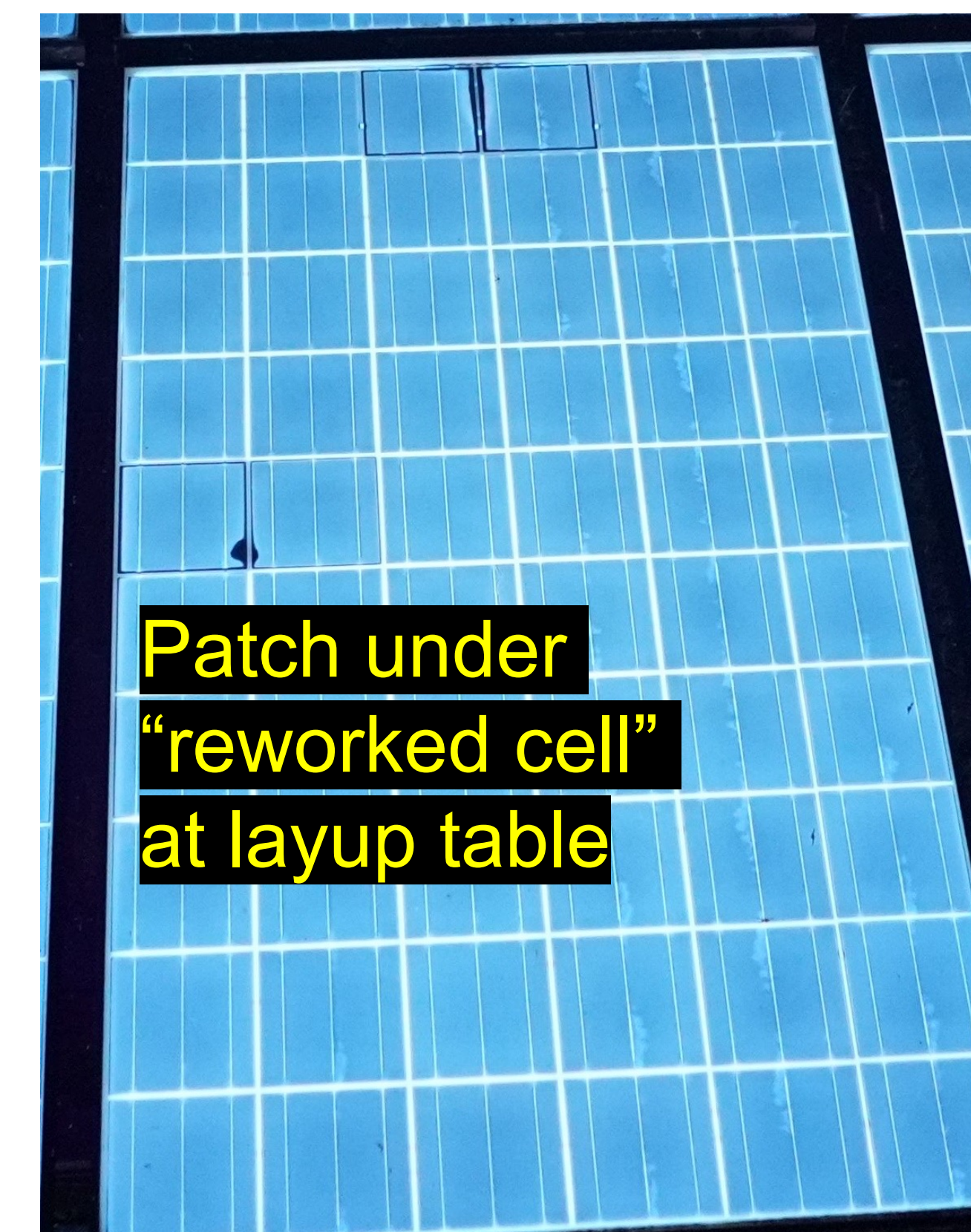
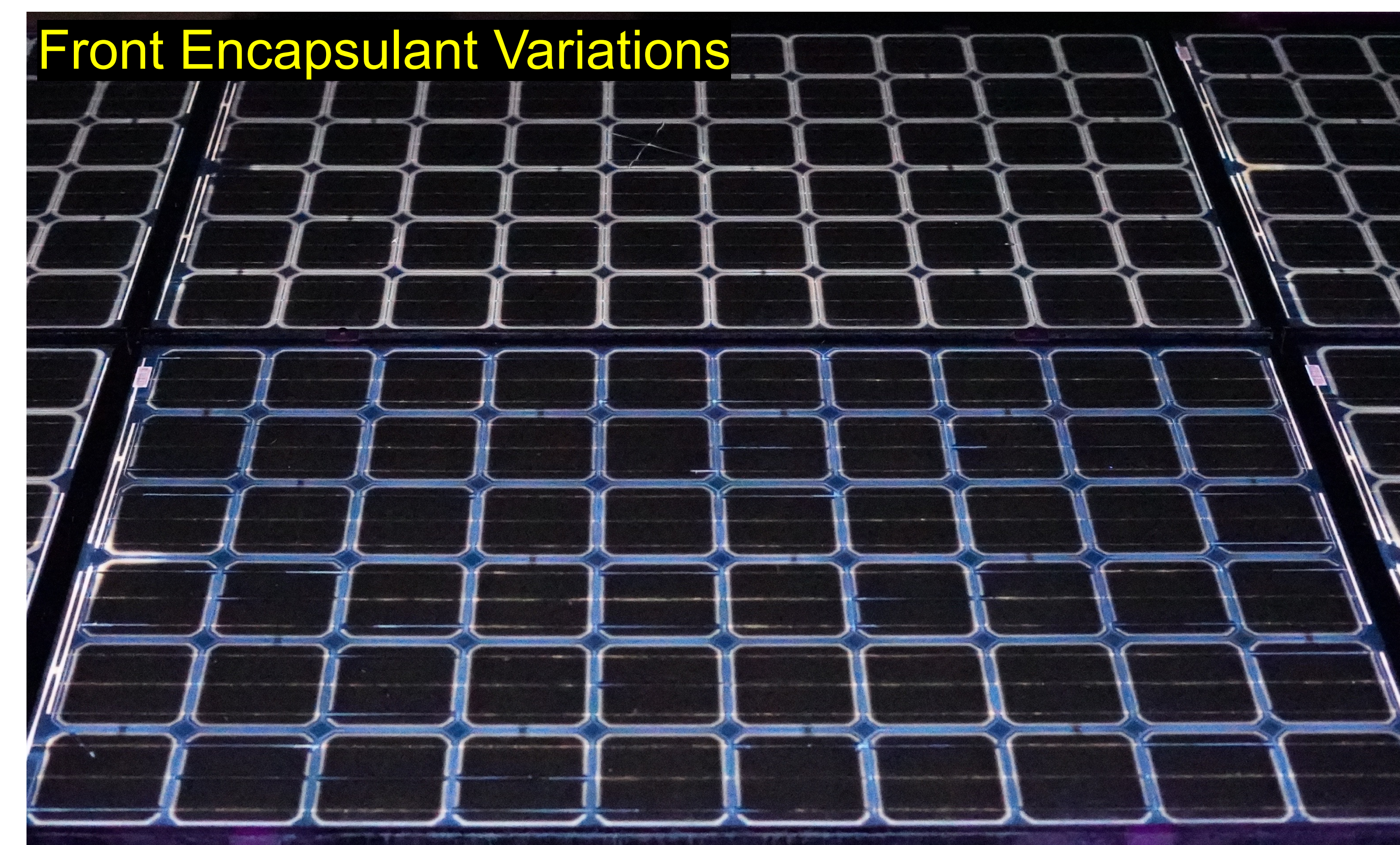
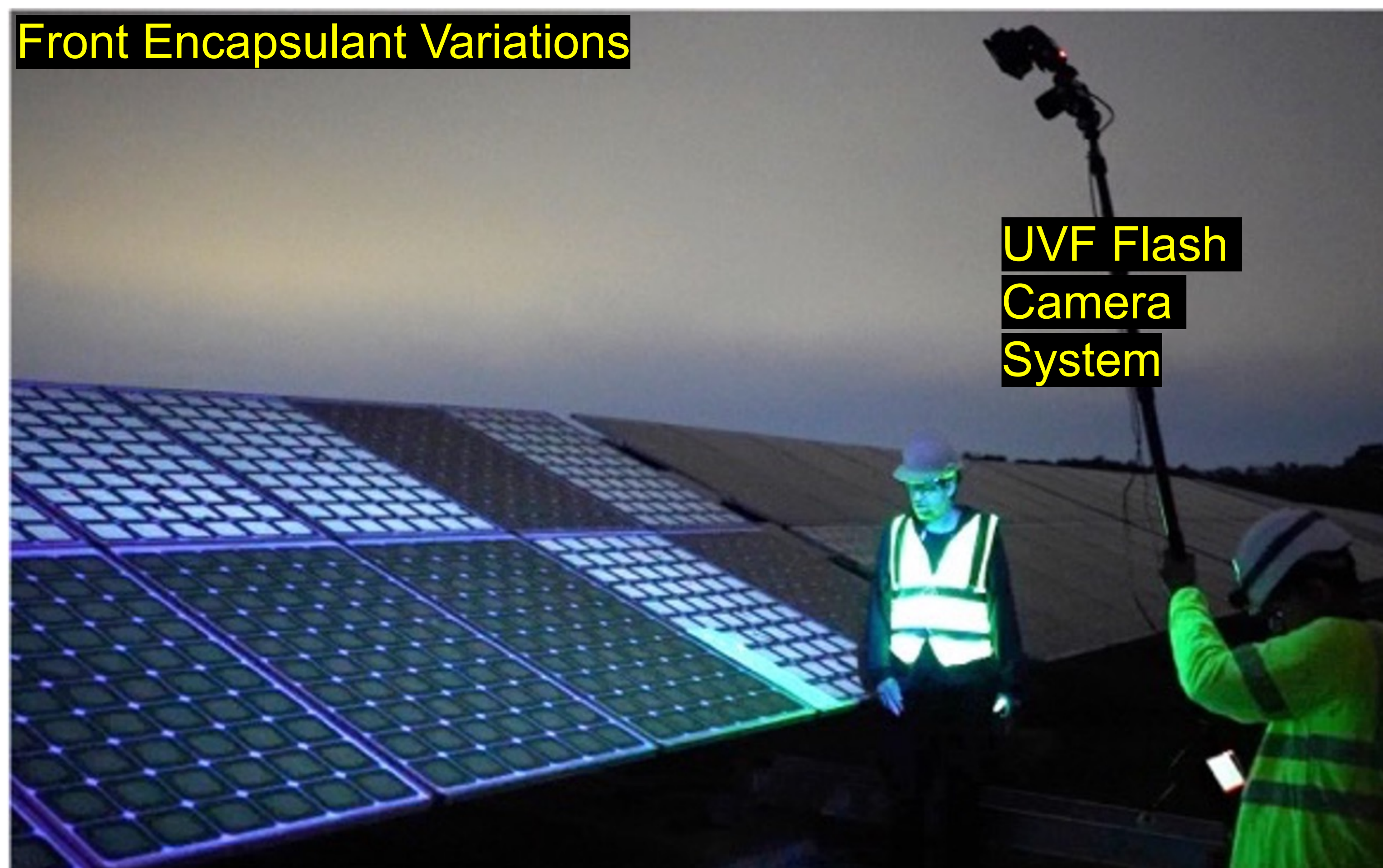
- UV Fluorescence (UVF) is a low-cost, high-throughput method of directly or indirectly seeing variations in the encapsulant layers, the polymer backsheet, silver paste, and other materials
- Can strengthen **warranty claims** and **insurance claims**
- Can strengthen the hand of system investors and insurers in conflicts with panel suppliers
- Can help determine which backsheets need “patching” due to cracking
- Can motivate panel suppliers to minimize BOM variations and to put each BOM through certification testing, driving quality through the industry

3. UV Fluorescence Background

- Heat and UV exposure cause the front encapsulant layer to fluoresce under UV exposure
- Oxygen activity “quenches” the fluorescence
- Oxygen can penetrate the polymer backsheet and cracks in the solar cells, resulting in dark bands by cracks
- Alternatively, if there is a much higher concentration of fluorophores in the rear encapsulant, these can diffuse through the cracks, results in bright lines in the crack locations
- Different encapsulants and backsheets fluoresce differently
- Corrosion of silver gridlines often appears as dark bands parallel to the gridlines

4. What BOM Variations Can We See?

- All UVF images captured with the BrightSpot Automation UVF Flash Camera System



This material is based upon work supported in part by the United States Department of Energy contract DE-EE0009347