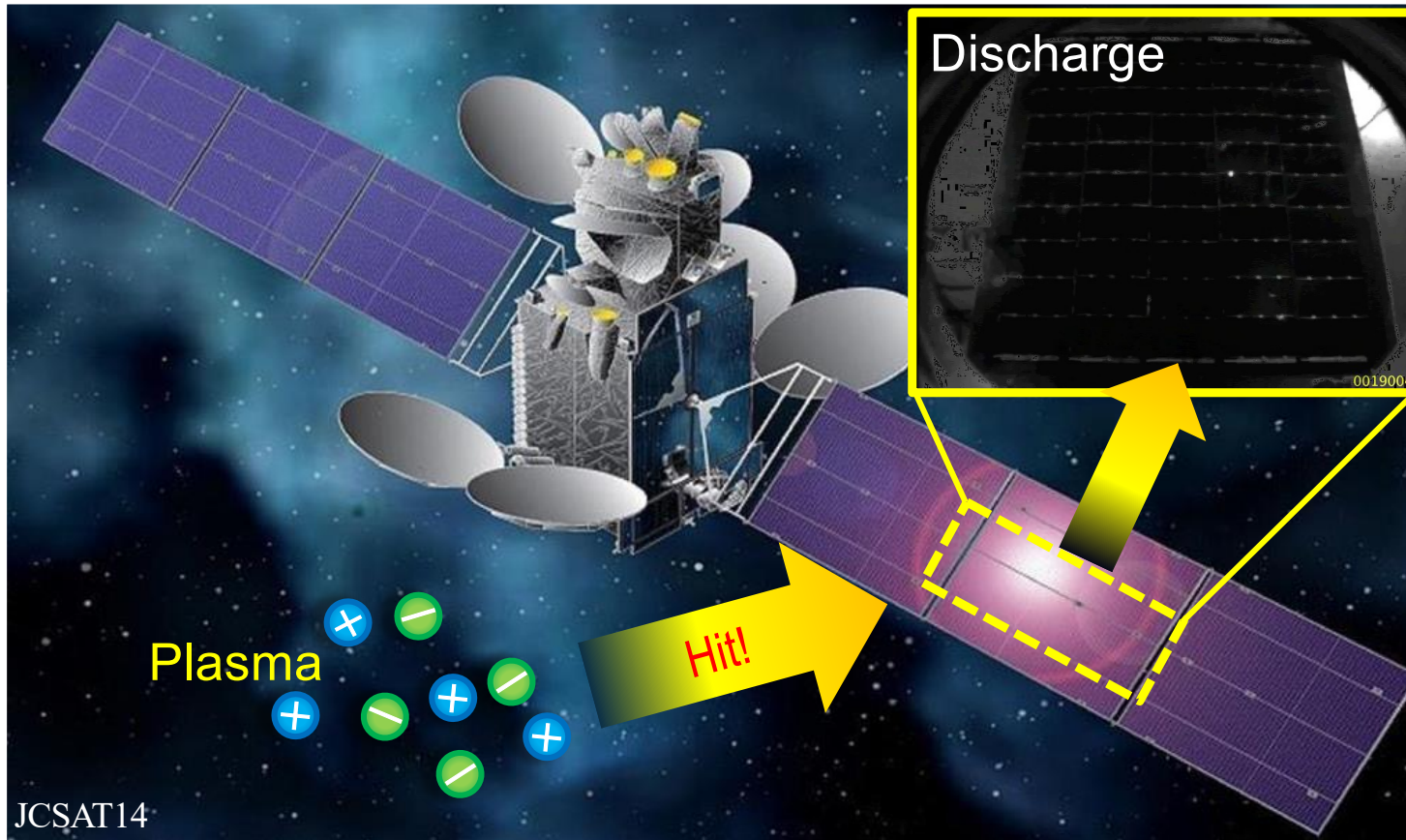


Surface potential measurement with Pockels effect under electron beam and vacuum ultraviolet environment

**Kazuhiro Toyoda, Masaki Takuma, Sayaka Kose, and Mengu Cho
Kyushu Institute of Technology**

Spacecraft charging and discharging



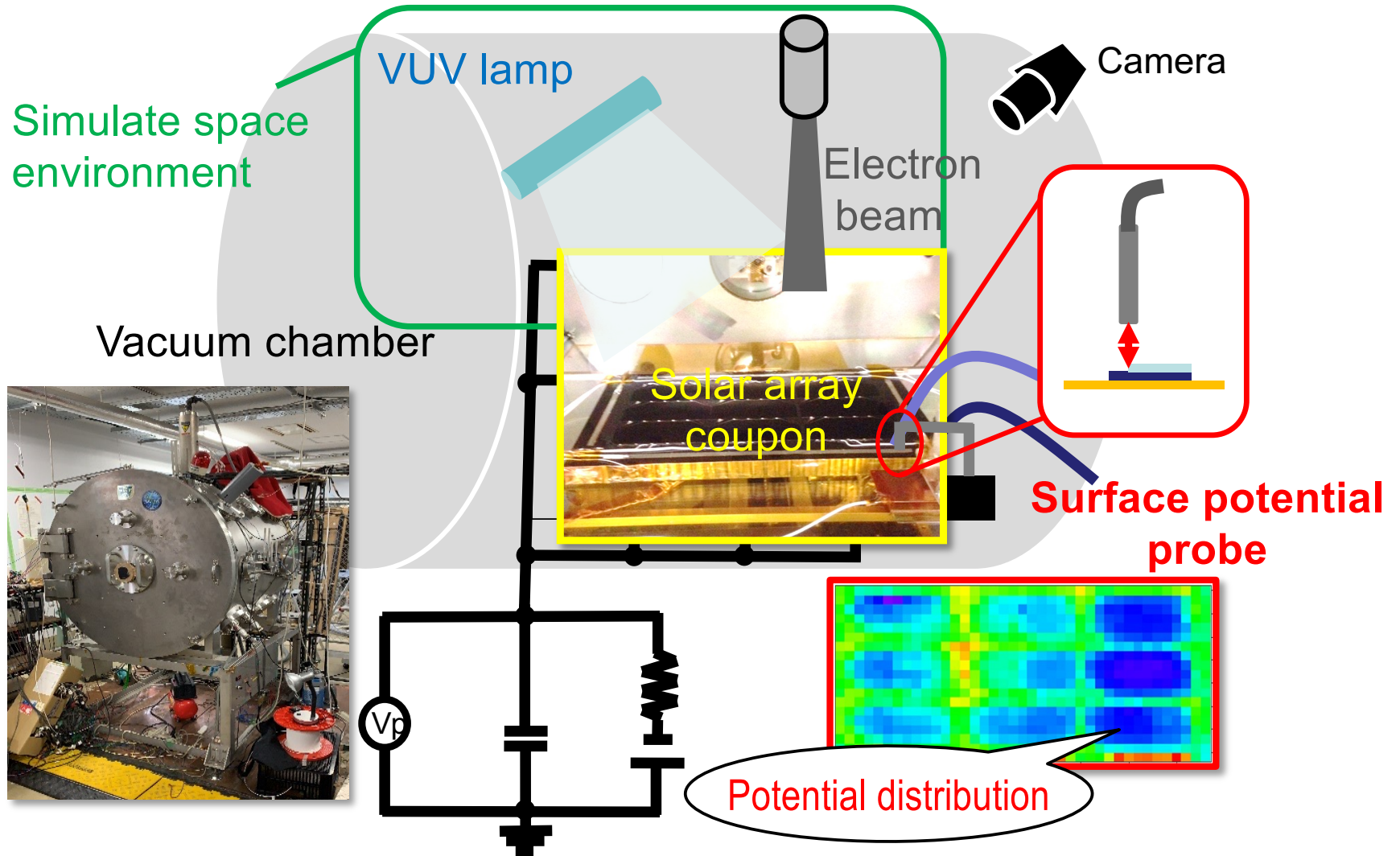
2

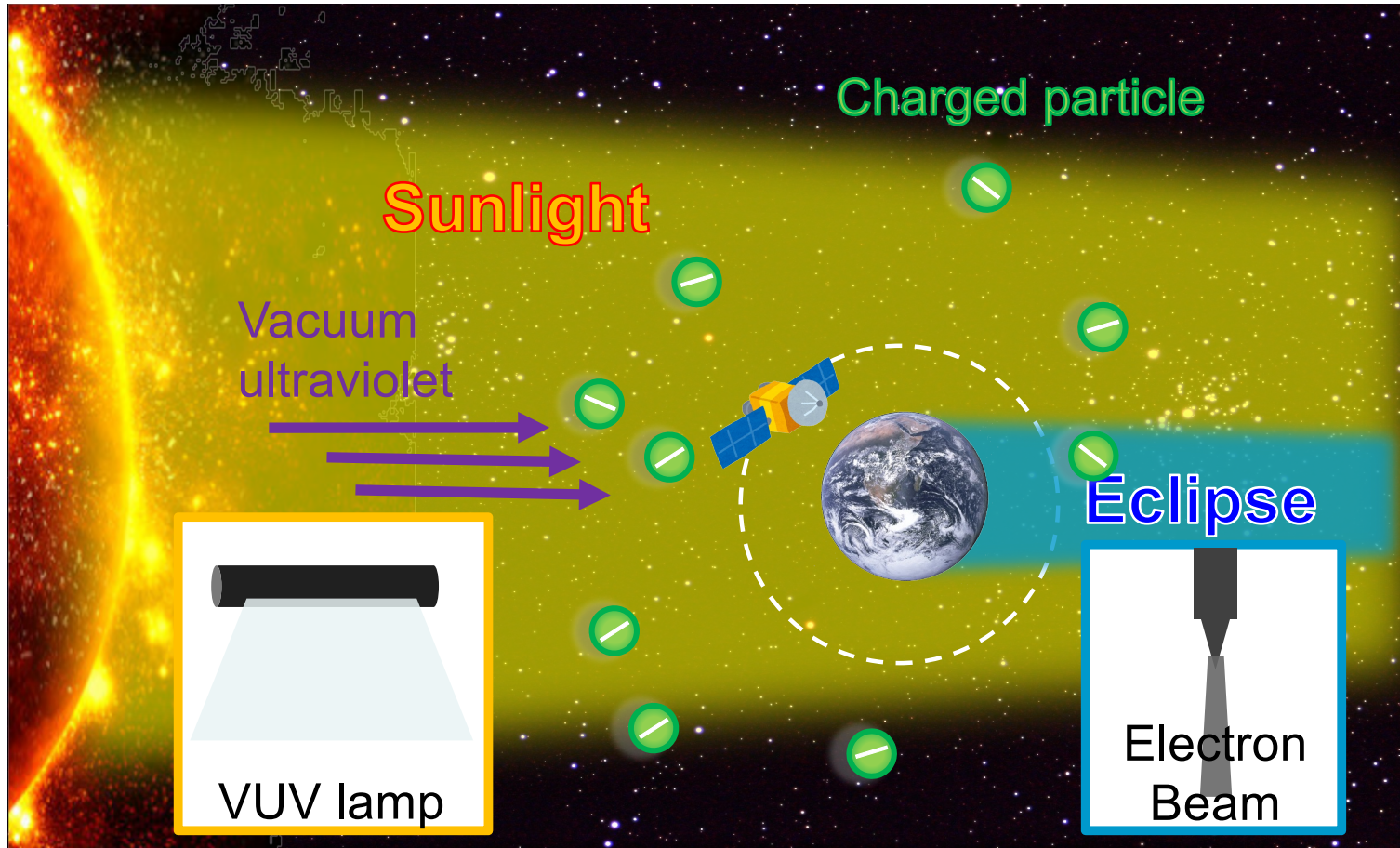


ESD ground test: ISO 11221

<https://www.jsat.net/jp/>

ESD experiment



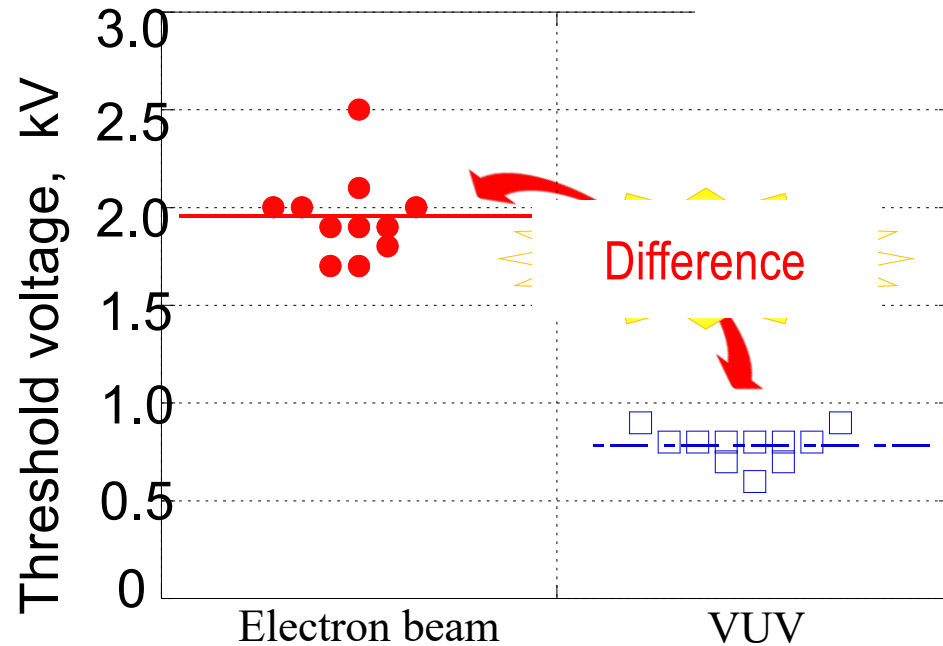
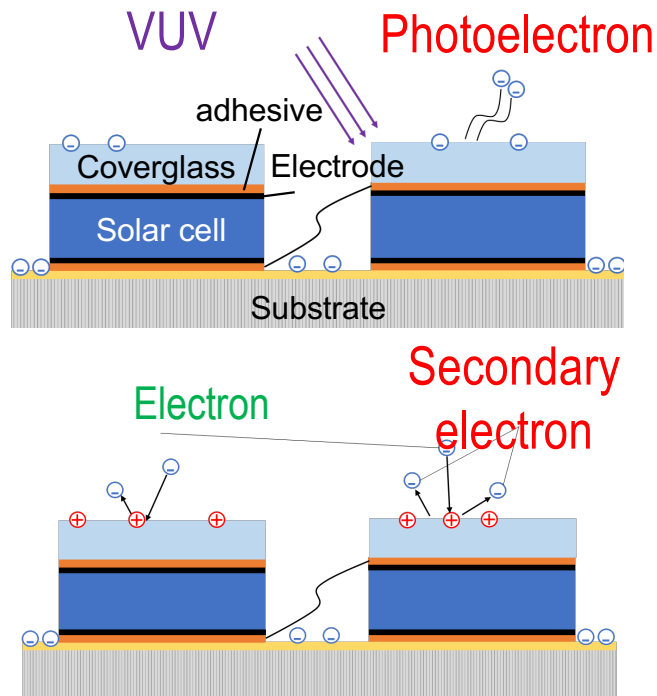


4



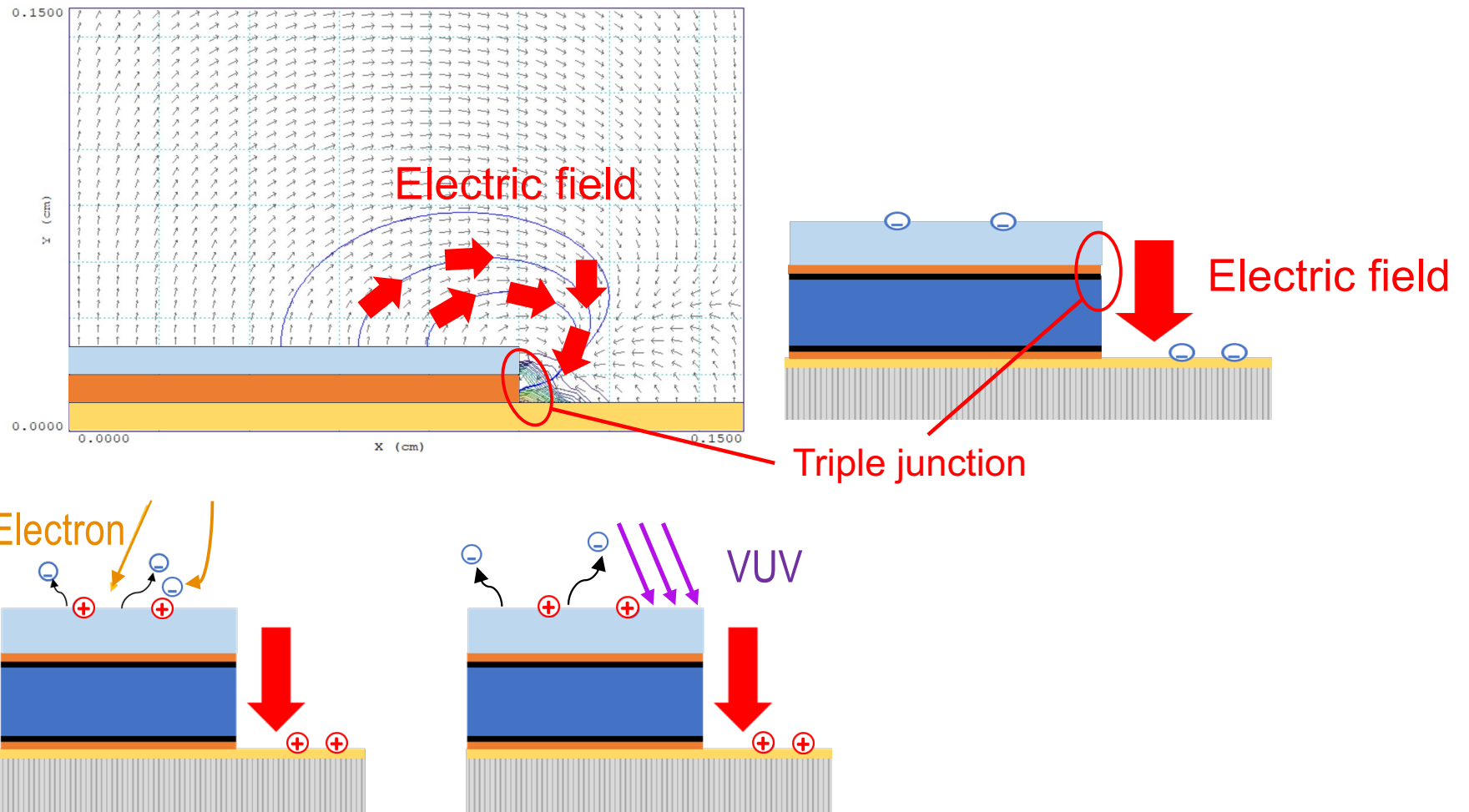
Difference in charging condition?

Difference of threshold in charging method



Caused by the difference in charging near edge?

Hypothesis of threshold difference

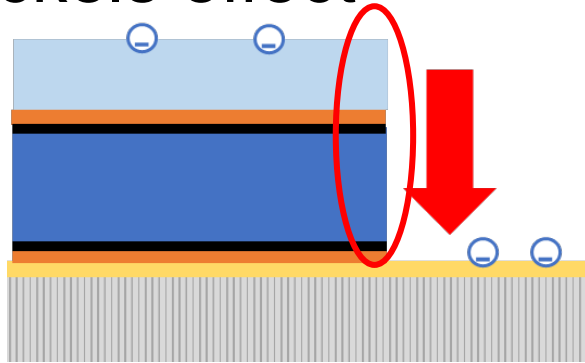


Purpose of this study

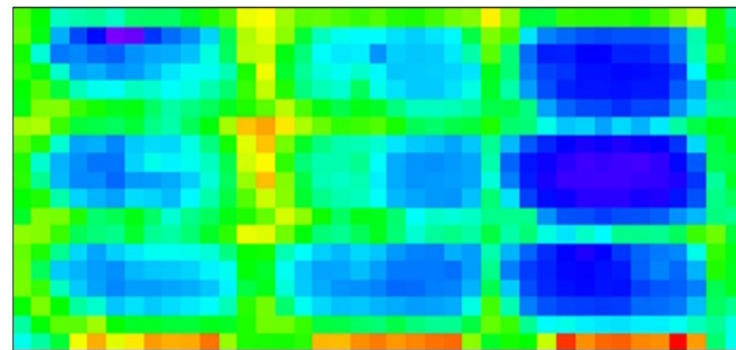
Consideration of the difference in threshold voltage due to the difference in charging method

➡ Observe the surface potential distribution near edge

➡ Improve spatial resolution of surface potential with Pockels effect

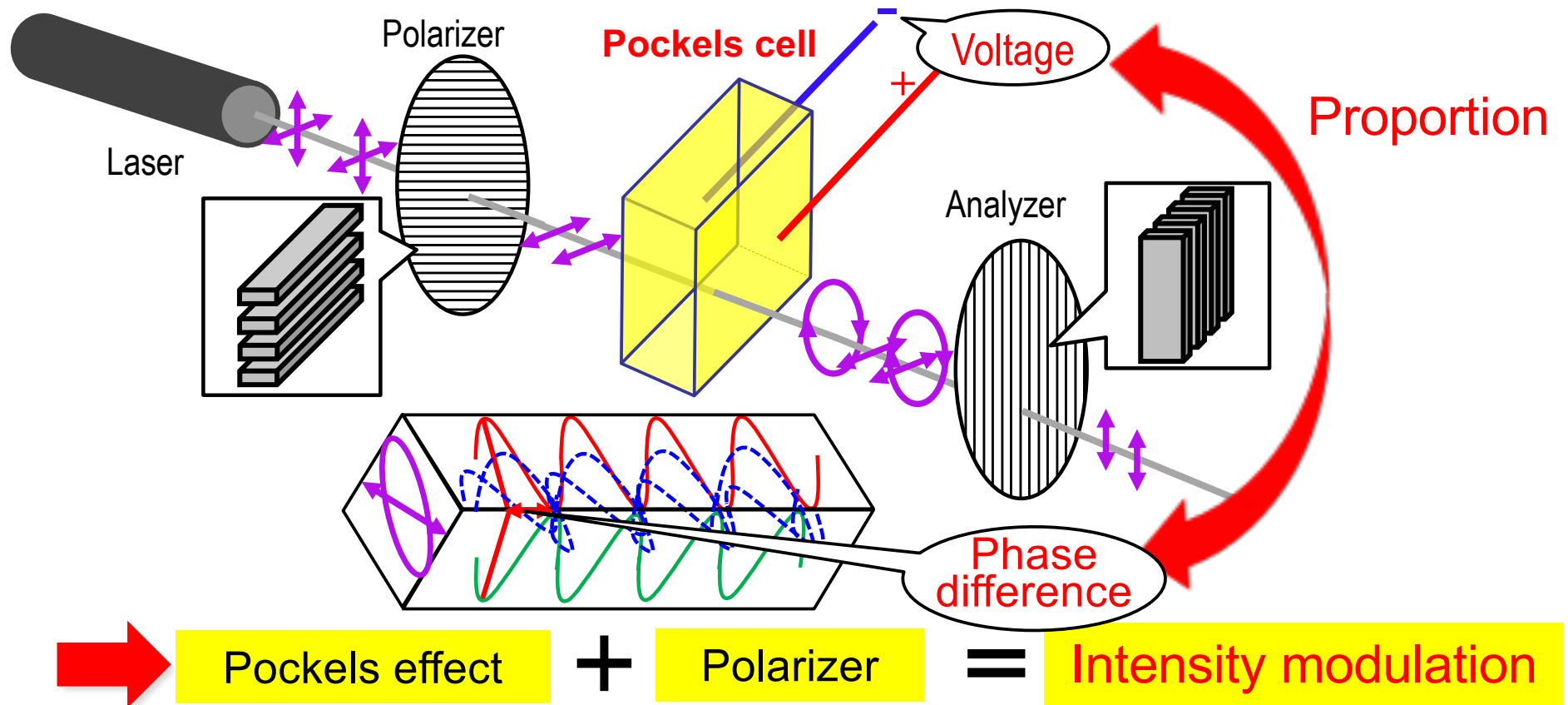


Low spatial resolution

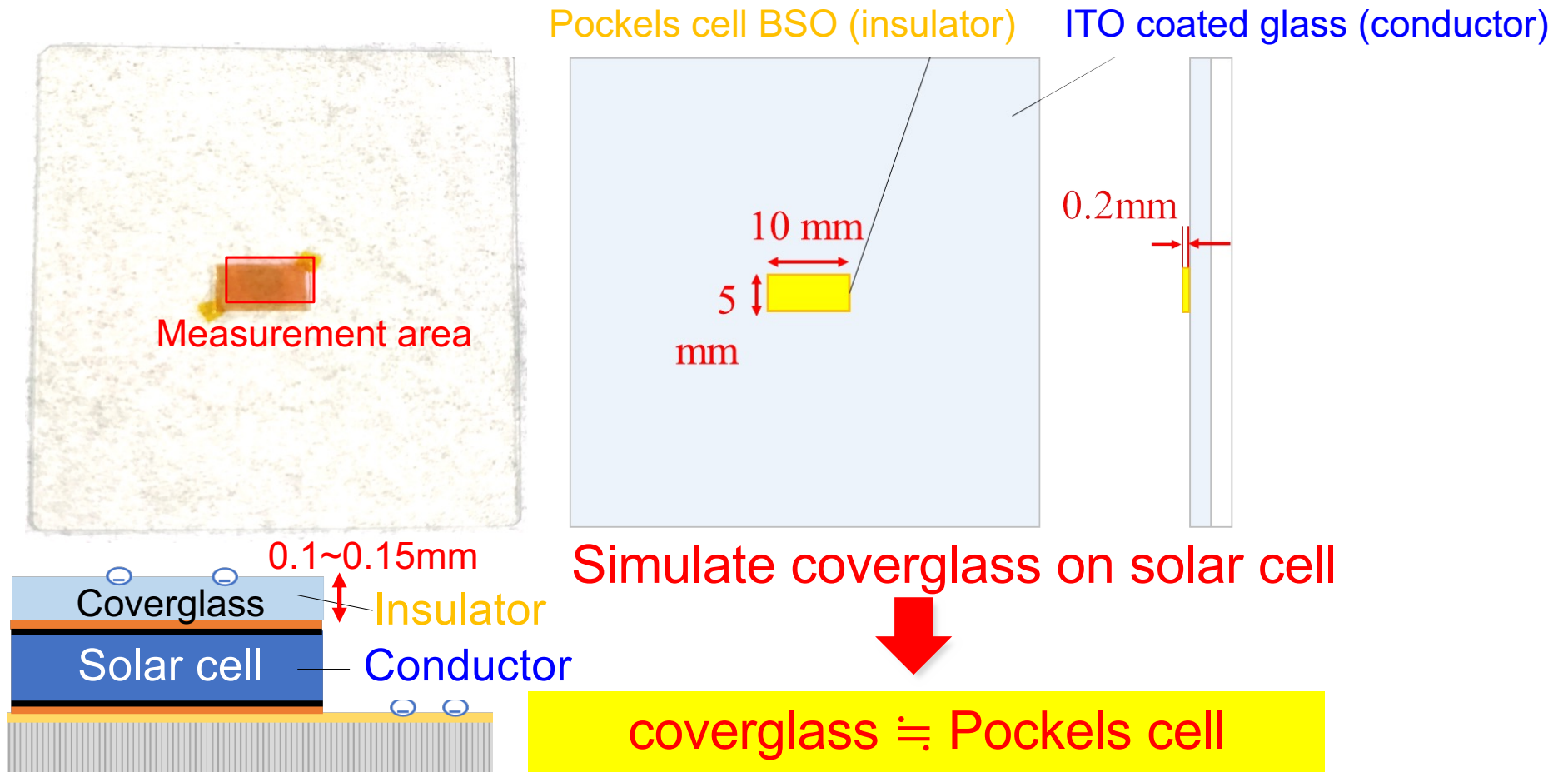


Pockels effect

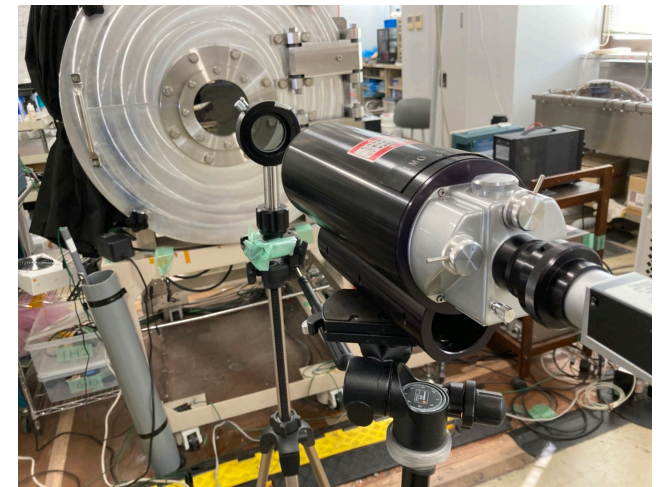
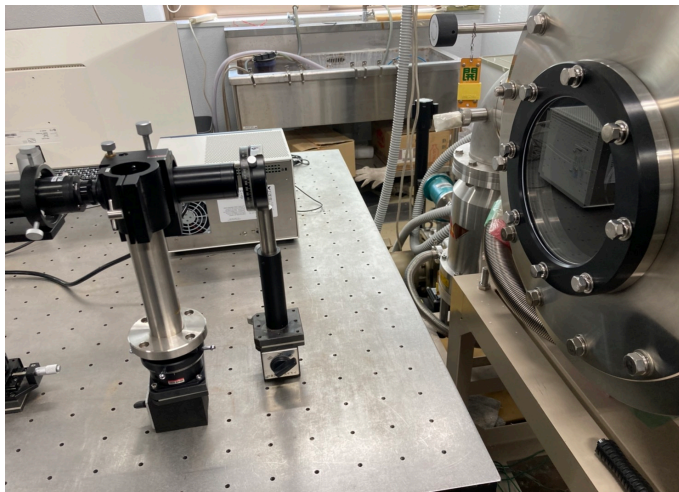
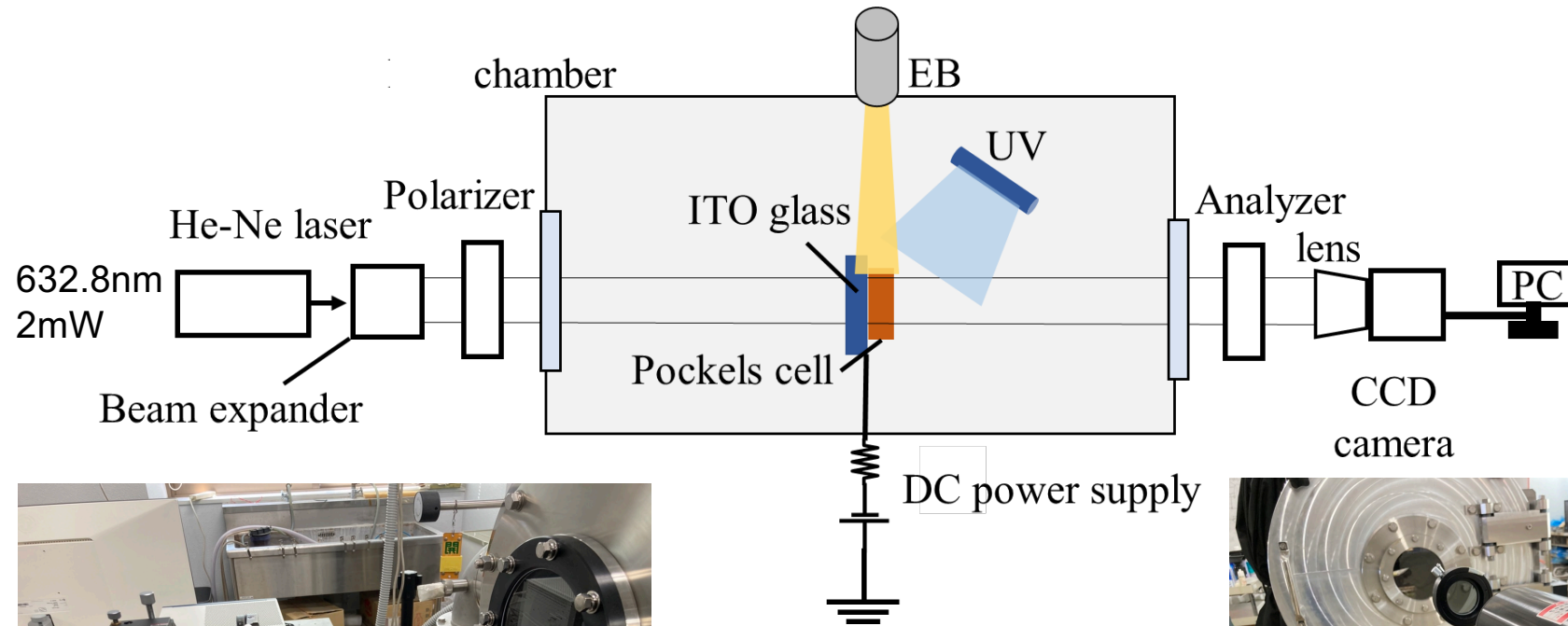
Change of refractive index in optical medium induced by an electric field



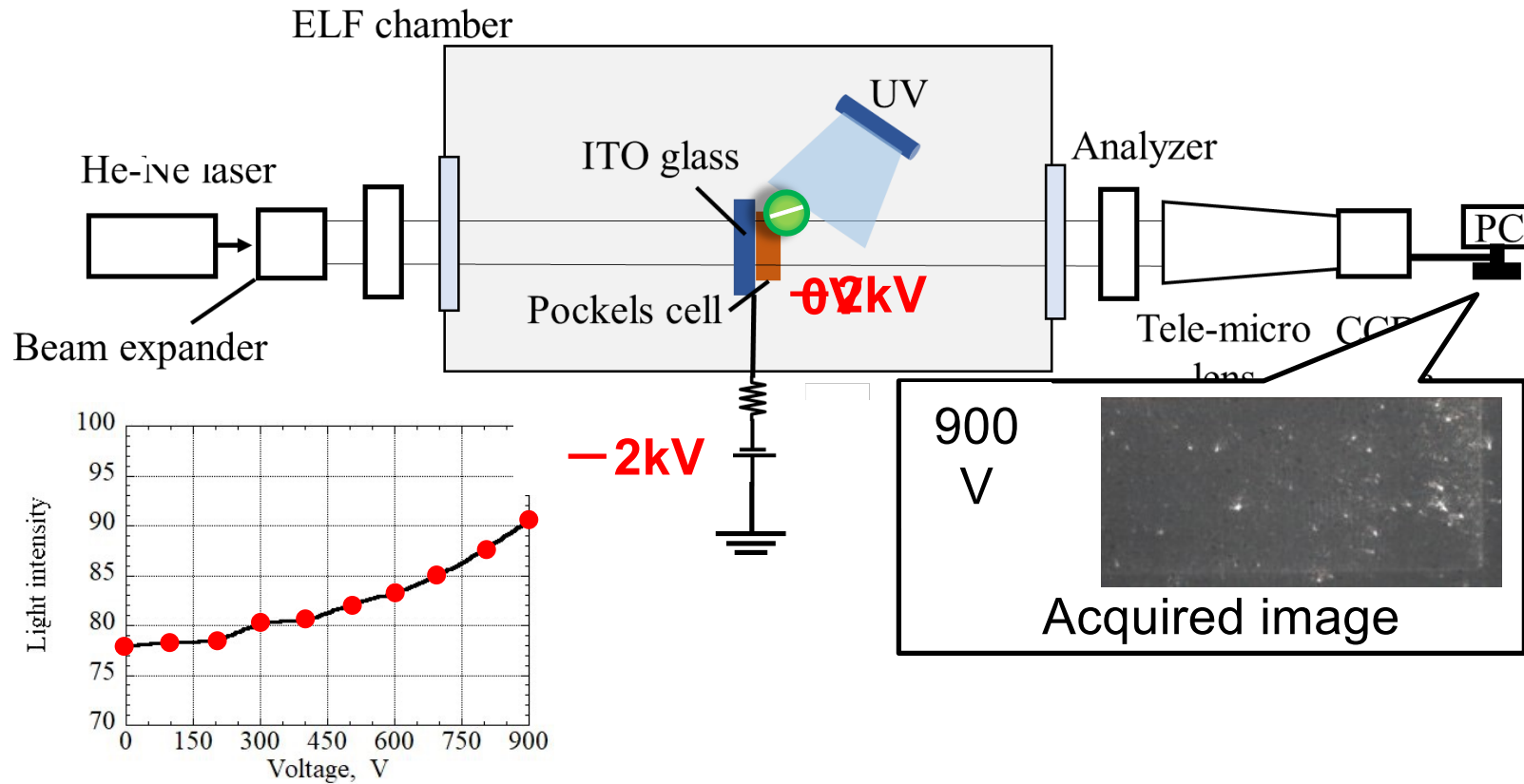
Experimental sample



Experimental setup



Calibration

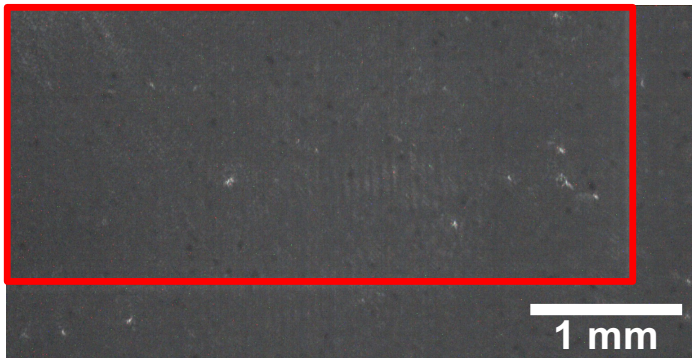


Acquire image for each
vias voltage

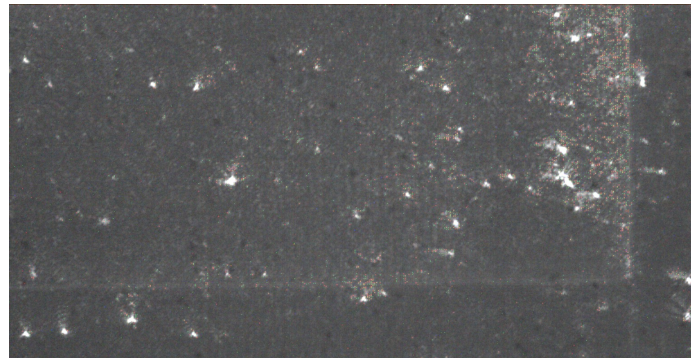
→ Average →

Calibration

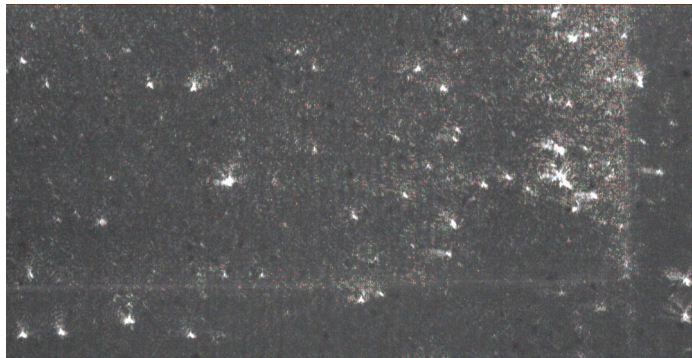
Result with VUV



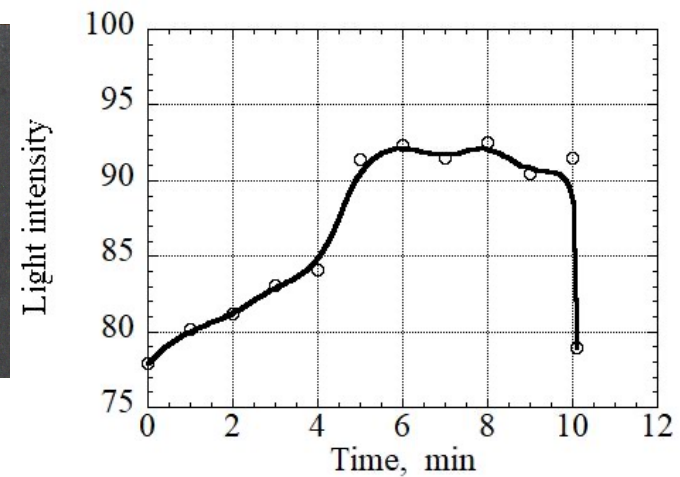
(a) Before



(b) During charging

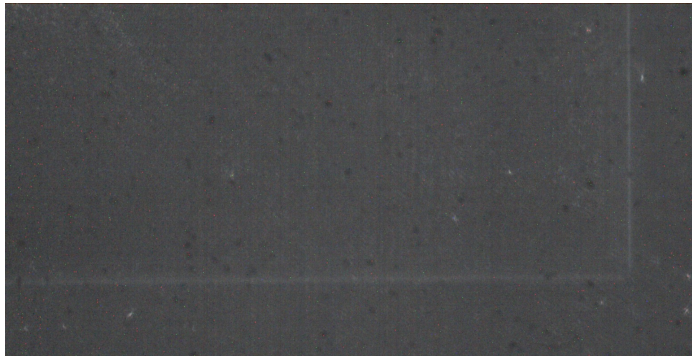


(c) Just before discharge

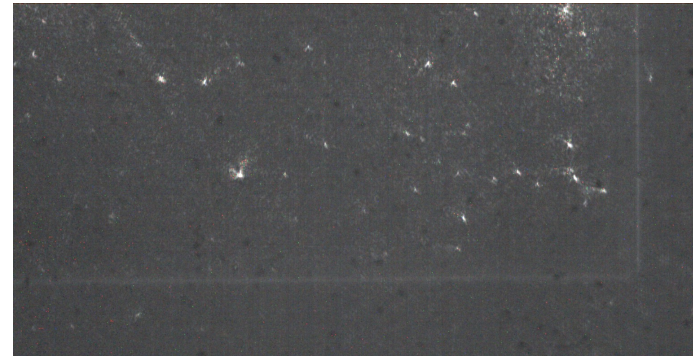


 Confirm intensity modulation with VUV irradiation

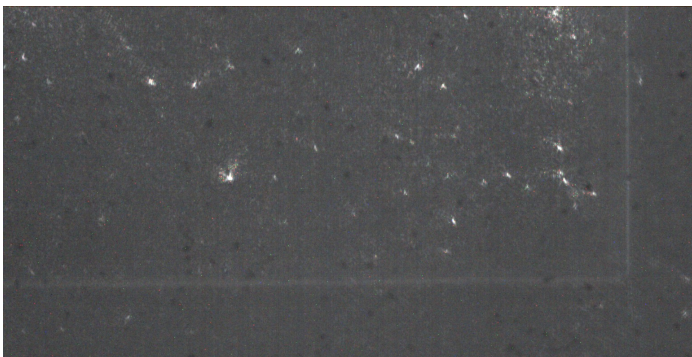
Result with electron beam



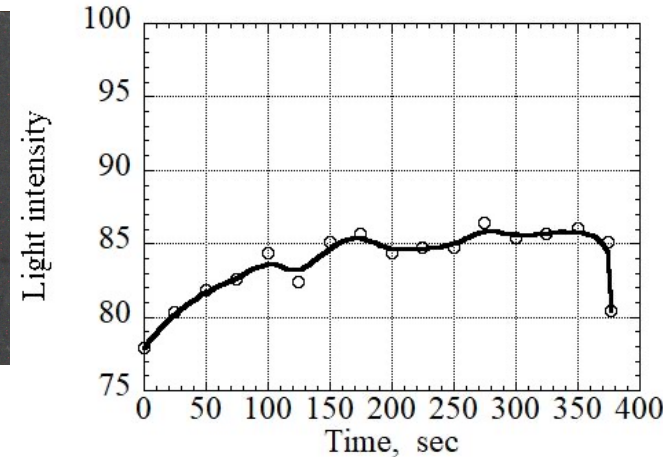
(a)Initial



(b)During charging

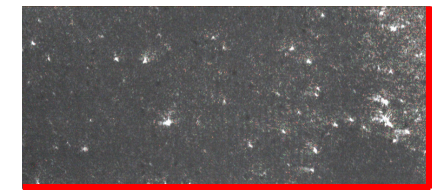
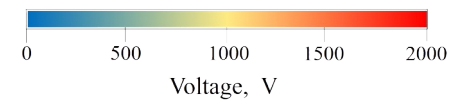
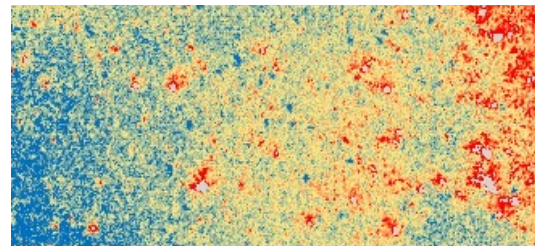
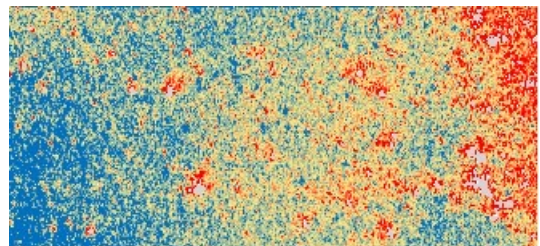
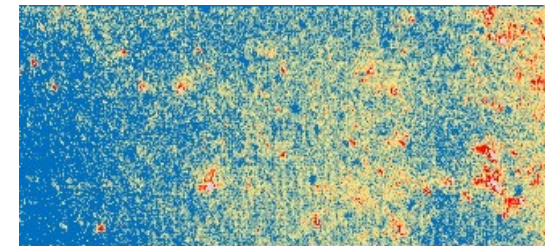
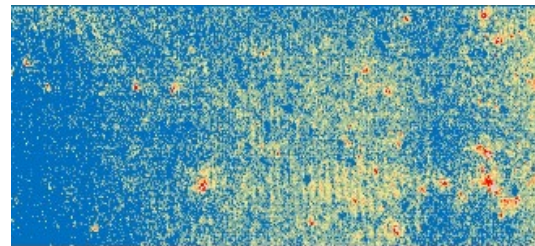
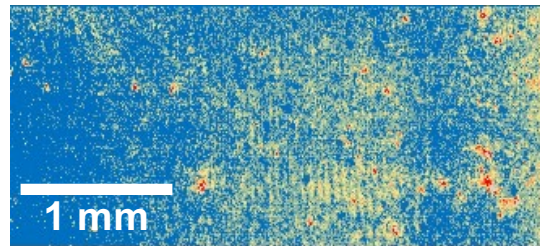


(c)Just before discharge



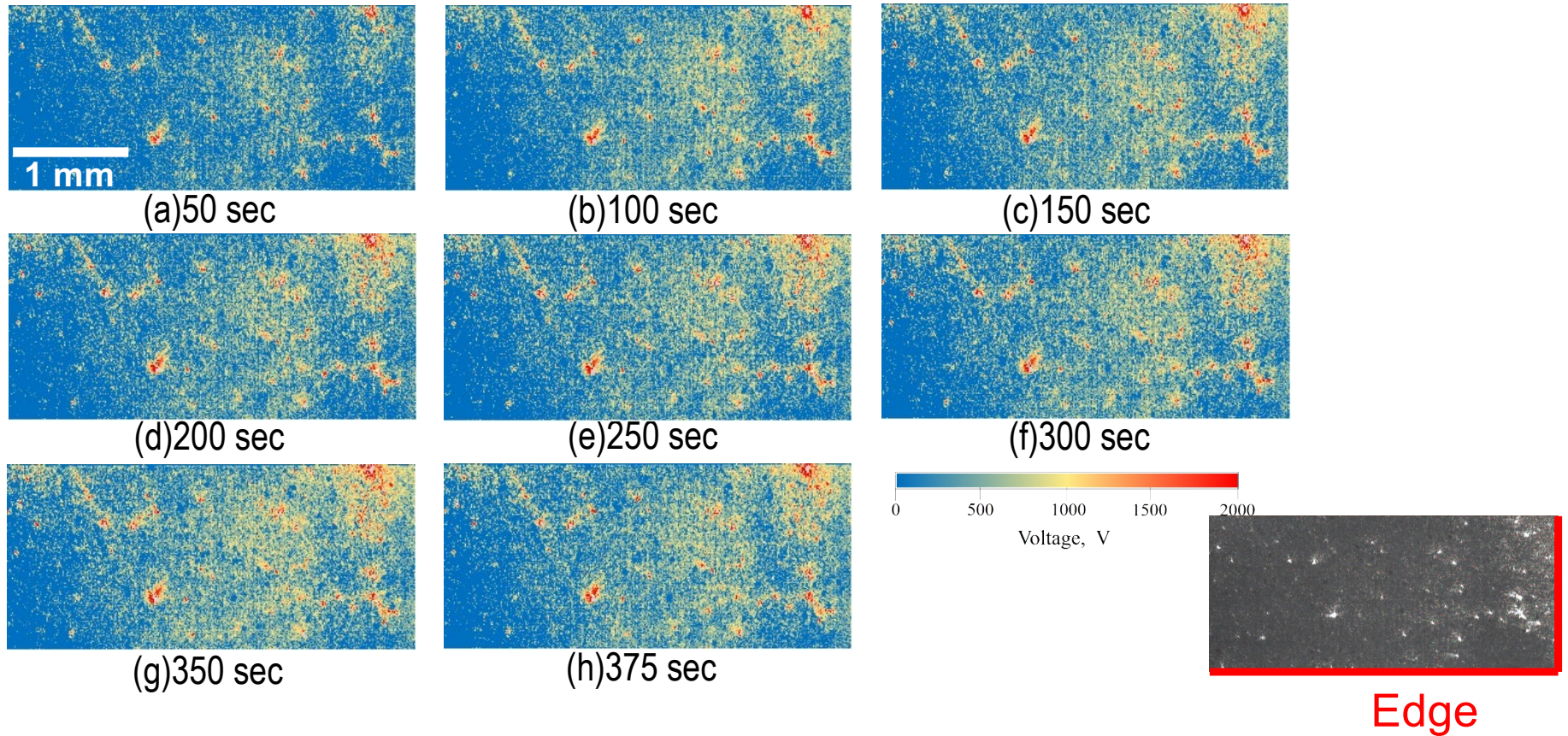
Confirm intensity modulation with electron beam

Potential distribution with VUV



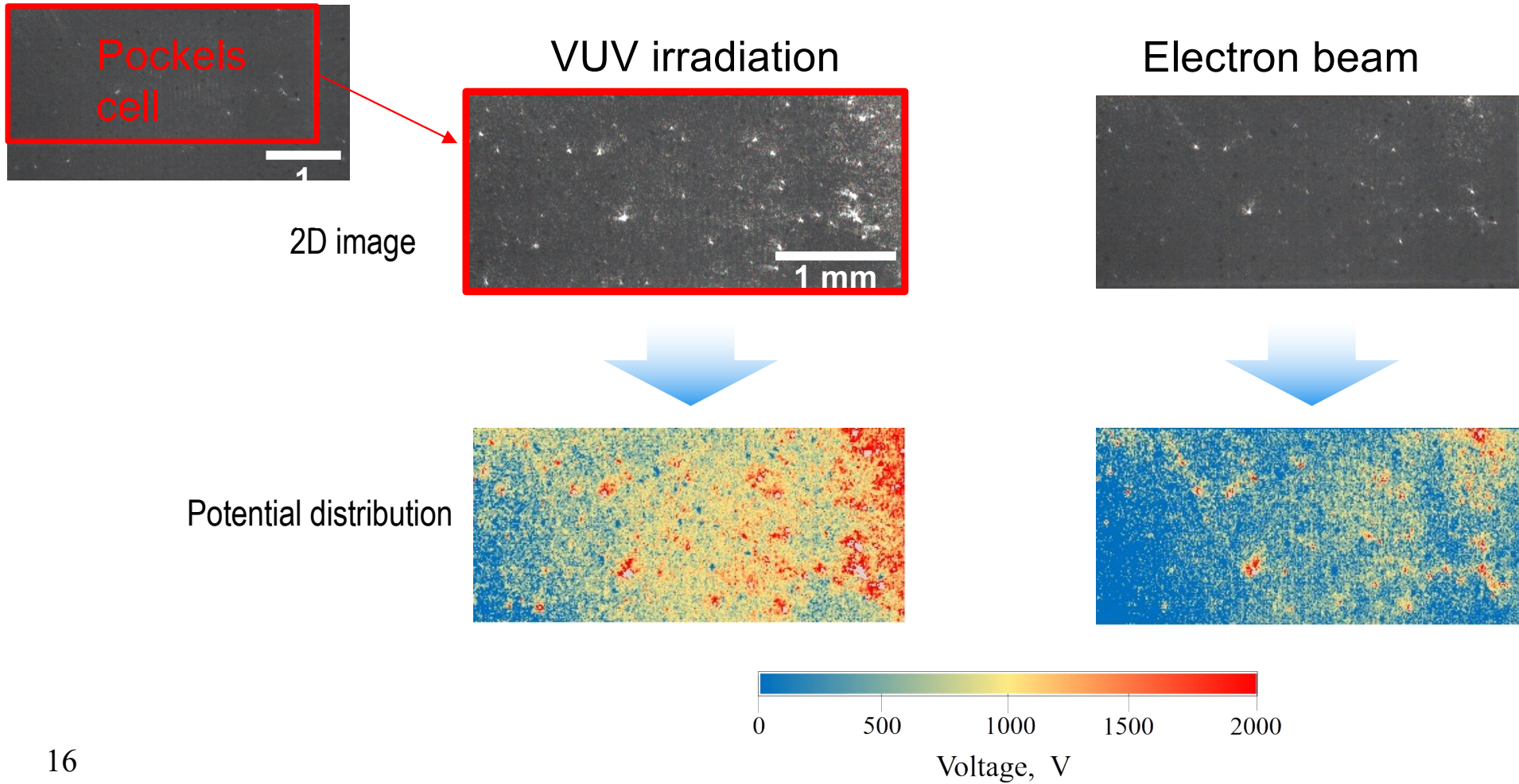
Pockels cell edge is charged

Potential distribution with electron beam



Pockels cell edge is hard to charge

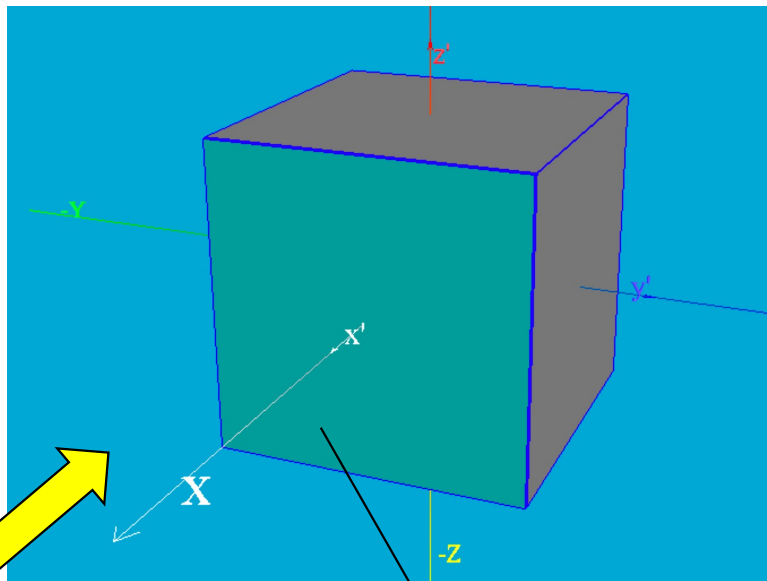
Surface potential distribution



Simulation

MUSCAT

100 mm aluminum cube



Sunlight

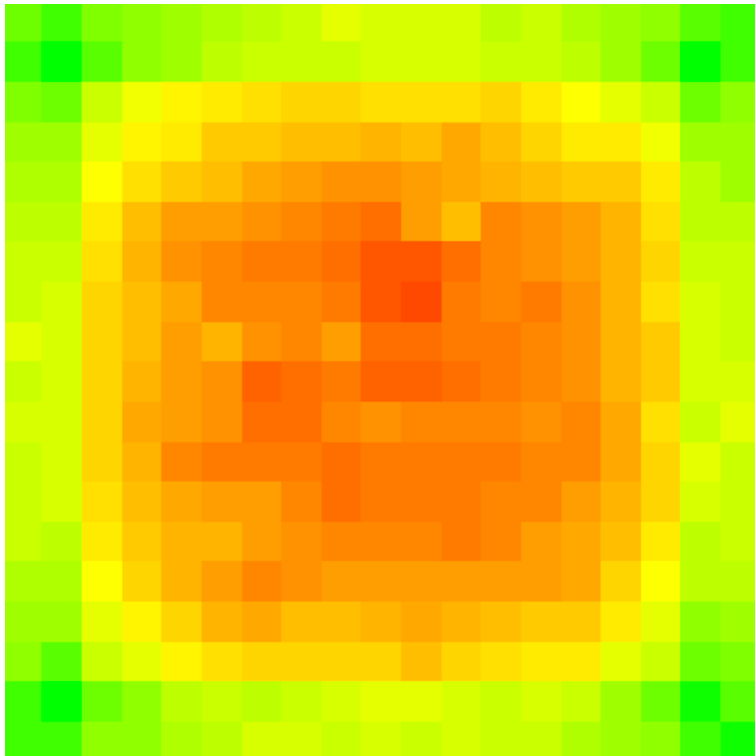
Coverglass

GEO environment:
electron & ion
5 keV 10^6 m^{-3}

Calculation termination condition:
potential difference $> 1\text{kV}$

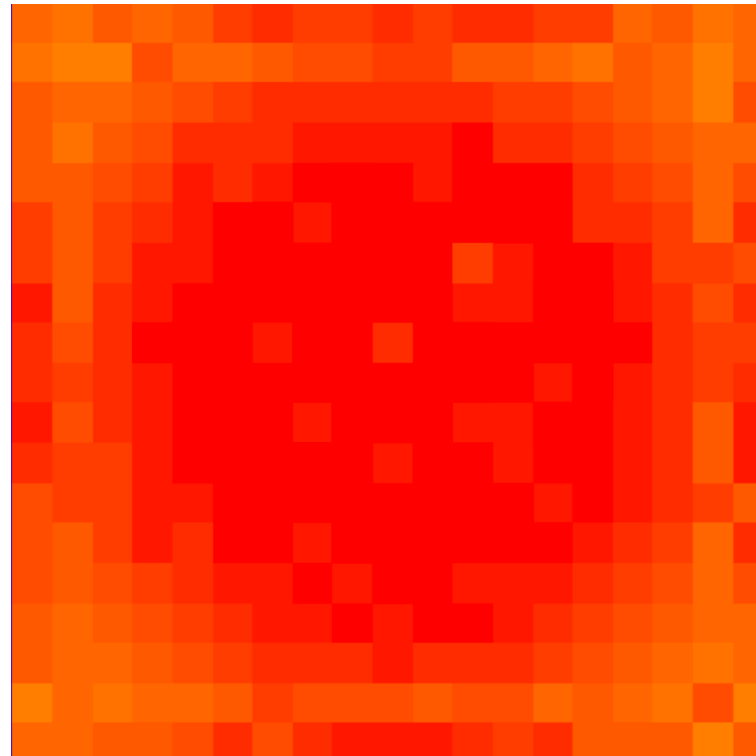
Result

without sunlight

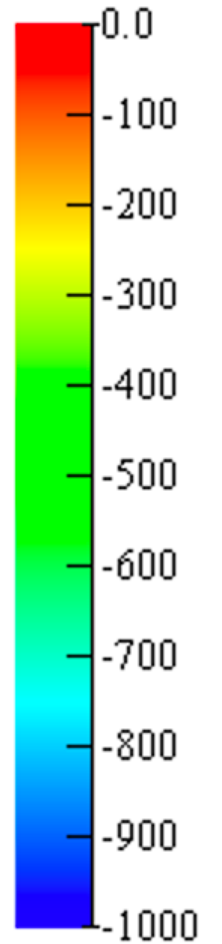


Electron beam

with sunlight



VUV (and Electron)



Conclusion

- Surface potential distribution was acquired visually with the Pockels effect.
- The Pockels cell edge was charged with VUV irradiation, however the edge was hard to charge with electron beam.
- The surface charging simulation also showed that the insulator edge was hard to charge with electron beam.

Thank you for your kind attention!