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Temperature Dependence on Electrostatic Discharge in a Simulated Space Plasma Environment

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JAXA

宇宙航空研究開発機構

Japan Aerospace Exploration Agency

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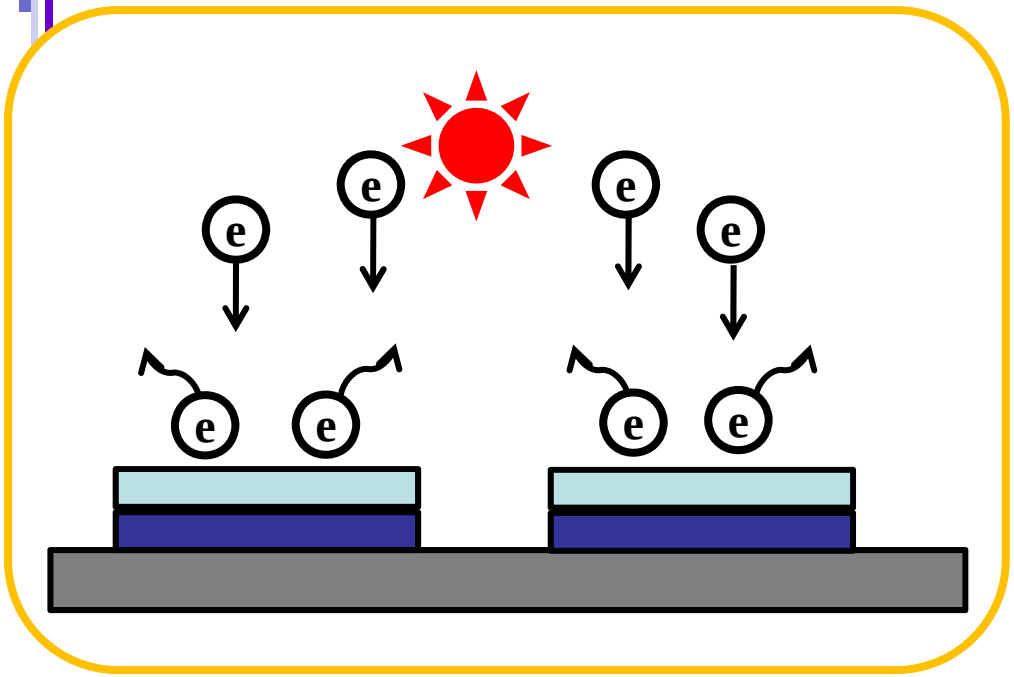
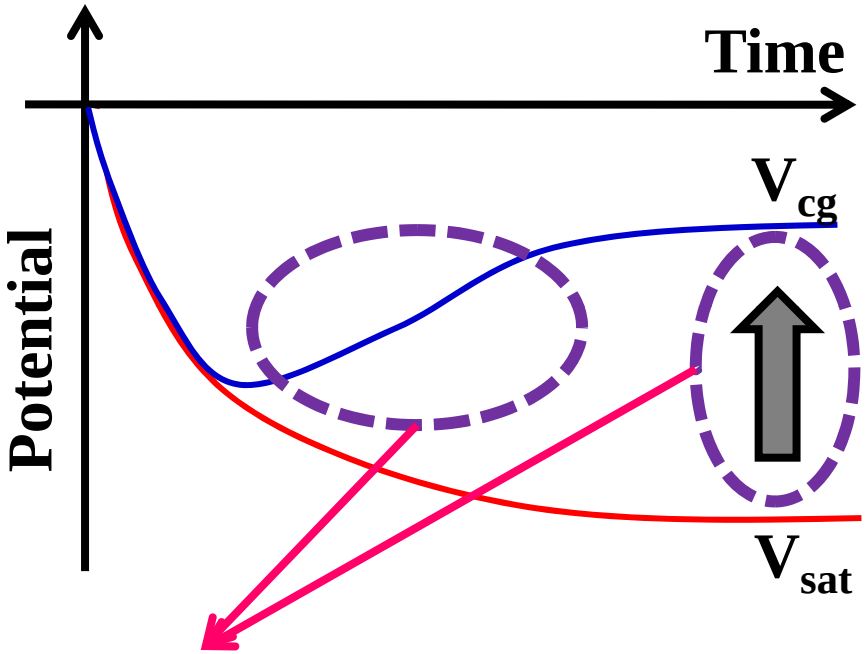
Background





Depends on temperature??

- **Discharge number estimation**
- **Proper experiment condition for ESD test**

Collaboration research

宇宙航空研究開発機構
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Temperature dependence on primary discharge

	JAXA	KIT
Threshold voltage	GEO	
Discharge frequency		LEO

Threshold of differential voltage

Experiment technique and result

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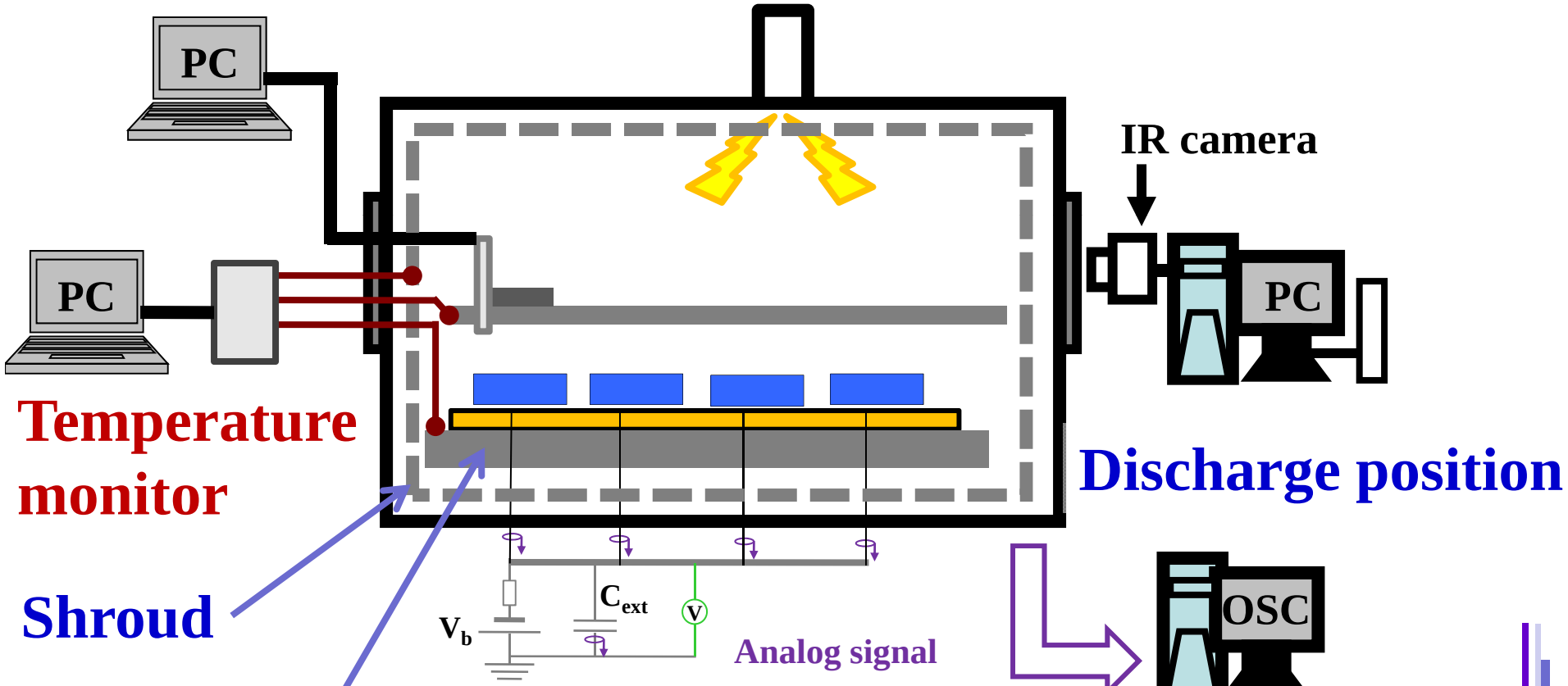
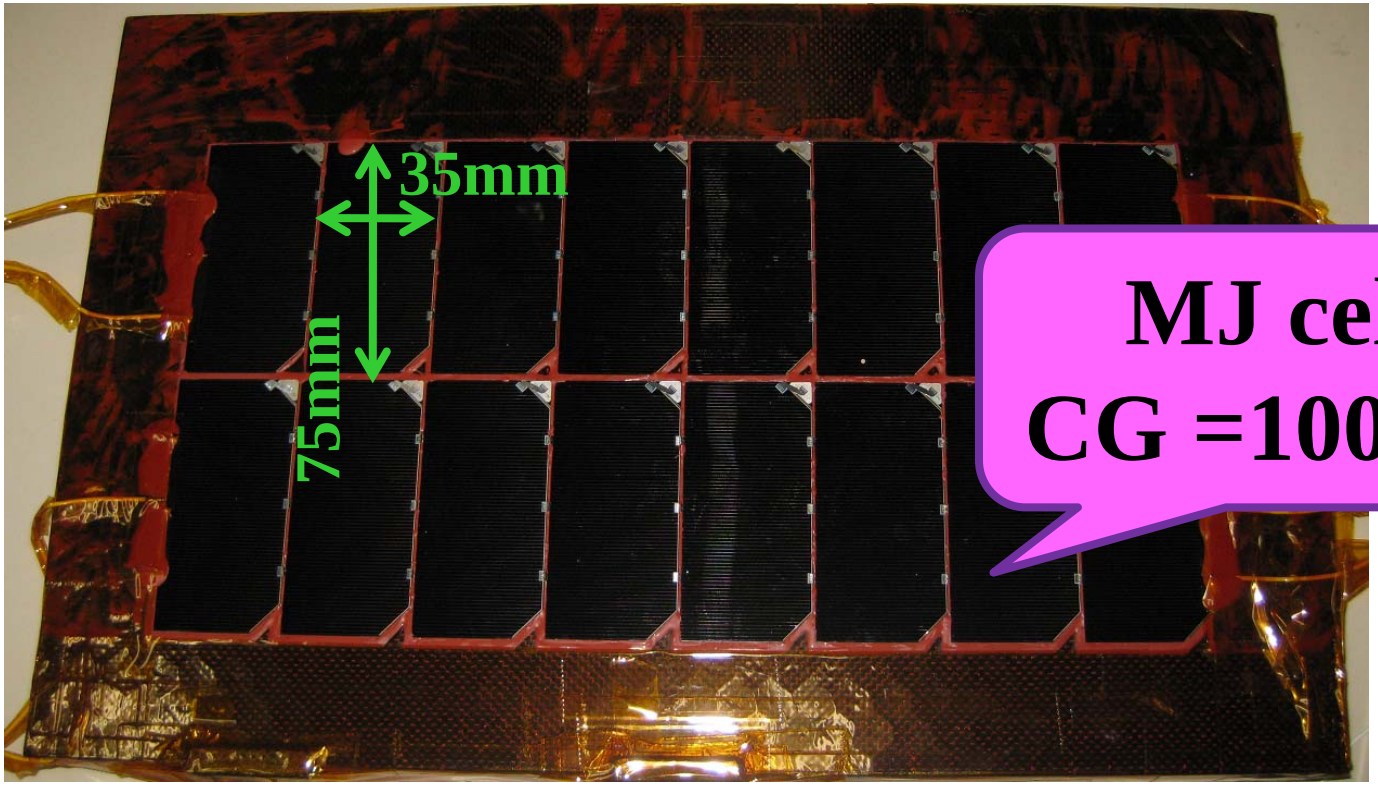
Experiment system (JAXA)

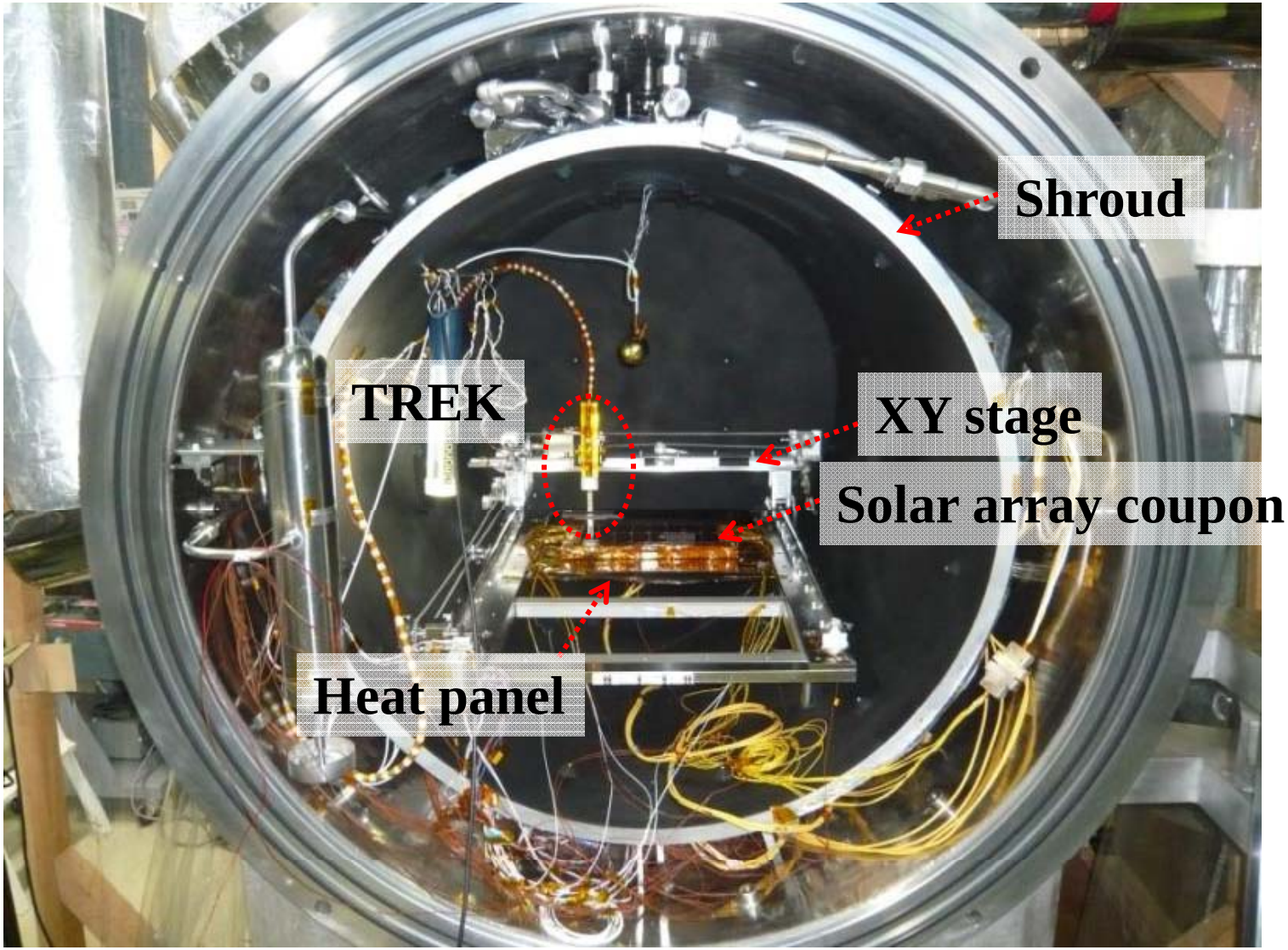


No6

Solar array coupon



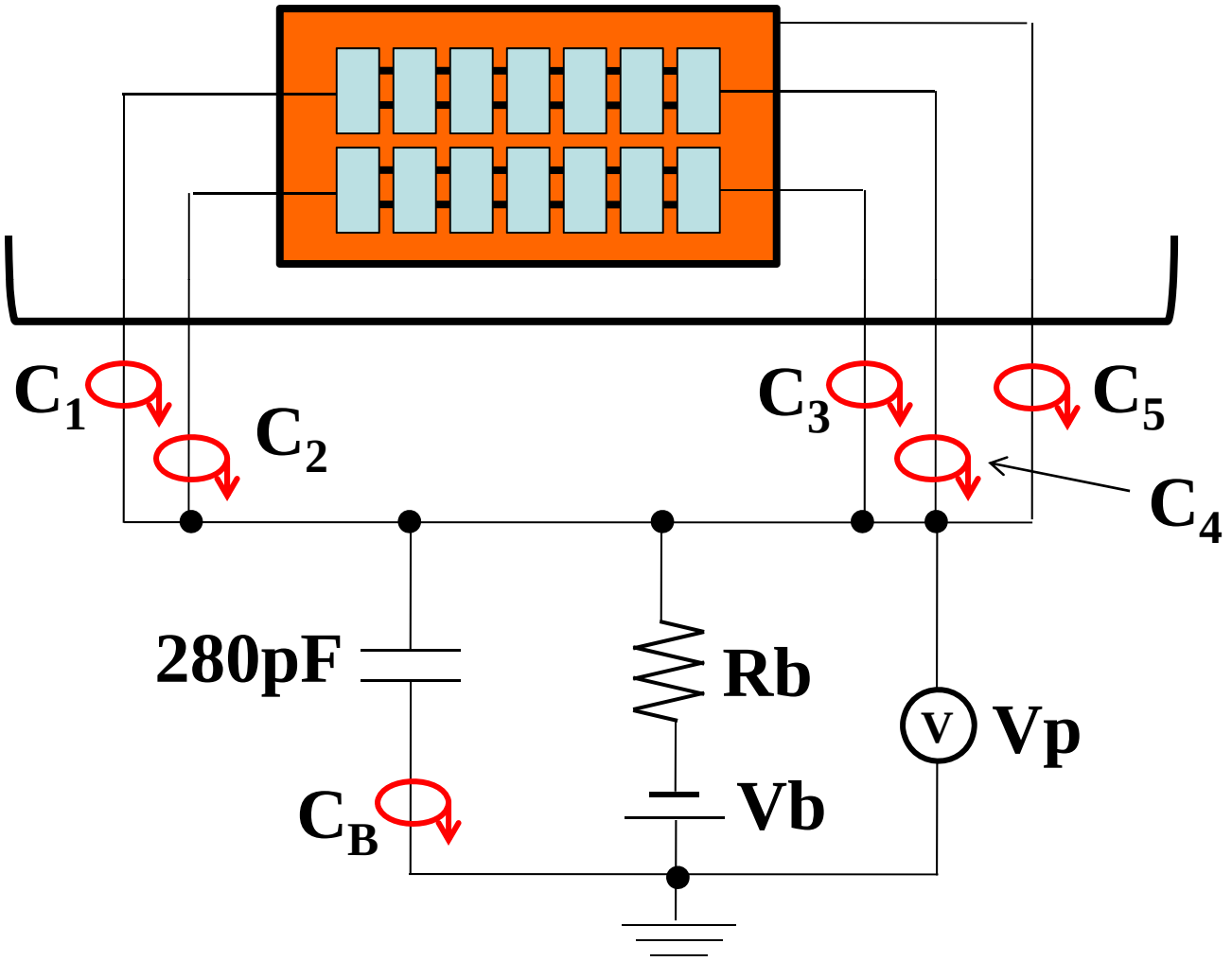
Experiment system (JAXA)



Experiment condition

- Pressure: $5x10^{-5}Pa$
- Current density: $4mA/m^2$
- Acceleration voltage: 9kV
- Bias voltage: 6kV

Discharge circuit



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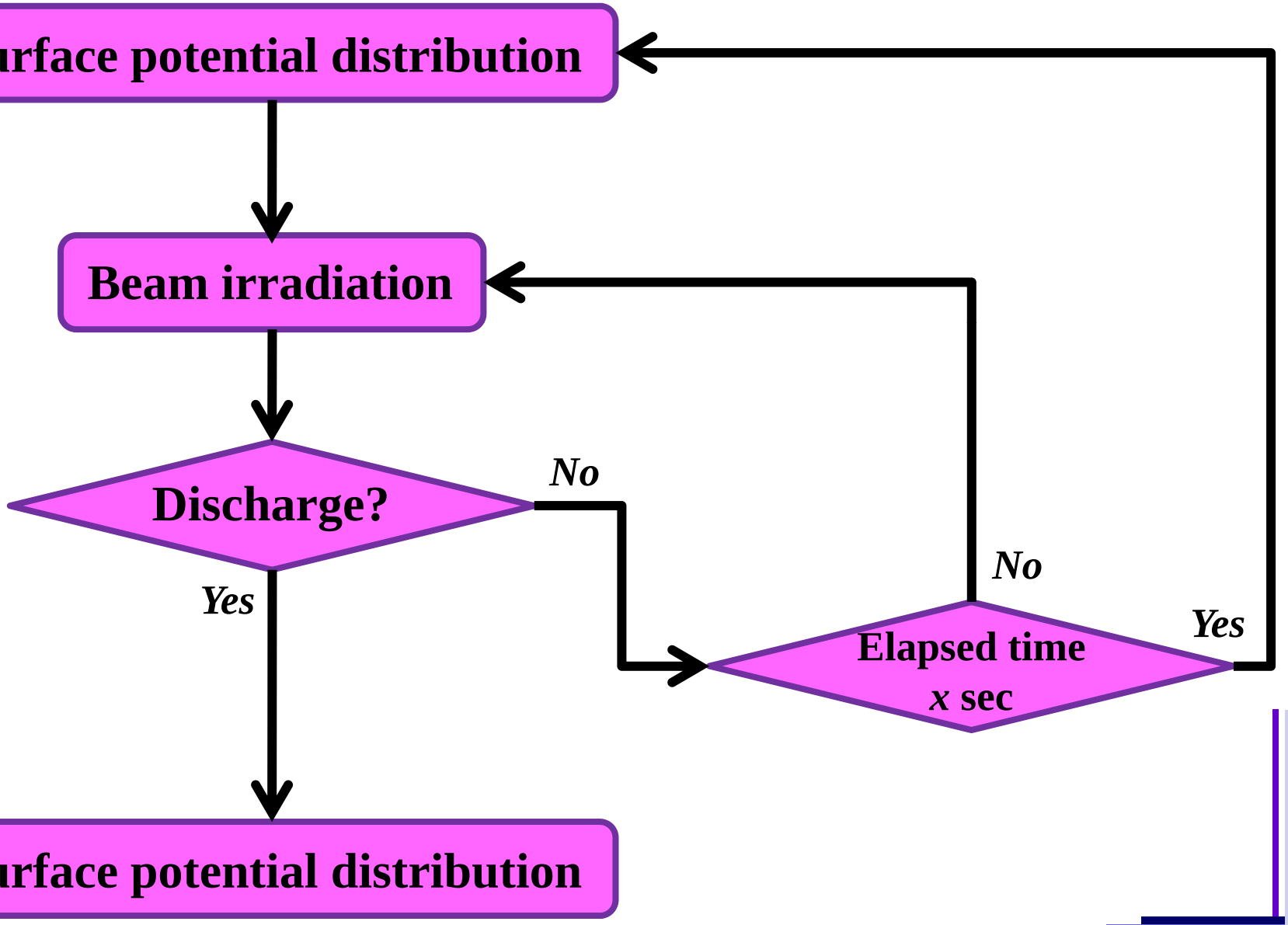
Test sequence



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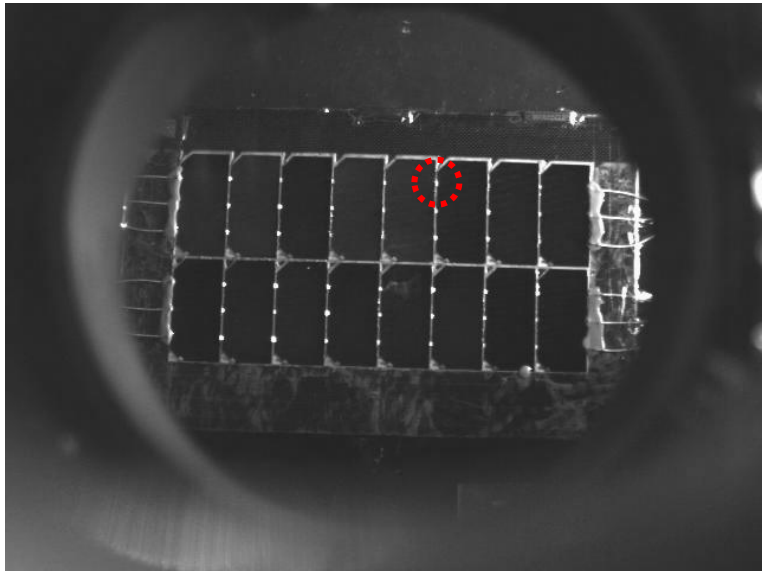
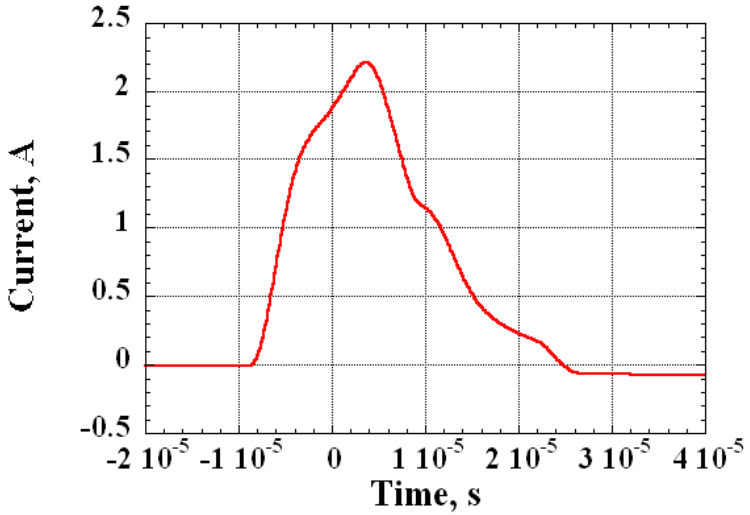
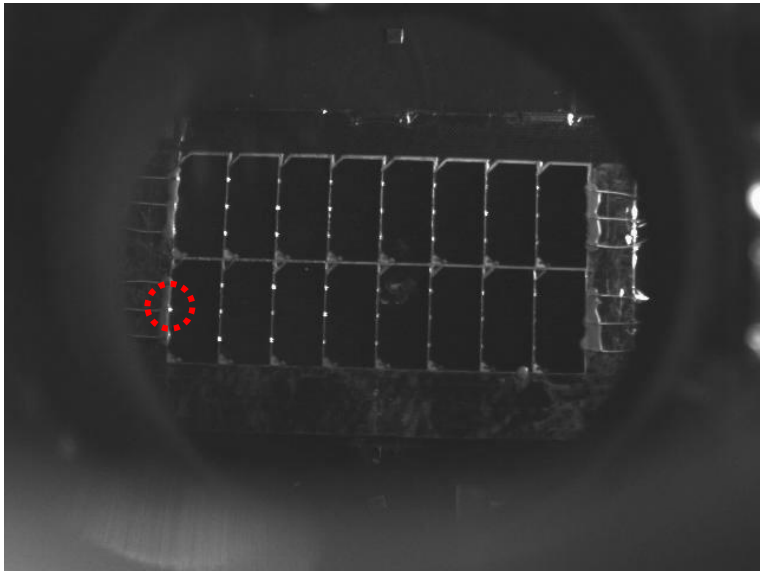
Discharge position and current waveform

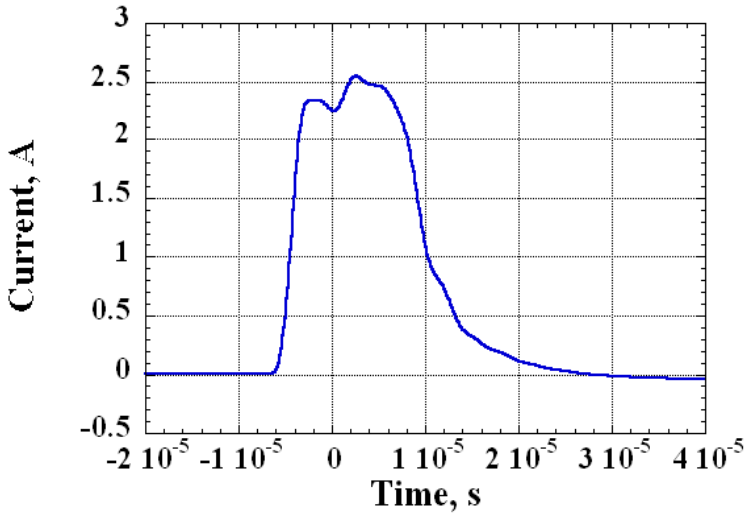
20’C





-110’C





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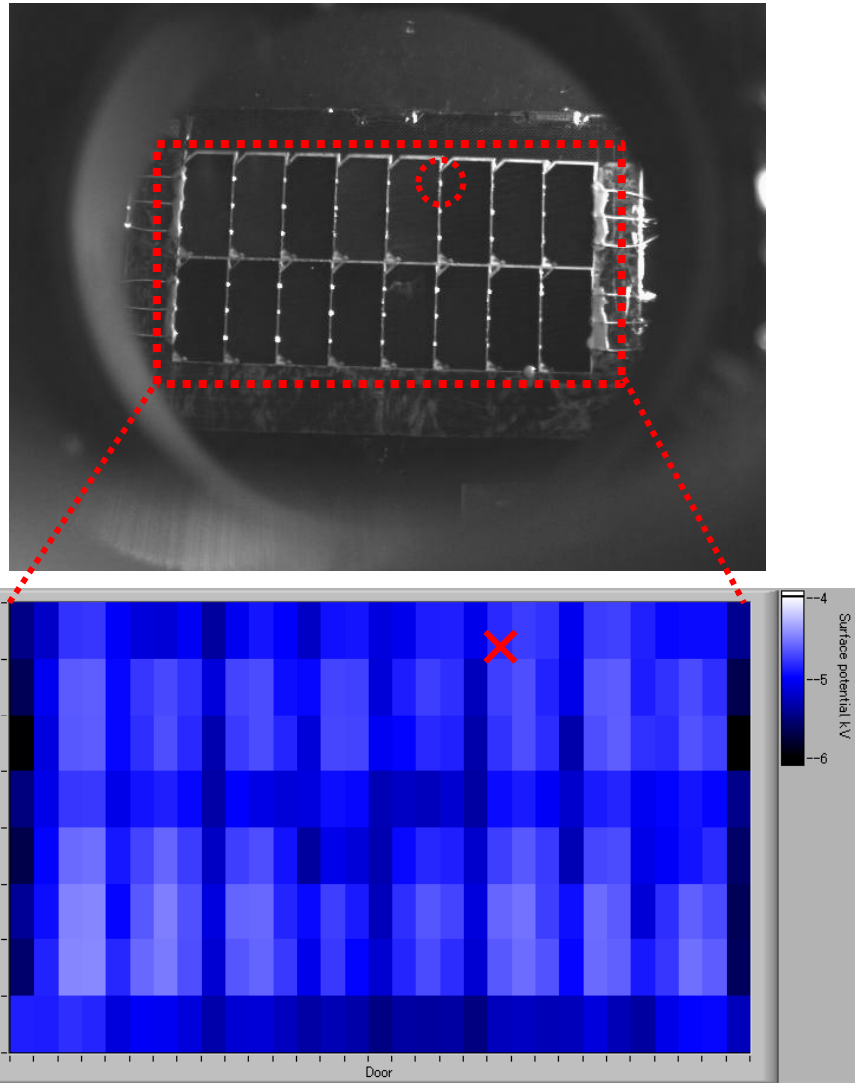
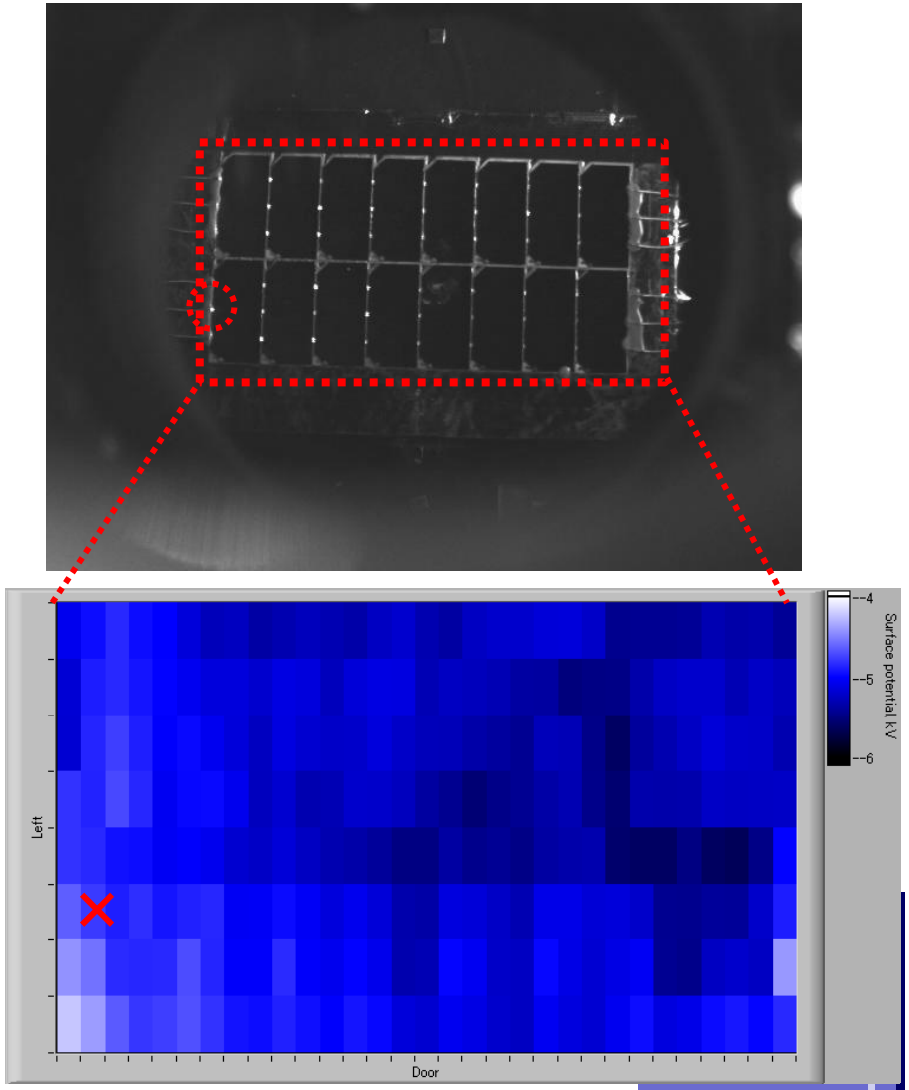
Discharge position and surface potential

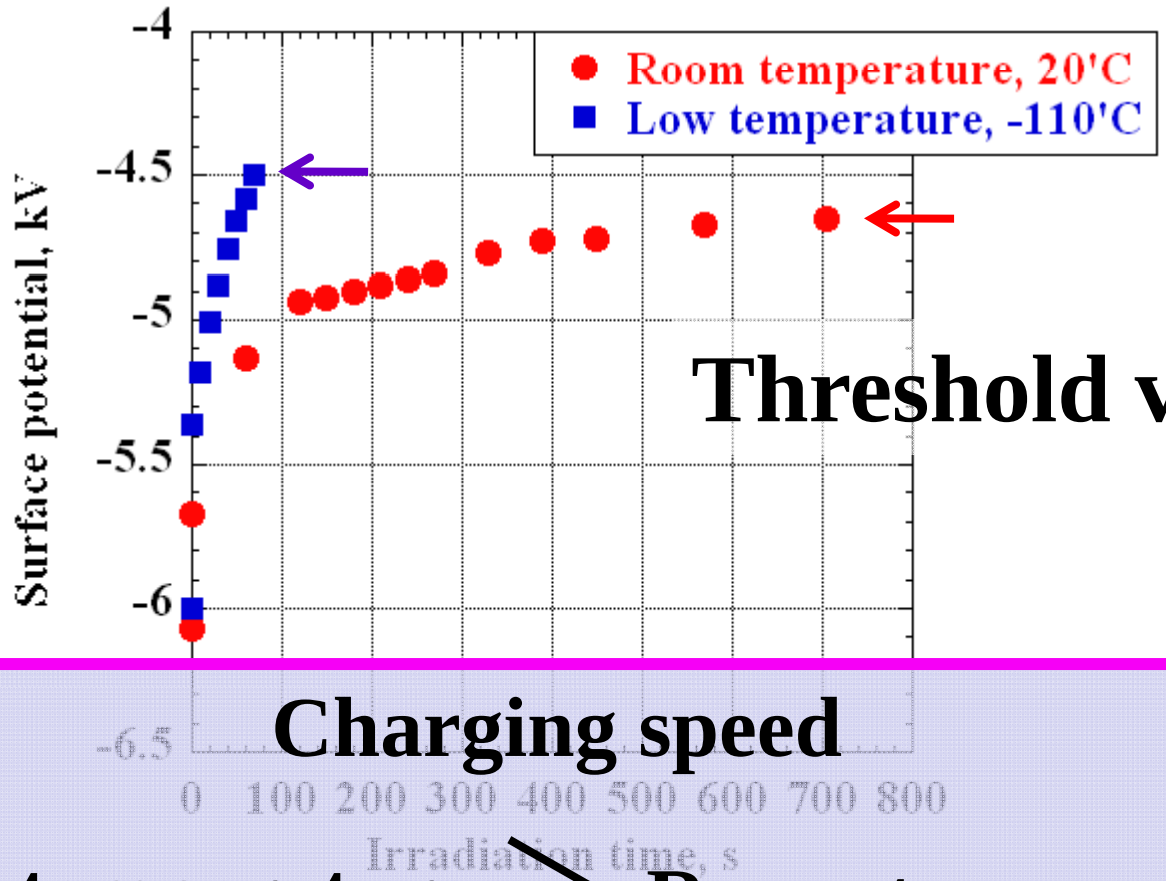
20’C



-110’C



Surface potential profile



Threshold voltage

Charging speed

Low temperature > Room temperature

Threshold volatage

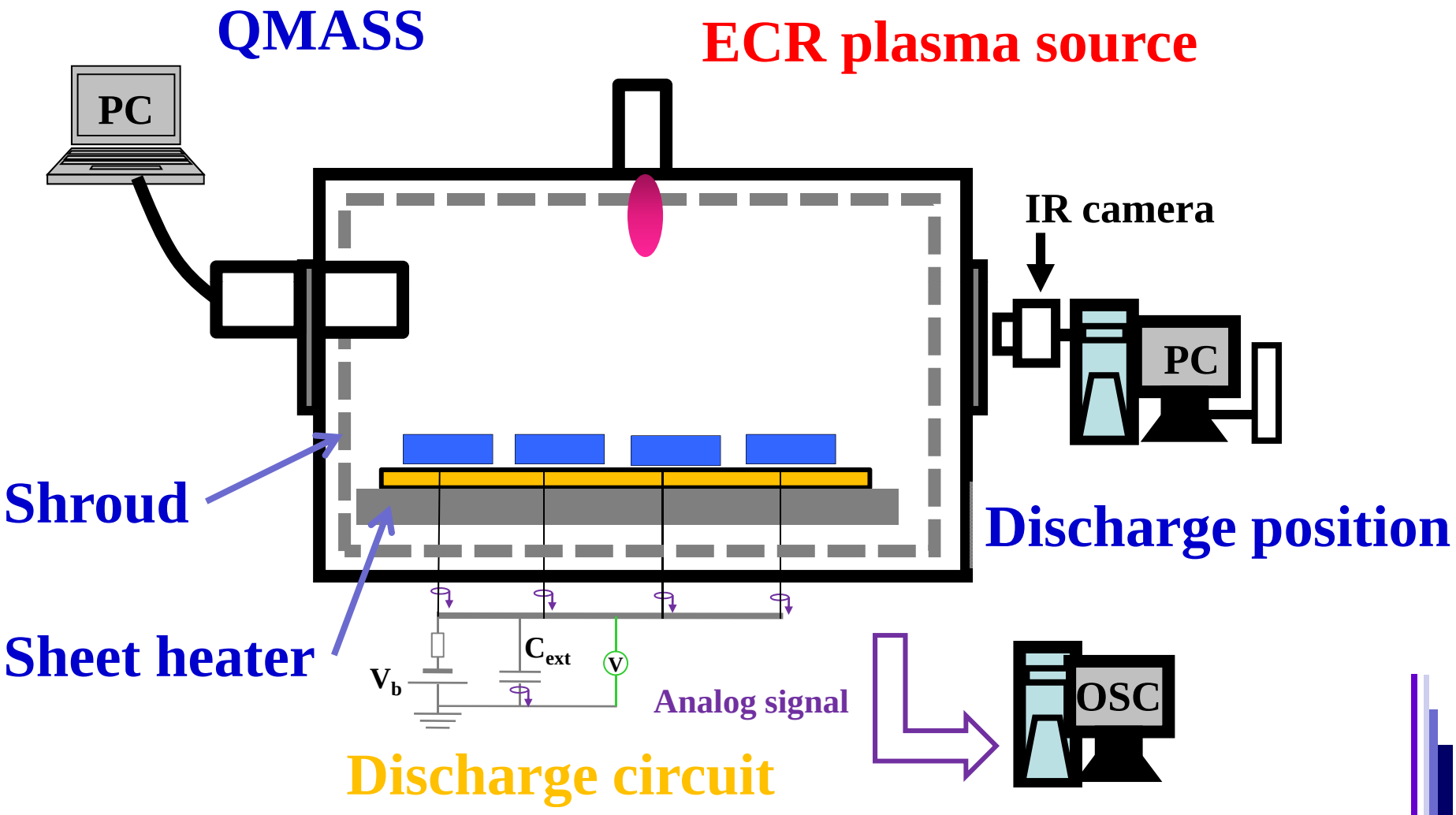
	Room temperature	Low temperature
Threshold voltage	1.3kV	1.4kV
Standard deviation	0.5	0.1

Threshold voltage does not depend on the temperature

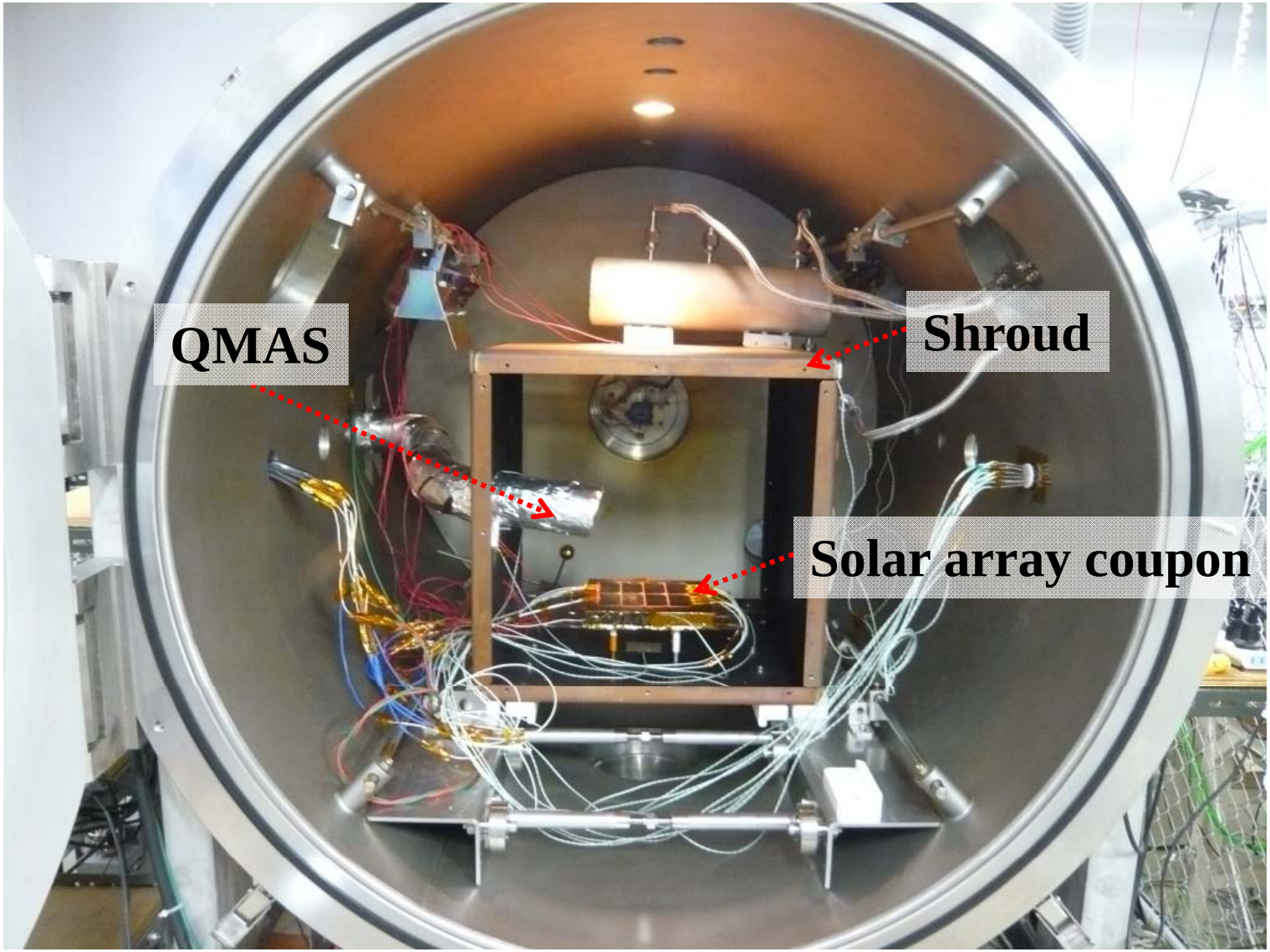
Discharge frequency

Experiment technique and result

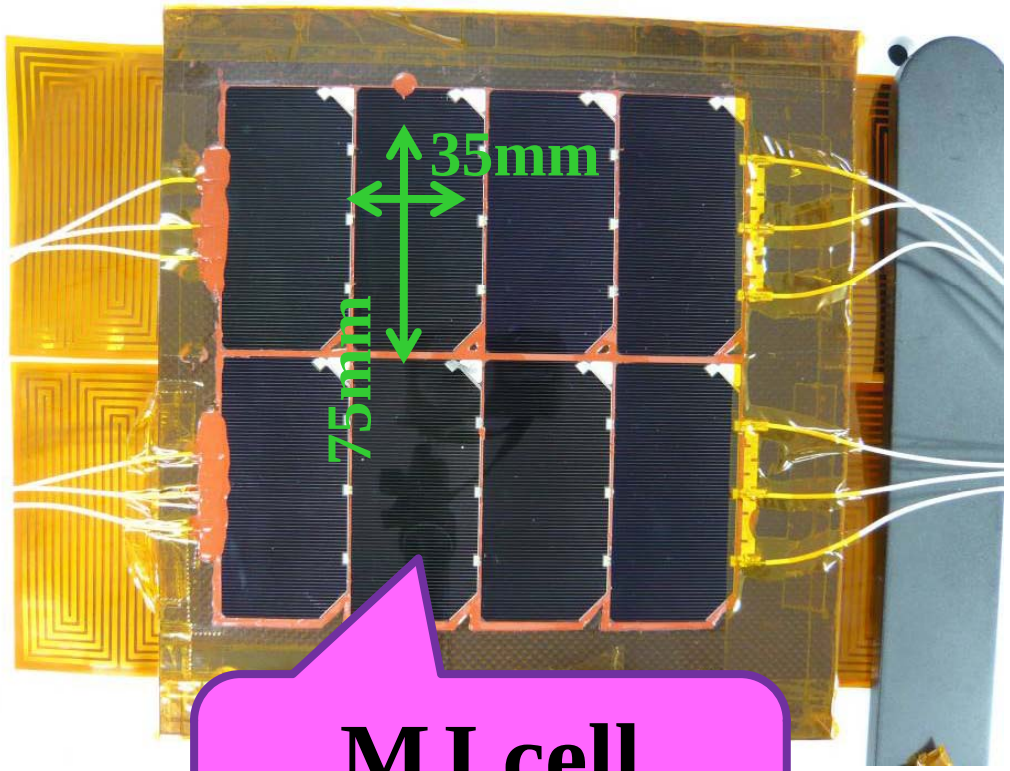
Experiment system (KIT)



Experiment system (KIT)

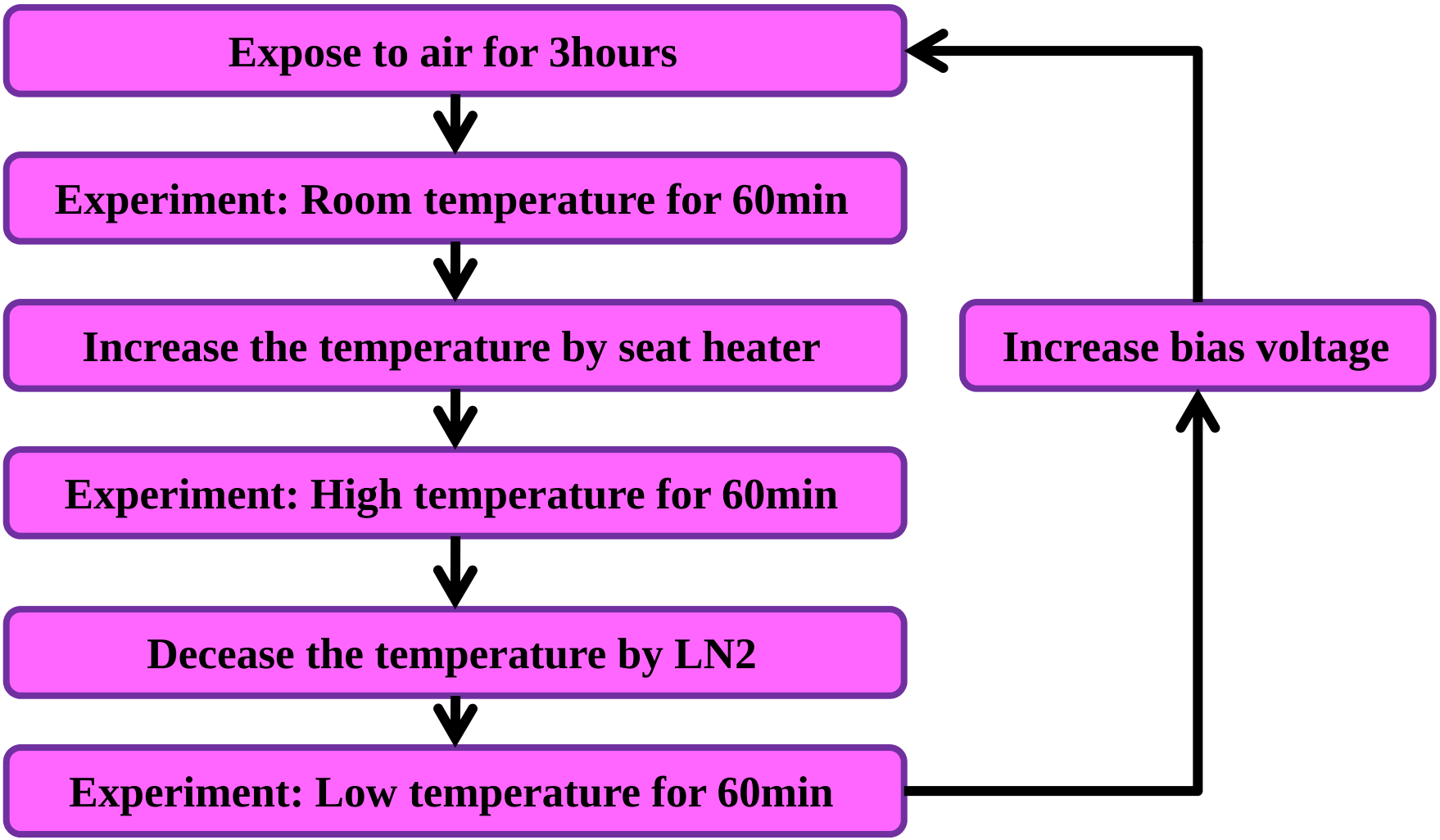


Solar array coupon



MJ cell
CG =100μm

Test sequence



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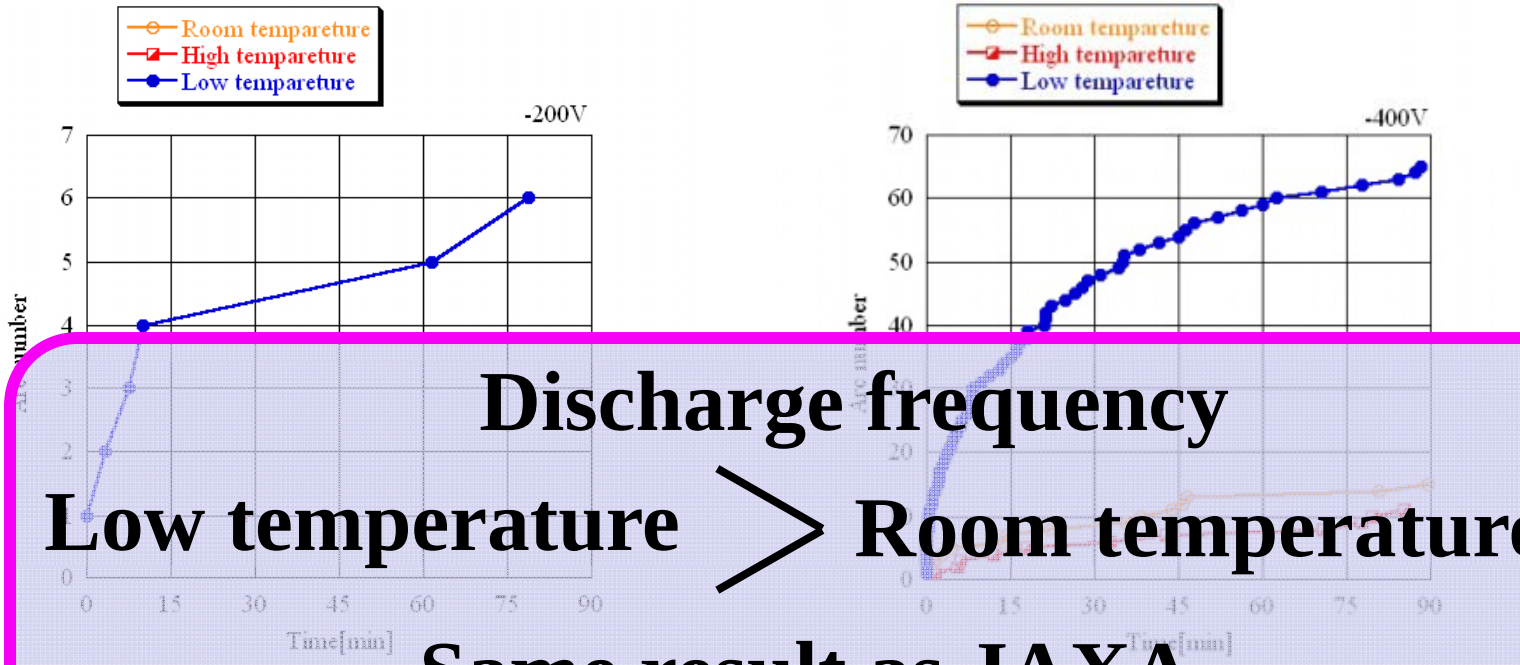
Experiment condition

V_{bias}[V]	Experiment time[min]	Ne[1/m^3]	Te[eV]	Pressure [Pa]	Coupon temperature[℃]		
					High	room	low
-200	60	6×10^{12}	0.7	2.9×10^{-2}	64 ~ 66	30 ~ 31	-34 ~ -29
-300	60	7×10^{12}	0.7	2.7×10^{-2}	64 ~ 65	30 ~ 30	-42 ~ -34
-400	60	7×10^{12}	0.7	3.6×10^{-2}	63 ~ 65	20 ~ 39	-46 ~ -33

Temperature dependence on discharge number

Bias	Room(30℃)	High(60℃)	Low(-30℃)
-200	0	1	6
-300	3	9	28
-400	15	11	60



Discharge frequency

Low temperature > Room temperature

Same result as JAXA

Summary

- Threshold differential voltage does not depend on temperature in GEO environment
- Arc frequency increases with decreasing temperature in JAXA and KIT

Future work

- ESD test under GEO environment in KIT
- Absorbed material effect on discharge frequency

Thank you for your attention

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