Bulk Resistivity measurement of Phenolic

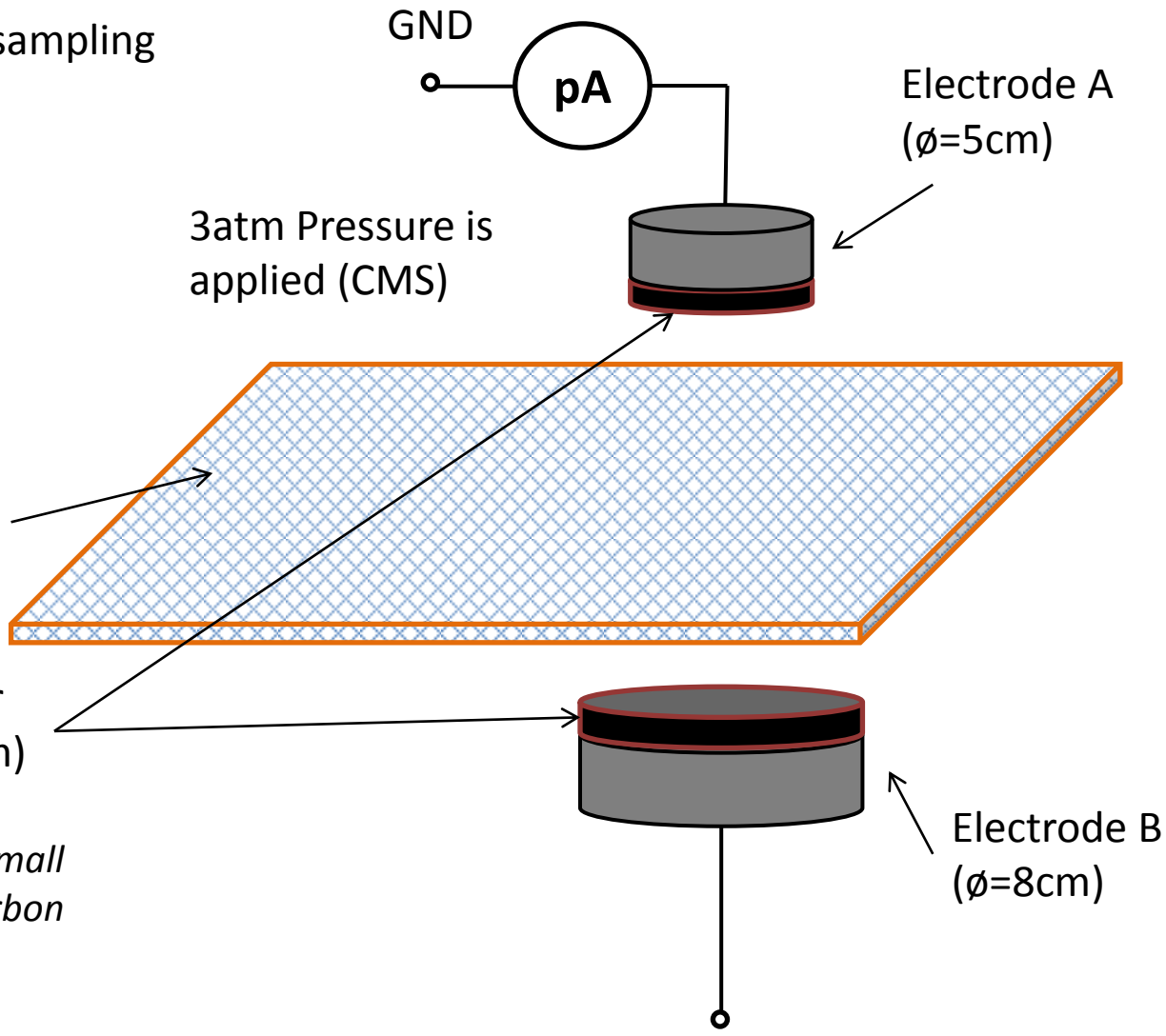
Liang Guan

>> Method
>> New measurement on Sample Batch4-T1

Bulk Resistivity measurement-Method (1)

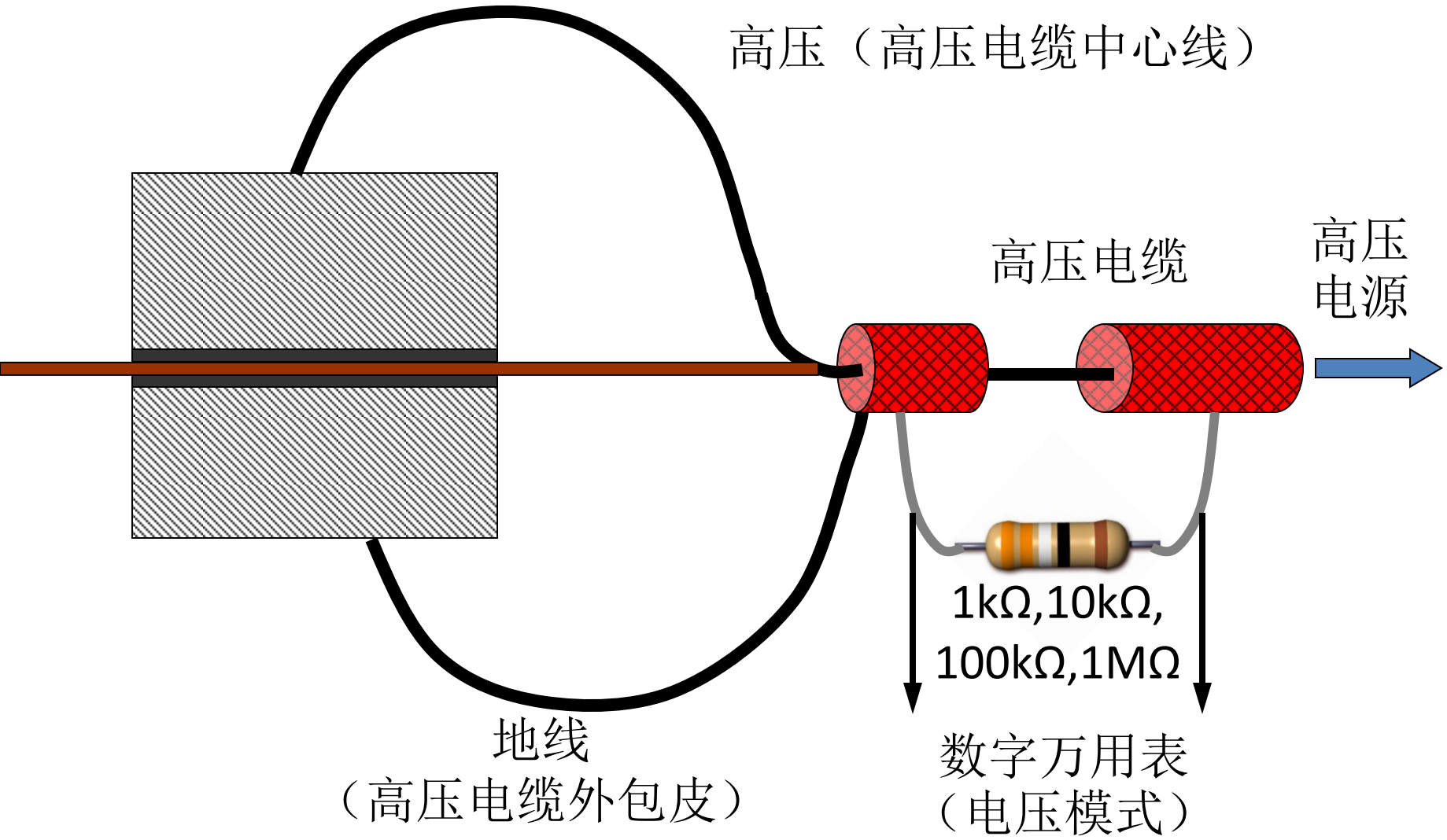
- 9(3×3)/25(5×5) points sampling

11	12	13	14	15
21	22	23	24	25
31	32	33	34	35
41	42	43	44	45
51	52	53	54	55



** rubber filled with small conductive metal or carbon spheres*

Bulk Resistivity measurement-Method (1)



Bulk Resistivity measurement-Method (3)

- Assume Effective area

$$S = 3.14 \times (2.5cm)^2 = 19.6\ cm^2$$

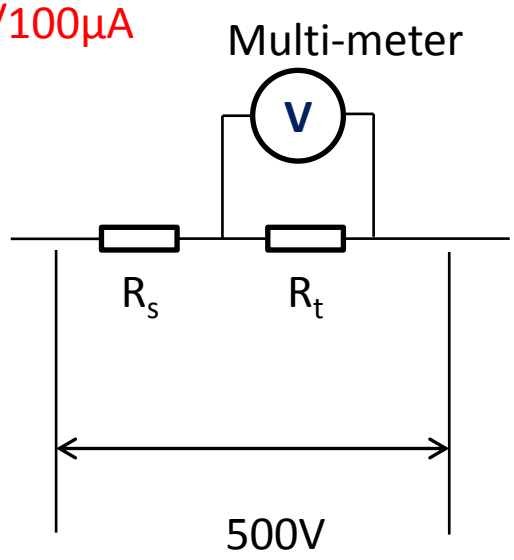
- Sample bulk resistivity on the order of 10^8 Ω·cm/ 10^9 Ω·cm and thickness of 1 mm

$$R_s = \rho_v \frac{t}{S} = 10^8 \times \frac{0.1cm}{19.6cm^2} = 5.1 \times 10^5\ \Omega \qquad R_s = \rho_v \frac{t}{S} = 10^9 \times \frac{0.1cm}{19.6cm^2} = 5.1 \times 10^6\ \Omega$$

- For HV=500V, current flowing through sample ~1000μA/100μA

- Voltage scale on R_t

R_t [kΩ] / Rs [Ω]	1	10	100
5×10^6	0.1V	1V	10V
5×10^5	1V	10V	100V



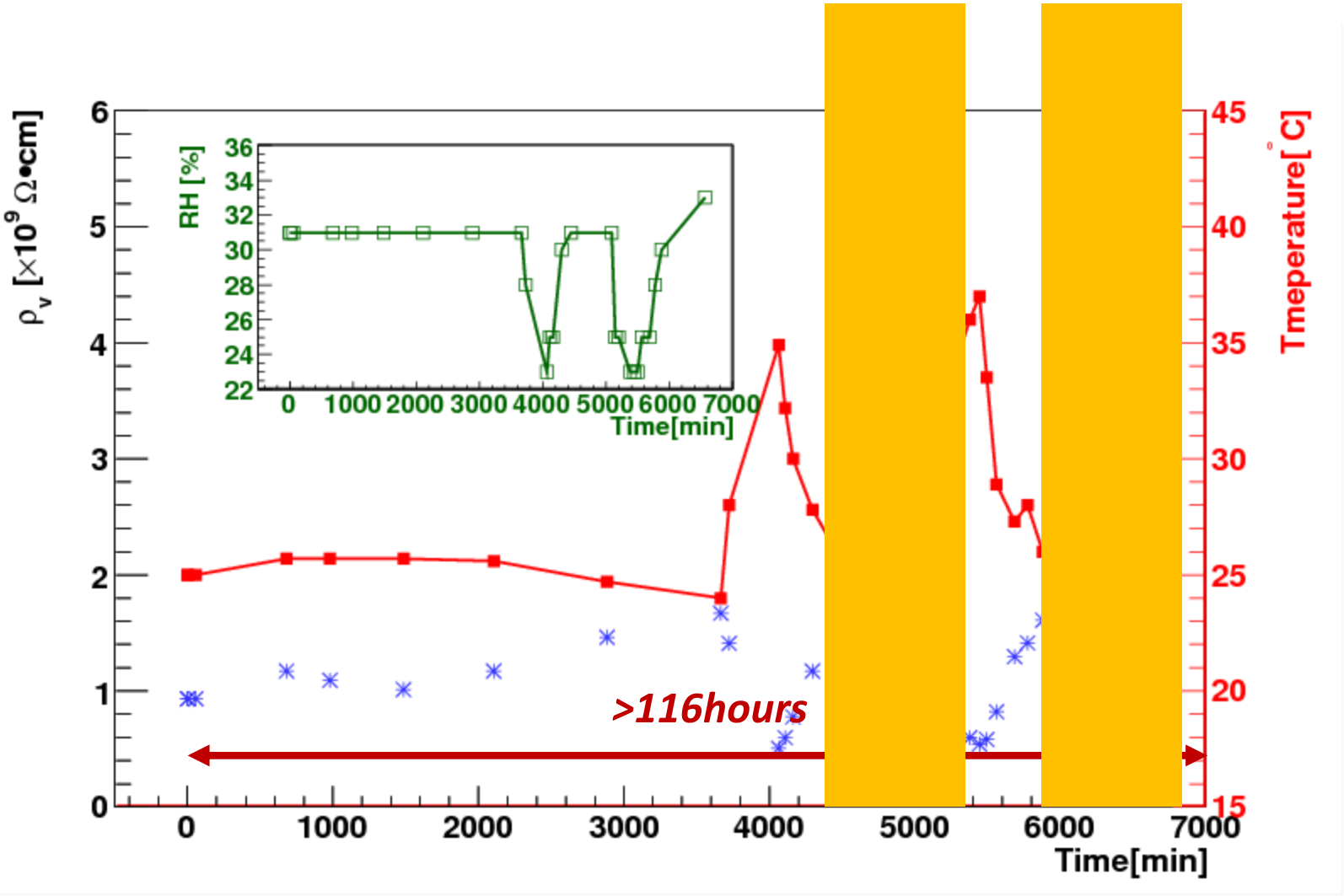
Logbook

- Specify the sample ID, charging time, RH, Temperature etc.

Preliminary

Sample ID	Test Point	HV[V]	Aeff[cm^2]	Thickness[cm]	Current[A]	Comment	Tester	TestDate	TestTime	Charging Time[min]	ρ	Temp[C]	RH[%]
T1	center	500	19.6	0.21	5.00E-05	w/o guard electrode	Liang Guan	30-05-2011	21:56	1	9.33E+08	25	31
T1	center	500	19.6	0.21	5.00E-05	"	"	30-05-2011	21:58	3	9.33E+08	25	31
T1	center	500	19.6	0.21	5.00E-05	with guard electrode	"	30-05-2011	22:52	57	9.33E+08	25	31
T1	center	500	19.6	0.21	4.00E-05	"	"	31-05-2011	9:15	680	1.17E+09	25.7	31
T1	center	500	19.6	0.21	4.30E-05	"	"	31-05-2011	14:15	980	1.09E+09	25.7	31
T1	center	500	19.6	0.21	4.60E-05	"	"	31-05-2011	22:40	1485	1.01E+09	25.7	31
T1	center	500	19.6	0.21	4.00E-05	"	"	01-06-2011	9:00	2105	1.17E+09	25.6	31
T1	center	500	19.6	0.21	3.20E-05	"	"	01-06-2011	22:00	2885	1.46E+09	24.7	31
T1	center	500	19.6	0.21	2.80E-05	"	"	02-06-2011	9:00	3665	1.67E+09	24	31
T1	center	500	19.6	0.21	3.30E-05	dehumidifier on	"	02-06-2011	10:00	3725	1.41E+09	28	28
T1	center	500	19.6	0.21	9.20E-05	"	"	02-06-2011	15:38	4063	5.07E+08	34.9	23
T1	center	500	19.6	0.21	7.80E-05	dehumidifier off	"	02-06-2011	16:23	4108	5.98E+08	32.2	25
T1	center	500	19.6	0.21	6.00E-05	"	"	02-06-2011	17:18	4163	7.78E+08	30	25
T1	center	500	19.6	0.21	4.00E-05	"	"	02-06-2011	19:32	4297	1.17E+09	27.8	30
T1	center	500	19.6	0.21	3.20E-05	"	"	02-06-2011	22:02	4447	1.46E+09	26.2	31
T1	center	500	19.6	0.21	2.70E-05	dehumidifier on	"	03-06-2011	9:20	5089	1.73E+09	25.2	31
T1	center	500	19.6	0.21	3.40E-05	"	"	03-06-2011	10:15	5144	1.37E+09	30.3	25
T1	center	500	19.6	0.21	4.40E-05	"	"	03-06-2011	11:07	5196	1.06E+09	32.5	25
T1	center	500	19.6	0.21	7.80E-05	"	"	03-06-2011	14:10	5379	5.98E+08	36	23
T1	center	500	19.6	0.21	8.60E-05	dehumidifier off	"	03-06-2011	15:15	5444	5.43E+08	37	23
T1	center	500	19.6	0.21			"						
T1	center	500	19.6	0.21			"						
T1	center	500	19.6	0.21			"						
T1	center	500	19.6	0.21			"						
T1	center	500	19.6	0.21			"						
T1	center	500	19.6	0.21			"						

Bulk resistivity of Batch 4-T1 sample



Bulk resistivity of Batch 4-T1 sample

- Measured resistivity is on the order of 10^9 Ohm.cm at Room temperature → similar to the value measured 2 weeks ago but still a factor of two higher than the value measured 2 months ago when the sample just arrived.

- Bulk resistivity value of the sample Batch4-T1 shows some correlation with the temperature
    - lower temperature results in higher resistivity
    - resistivity value @ ~25C slightly increasing during one week test (RH<40%)

Material study - Prof. Changguo Lu's study

- Surface condition: defects such as pins, hole, ridge etc. present on the inner surface of Bakelite will make shape electric field thus increasing the noise rate

- UV absorption

- Ageing: HF acid *chemical active*

ATLAS RPC	CMS RPC
C4H10 5% SF6 0.3% C2H2F2 94.7%	C4H10 3.5% SF6 0.3% C2H2F2 96.2%

→ Significantly reduce resistivity
→ surface smoothness

- Water : Help to slow down the decrease of resistivity but also help to form HF