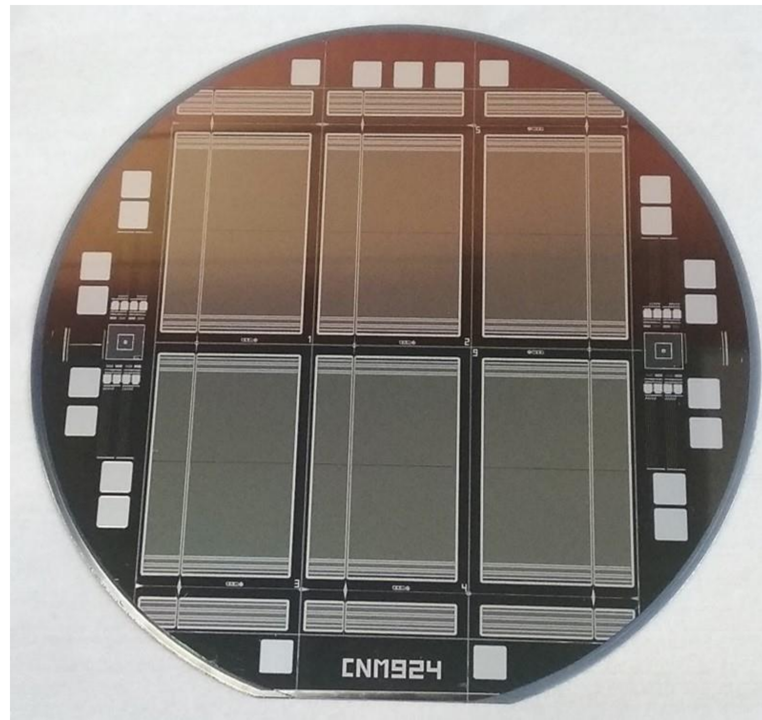
Preliminary characterization of microstrip detectors for HPS experiment



Characterization on wafer before dicing

Wafer	Chip	Pinholes Sector A	Pinholes Sector B
W01			
	S1	broken	
	S2	87	0
	S3	broken	
	S4	0	0
	S5	97, 99, 14, 100	91
	S6	0	0
W02			
	S1	0	0
	S2	121, 177, 118, 176	
	S3	0	0
	S4	0	0
	S5	97,99,100	0
	S6	0	0
W03			
	S1	0	0
	S2	0	0
	S3	0	0
	S4	0	0
	S5	37, 100	0
	S6	0	0
W04			
	S1	n.m.	n.m.
	S2	n.m.	n.m.
	S3	n.m.	n.m.
	S4	[illegible]	n.m.
	S5	n.m.	n.m.
	S6	n.m.	n.m.
W05			
	S1	0	0
	S2	0	0
	S3	55, 40, 46	0
	S4	0	0
	S5	155, 156	0
	S6	0	0

W04 to be characterized

Wafer	Chip	Pinholes Sector A	Pinholes Sector B
W06			
	S1	0	0
	S2	0	0
	S3	0	0
	S4	221	0
	S5	broken	
	S6	0	169, 170
W07			
	S1	0	0
	S2	0	0
	S3	0	176
	S4	0	0
	S5	n.m	n.m
	S6	32, 33, 34, 35, 36, 73, 74, 77, 79, 85	0
W08			
	S1	170, 171	0
	S2	65, 66	0
	S3	175, 176	0
	S4	0	0
	S5	n.m.	n.m.
	S6	0	0
W09			
	S1	45	0
	S2	0	0
	S3	0	0
	S4	0	182
	S5		
	S6	0	47
W10			
	S1	n.m.	n.m.
	S4	n.m.	n.m.
	S5	n.m.	n.m.
	S6	n.m.	n.m.

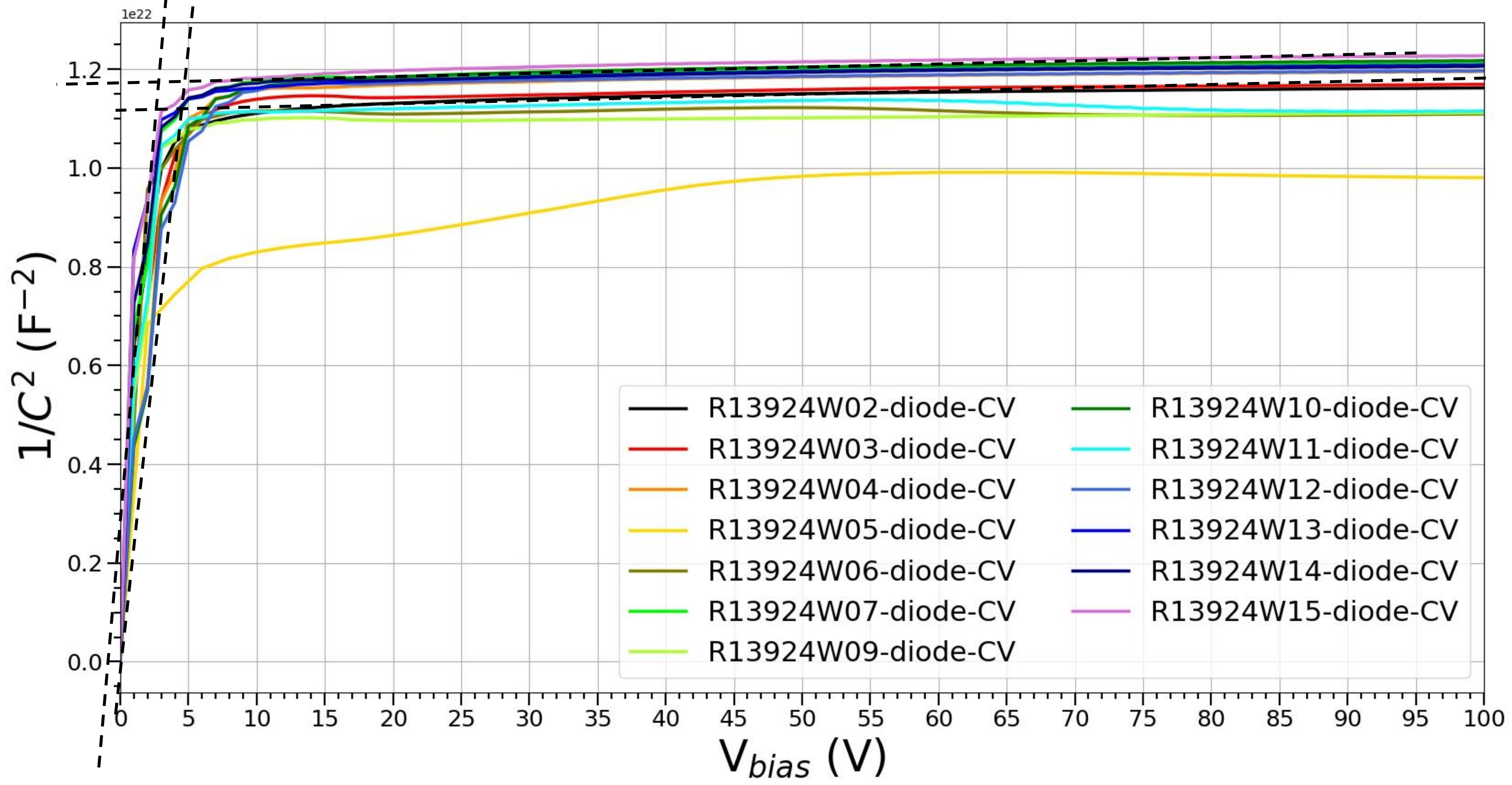
W10 to be characterized

Wafer	Chip	Pinholes Sector A	Pinholes Sector B
W11			
	S1	0	0
	S2	68	30, 31
	S3	65, 66	
	S4	146	
	S5	n.m.	n.m.
	S6	193, 196	45
W12			
	S1	0	216, 234, 235
	S2		17, 30, 31
	S3	0	0
	S4	39, 48, 49,64, 77, 78	0
	S5	0	0
	S6	193, 194, 196	0
W13			
	S1	0	0
	S2	0	0
	S3	0	0
	S4	0	0
	S5	0	0
	S6	0	0
W14			
	S1	0	0
	S2	0	0
	S3		97, 99, 108, 109, 110, 111
	S4	0	0
	S5	n.m.	n.m.
	S6		211, 212, 214
W15			
	S1	148	0
	S2	204, 205	0
	S3	0	0
	S4	201, 202, 203	
	S5	0	0
	S6	0	0

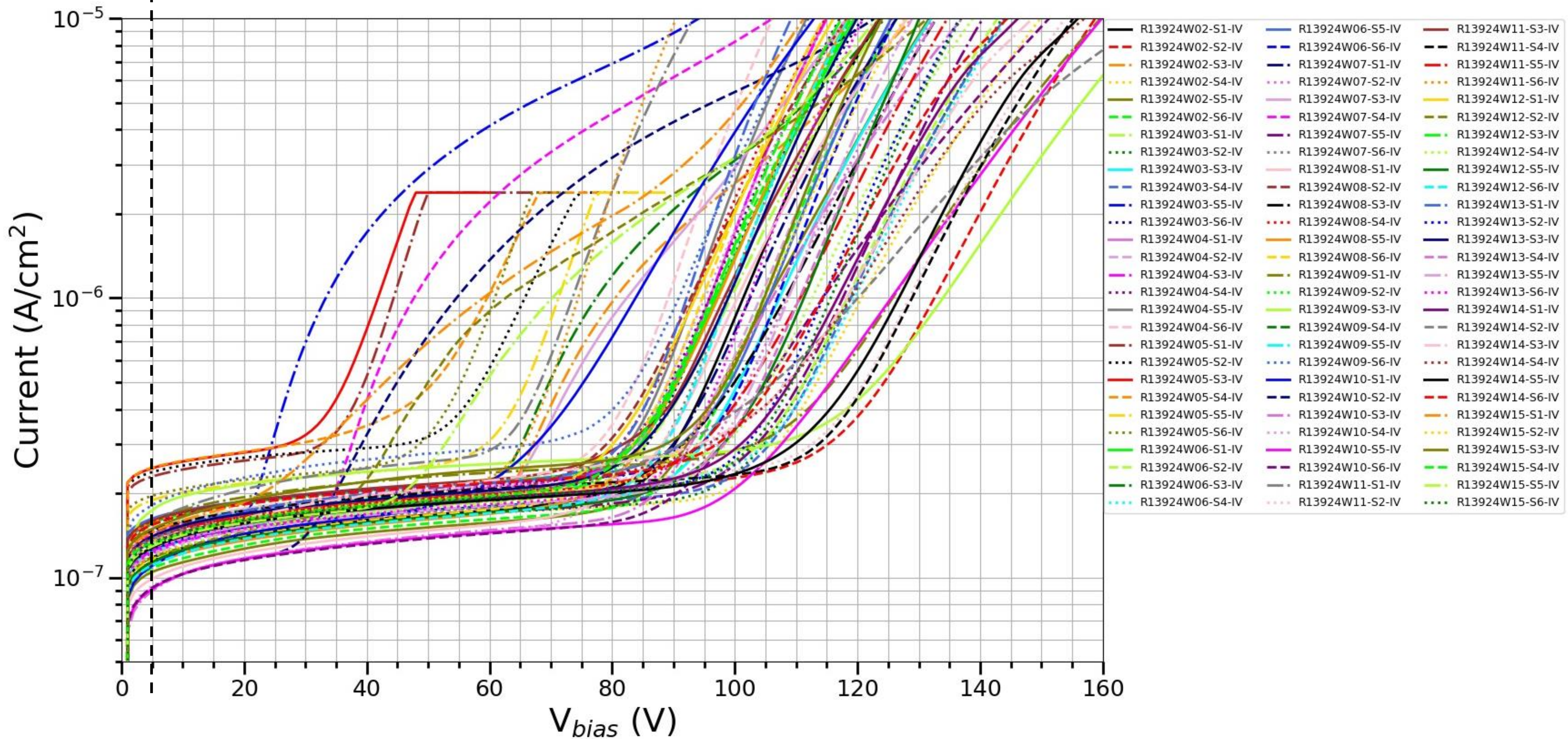
Coupling capacitance characterization

- ✓ Mean value: 48 pF/cm
- ✓ 97% Yield good chips
- ✓ 69 chips with less than 1% of pinholes (total of 512 strips)
- ✓ 16 chips (2 full wafers more 4 single chips) still to be characterized (n.m. not measured)

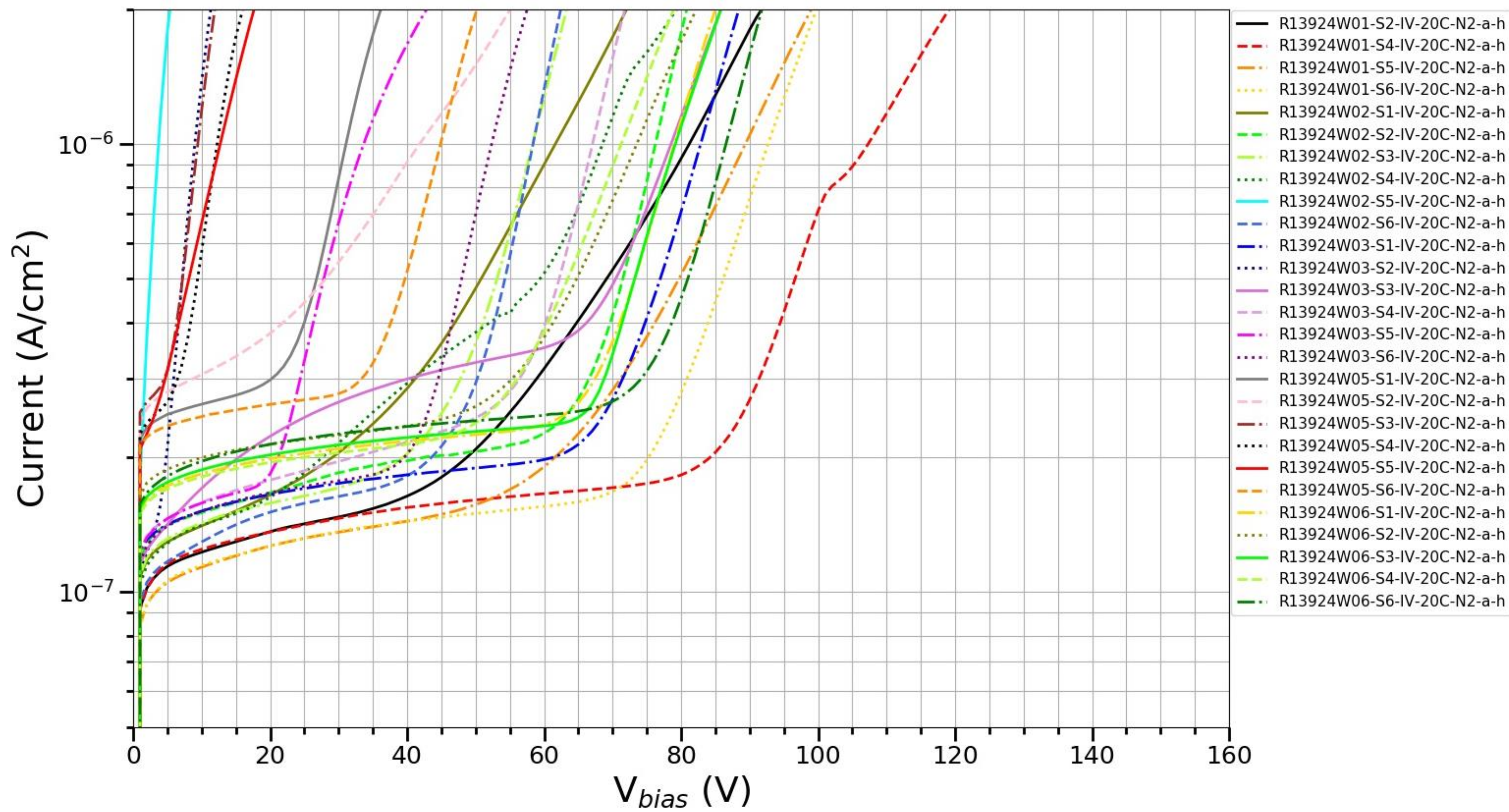
1/C² measured on wafers (diodes) before dicing: depletion voltage < 5 V



IV characteristic measured on detectors on wafers before dicing

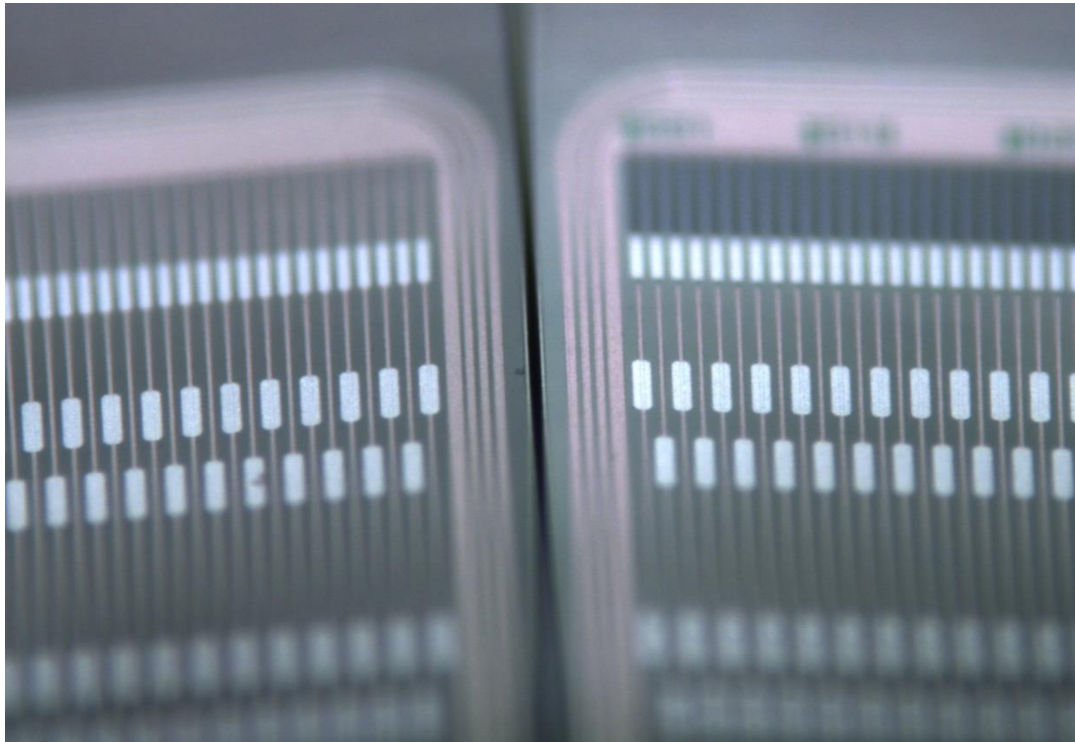


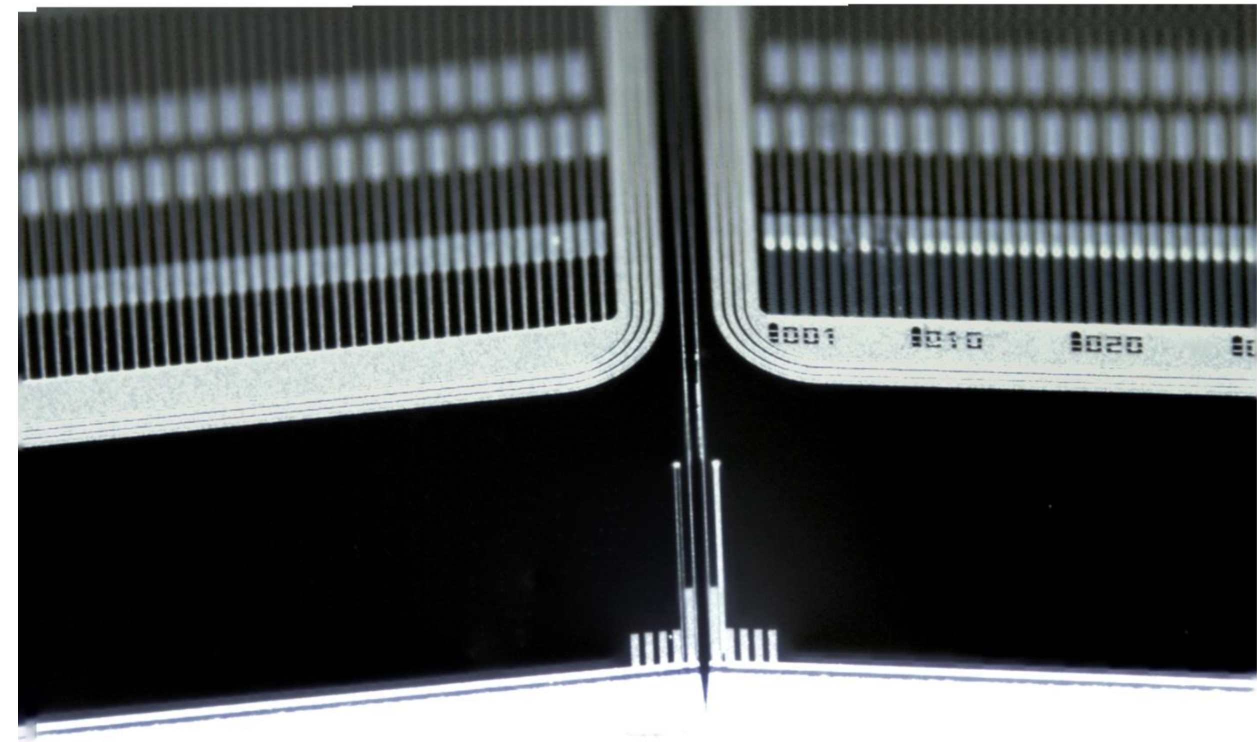
Sensors characterization after dicing but before cleaving

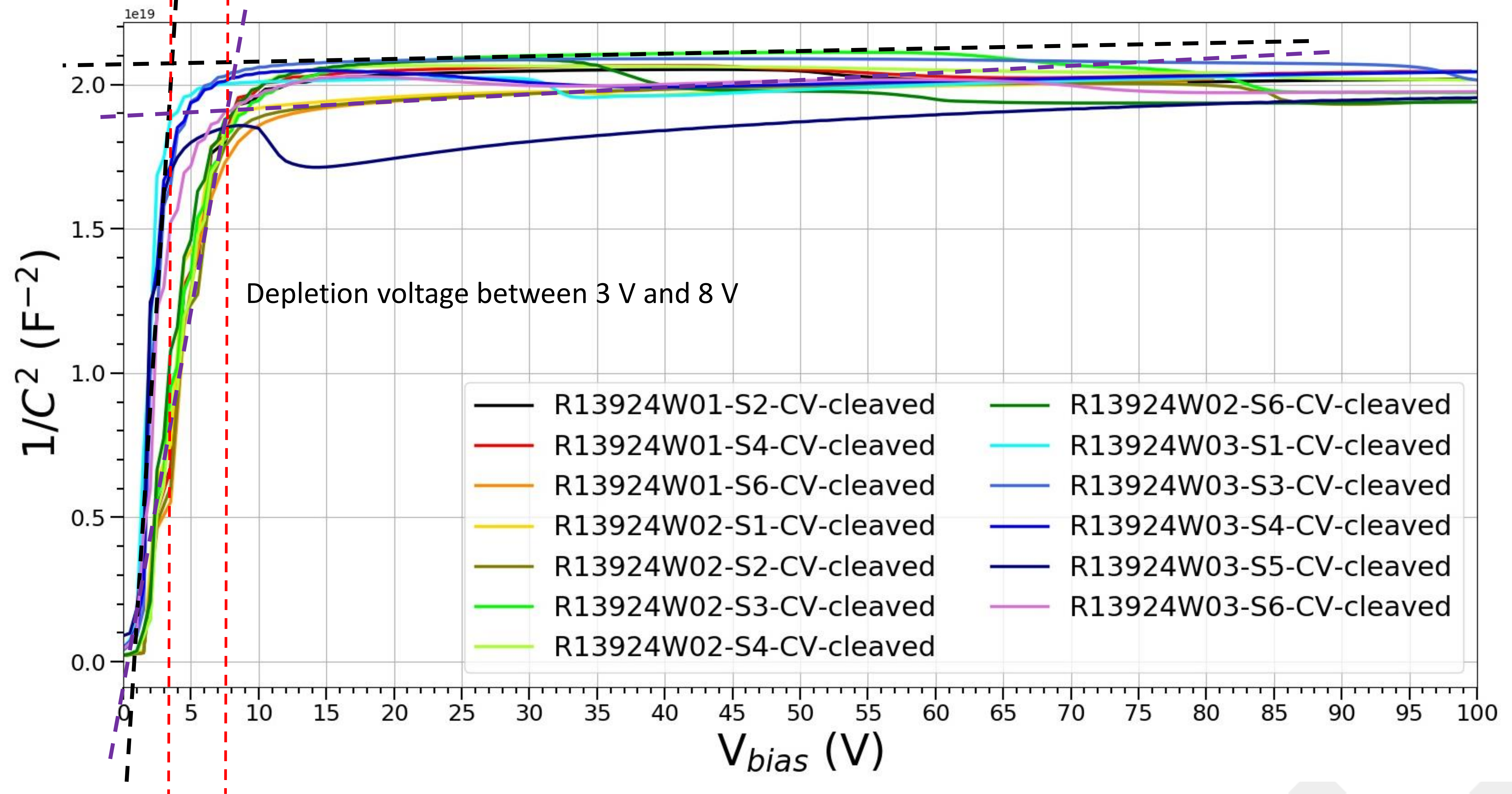

Current (A/cm^2)
10^{-6}
10^{-7}
0
20
40
60
80
100
120
140
160
V_{bias} (V)
R13924W01-S2-IV-20C-N2-a-h
R13924W01-S4-IV-20C-N2-a-h
R13924W01-S5-IV-20C-N2-a-h
R13924W01-S6-IV-20C-N2-a-h
R13924W02-S1-IV-20C-N2-a-h
R13924W02-S2-IV-20C-N2-a-h
R13924W02-S3-IV-20C-N2-a-h
R13924W02-S4-IV-20C-N2-a-h
R13924W02-S5-IV-20C-N2-a-h
R13924W02-S6-IV-20C-N2-a-h
R13924W03-S1-IV-20C-N2-a-h
R13924W03-S2-IV-20C-N2-a-h
R13924W03-S3-IV-20C-N2-a-h
R13924W03-S4-IV-20C-N2-a-h
R13924W03-S5-IV-20C-N2-a-h
R13924W03-S6-IV-20C-N2-a-h
R13924W05-S1-IV-20C-N2-a-h
R13924W05-S2-IV-20C-N2-a-h
R13924W05-S3-IV-20C-N2-a-h
R13924W05-S4-IV-20C-N2-a-h
R13924W05-S5-IV-20C-N2-a-h
R13924W05-S6-IV-20C-N2-a-h
R13924W06-S1-IV-20C-N2-a-h
R13924W06-S2-IV-20C-N2-a-h
R13924W06-S3-IV-20C-N2-a-h
R13924W06-S4-IV-20C-N2-a-h
R13924W06-S6-IV-20C-N2-a-h

Characterization after cleaving

Cleaved edge is perfectly along the cleaving path 250 µm far from the active area. Design alignment better than 0,1 degree






1e19
2.0
1.5
1.0
0.5
0.0
$1/C^2$ (F^{-2})
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
V_{bias} (V)
Depletion voltage between 3 V and 8 V
R13924W01-S2-CV-cleaved
R13924W01-S4-CV-cleaved
R13924W01-S6-CV-cleaved
R13924W02-S1-CV-cleaved
R13924W02-S2-CV-cleaved
R13924W02-S3-CV-cleaved
R13924W02-S4-CV-cleaved
R13924W02-S6-CV-cleaved
R13924W03-S1-CV-cleaved
R13924W03-S3-CV-cleaved
R13924W03-S4-CV-cleaved
R13924W03-S5-CV-cleaved
R13924W03-S6-CV-cleaved

Current (A/cm^2)

10^{-5}
10^{-6}
10^{-7}

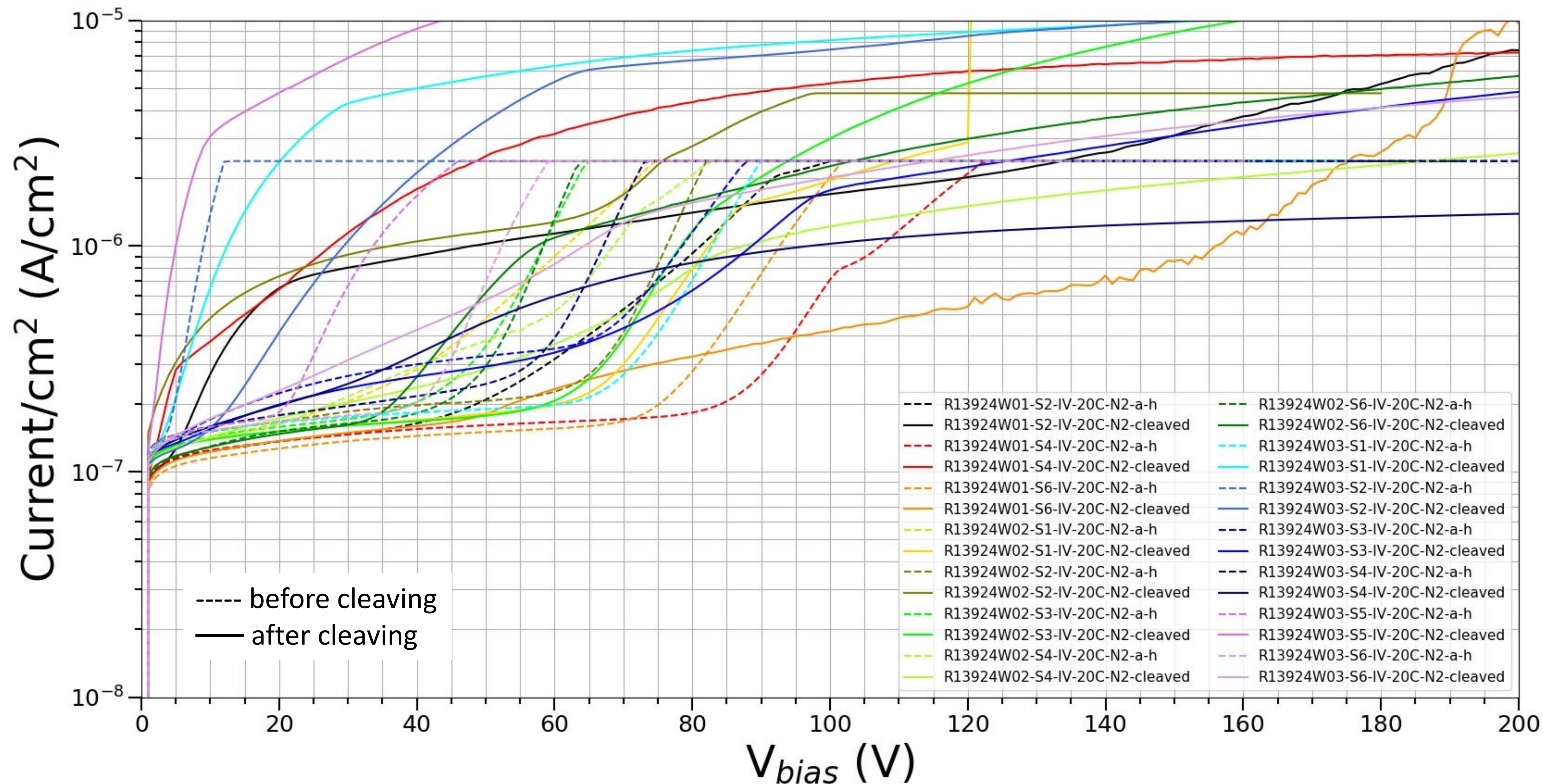
0 20 40 60 80 100 120 140 160

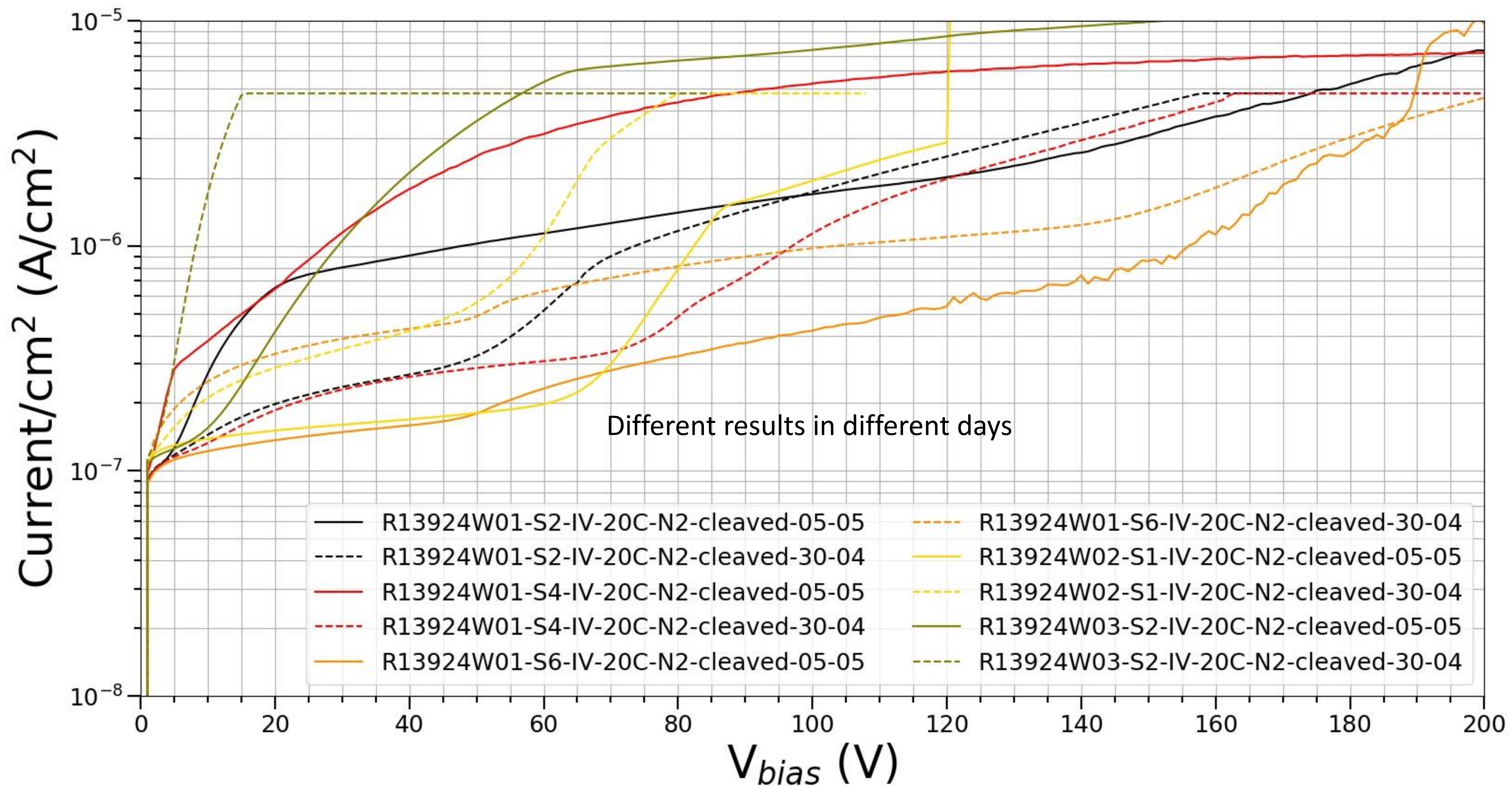
V_{bias} (V)

Depletion Voltage < 8V

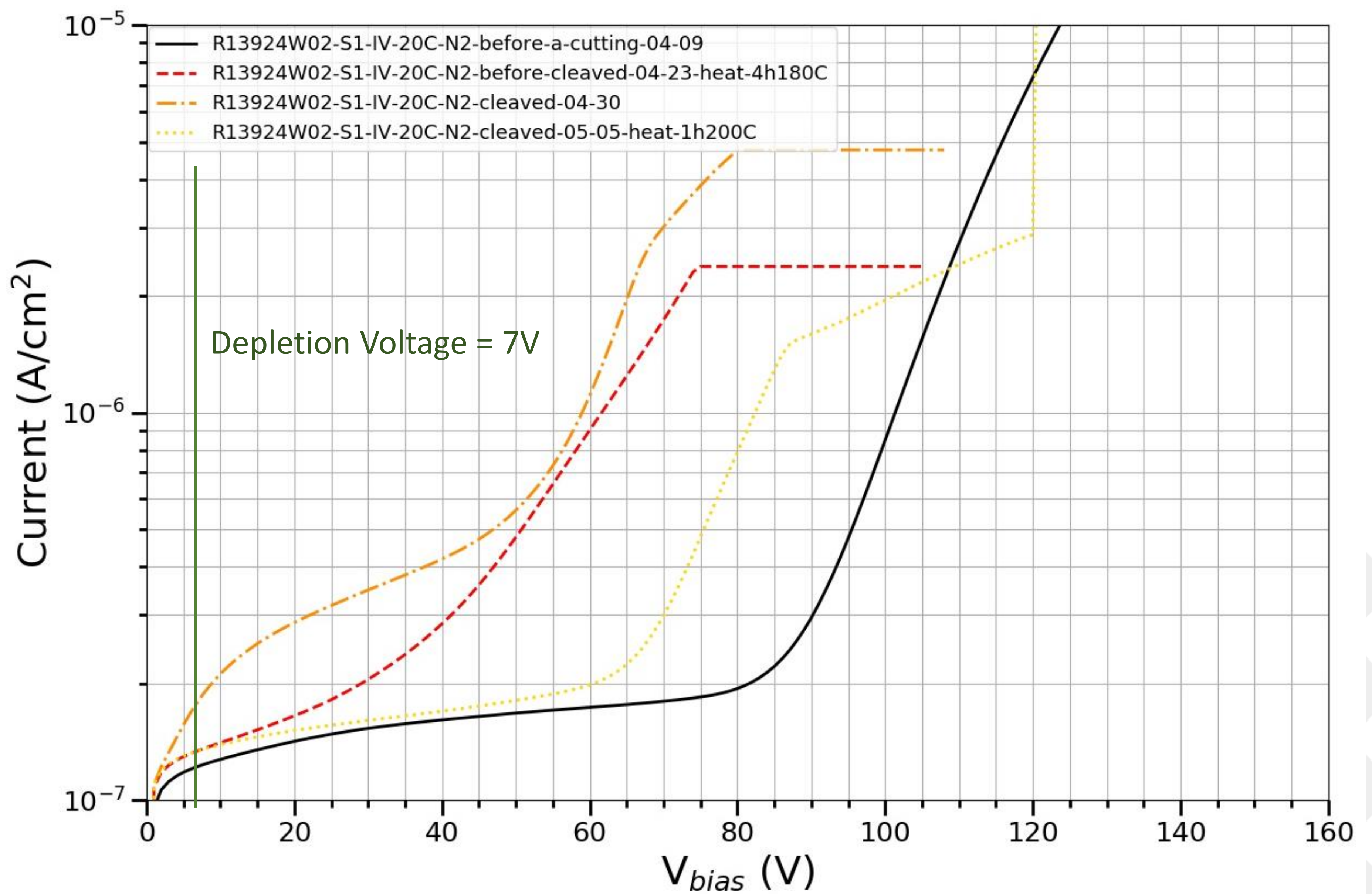
R13924W01-S2-IV-20C-N2-cleaved
R13924W01-S4-IV-20C-N2-cleaved
R13924W01-S6-IV-20C-N2-cleaved
R13924W02-S1-IV-20C-N2-cleaved
R13924W02-S2-IV-20C-N2-cleaved
R13924W02-S3-IV-20C-N2-cleaved
R13924W02-S4-IV-20C-N2-cleaved
R13924W02-S6-IV-20C-N2-cleaved
R13924W03-S1-IV-20C-N2-cleaved
R13924W03-S2-IV-20C-N2-cleaved
R13924W03-S3-IV-20C-N2-cleaved
R13924W03-S4-IV-20C-N2-cleaved
R13924W03-S5-IV-20C-N2-cleaved
R13924W03-S6-IV-20C-N2-cleaved

IV characteristic measured on sensors after cleaving


Current/cm^2 (A/cm^2)
10^{-5}
10^{-6}
10^{-7}
10^{-8}
0
20
40
60
80
100
120
140
160
180
200
V_{bias} (V)
----- before cleaving
—— after cleaving
R13924W01-S2-IV-20C-N2-a-h
R13924W01-S2-IV-20C-N2-cleaved
R13924W01-S4-IV-20C-N2-a-h
R13924W01-S4-IV-20C-N2-cleaved
R13924W01-S6-IV-20C-N2-a-h
R13924W01-S6-IV-20C-N2-cleaved
R13924W02-S1-IV-20C-N2-a-h
R13924W02-S1-IV-20C-N2-cleaved
R13924W02-S2-IV-20C-N2-a-h
R13924W02-S2-IV-20C-N2-cleaved
R13924W02-S3-IV-20C-N2-a-h
R13924W02-S3-IV-20C-N2-cleaved
R13924W02-S4-IV-20C-N2-a-h
R13924W02-S4-IV-20C-N2-cleaved
R13924W02-S6-IV-20C-N2-a-h
R13924W02-S6-IV-20C-N2-cleaved
R13924W03-S1-IV-20C-N2-a-h
R13924W03-S1-IV-20C-N2-cleaved
R13924W03-S2-IV-20C-N2-a-h
R13924W03-S2-IV-20C-N2-cleaved
R13924W03-S3-IV-20C-N2-a-h
R13924W03-S3-IV-20C-N2-cleaved
R13924W03-S4-IV-20C-N2-a-h
R13924W03-S4-IV-20C-N2-cleaved
R13924W03-S5-IV-20C-N2-a-h
R13924W03-S5-IV-20C-N2-cleaved
R13924W03-S6-IV-20C-N2-a-h
R13924W03-S6-IV-20C-N2-cleaved


Current/cm² (A/cm²)
V_{bias} (V)
Different results in different days
R13924W01-S2-IV-20C-N2-cleaved-05-05
R13924W01-S2-IV-20C-N2-cleaved-30-04
R13924W01-S4-IV-20C-N2-cleaved-05-05
R13924W01-S4-IV-20C-N2-cleaved-30-04
R13924W01-S6-IV-20C-N2-cleaved-05-05
R13924W01-S6-IV-20C-N2-cleaved-30-04
R13924W02-S1-IV-20C-N2-cleaved-05-05
R13924W02-S1-IV-20C-N2-cleaved-30-04
R13924W03-S2-IV-20C-N2-cleaved-05-05
R13924W03-S2-IV-20C-N2-cleaved-30-04

Current evolution in sensor W02 S1 at different stages



Current evolution in sensor W01 S2 at different stages

Current (A/cm^2)

10^{-6}

10^{-7}

Depletion Voltage = 7V

R13924W01-S2-IV-20C-N2-before-cleaved-04-22

R13924W01-S2-IV-20C-N2-cleaved-04-30

R13924W01-S2-IV-20C-N2-cleaved-05-05-before-heat

R13924W01-S2-IV-20C-N2-cleaved-05-05-heat-1h200C

0 20 40 60 80 100 120 140 160

V_{bias} (V)

Next steps

- Cleaning of the sensors from wafers 5 and 6 (May 11)
- Cleaning, **heating for 24 hours at 200°C** and passivation of the back side of the cleaved sensors (second week of May)
- Electrical characterization of the passivated sensors (3rd week of May)
- Delivery of the cleaved and passivated sensors (third week of May)
- Characterization of the capacitances of wafers 4 and 10 (next week)
- Cut wafers 7, 8, 9, 10, 11, 12, 13, 14, 15 (next week)
- Characterize the diced sensors (next week)
- Cleave and passivate the new sensors for delivery