CERAMIC CAPACITOR HV BIAS TEST RESULTS

MUZAFFER ATAC
FERMILAB/UCLA

CONTRIBUTERS TO THIS WORK:

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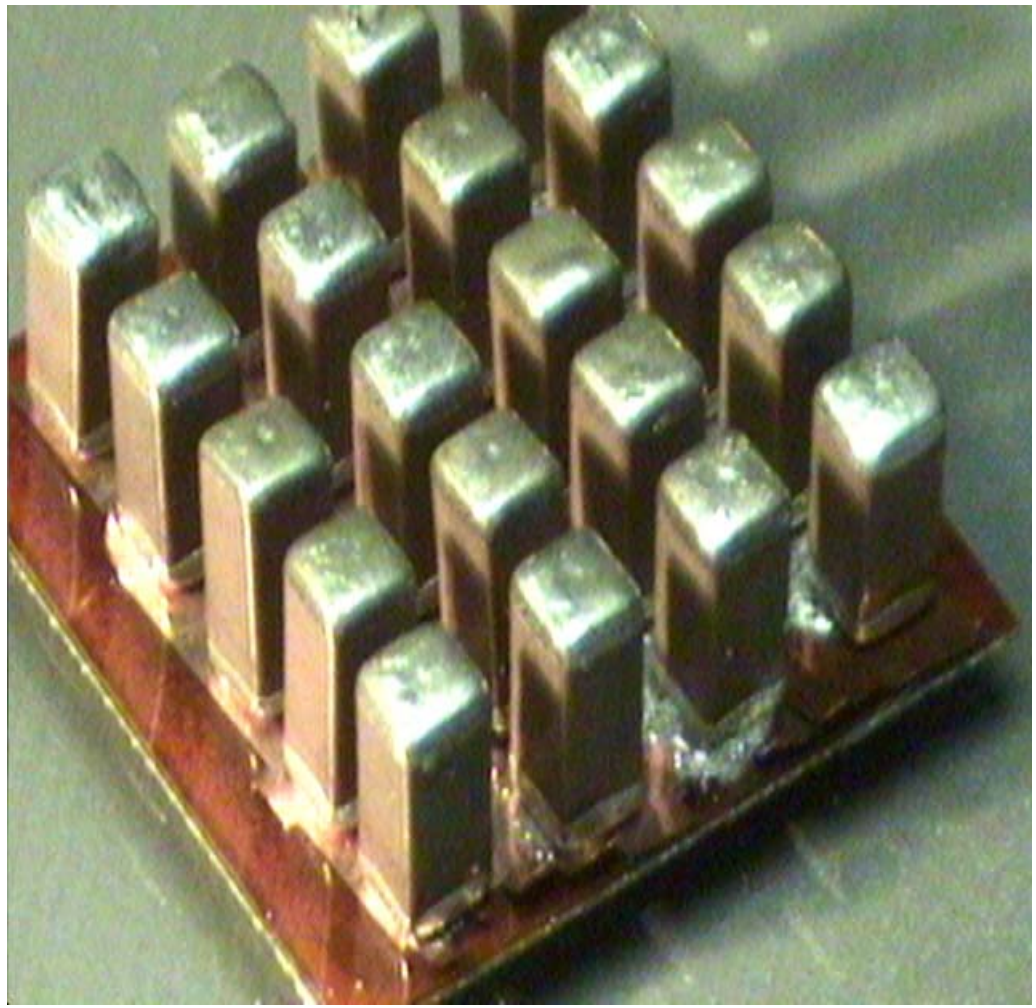
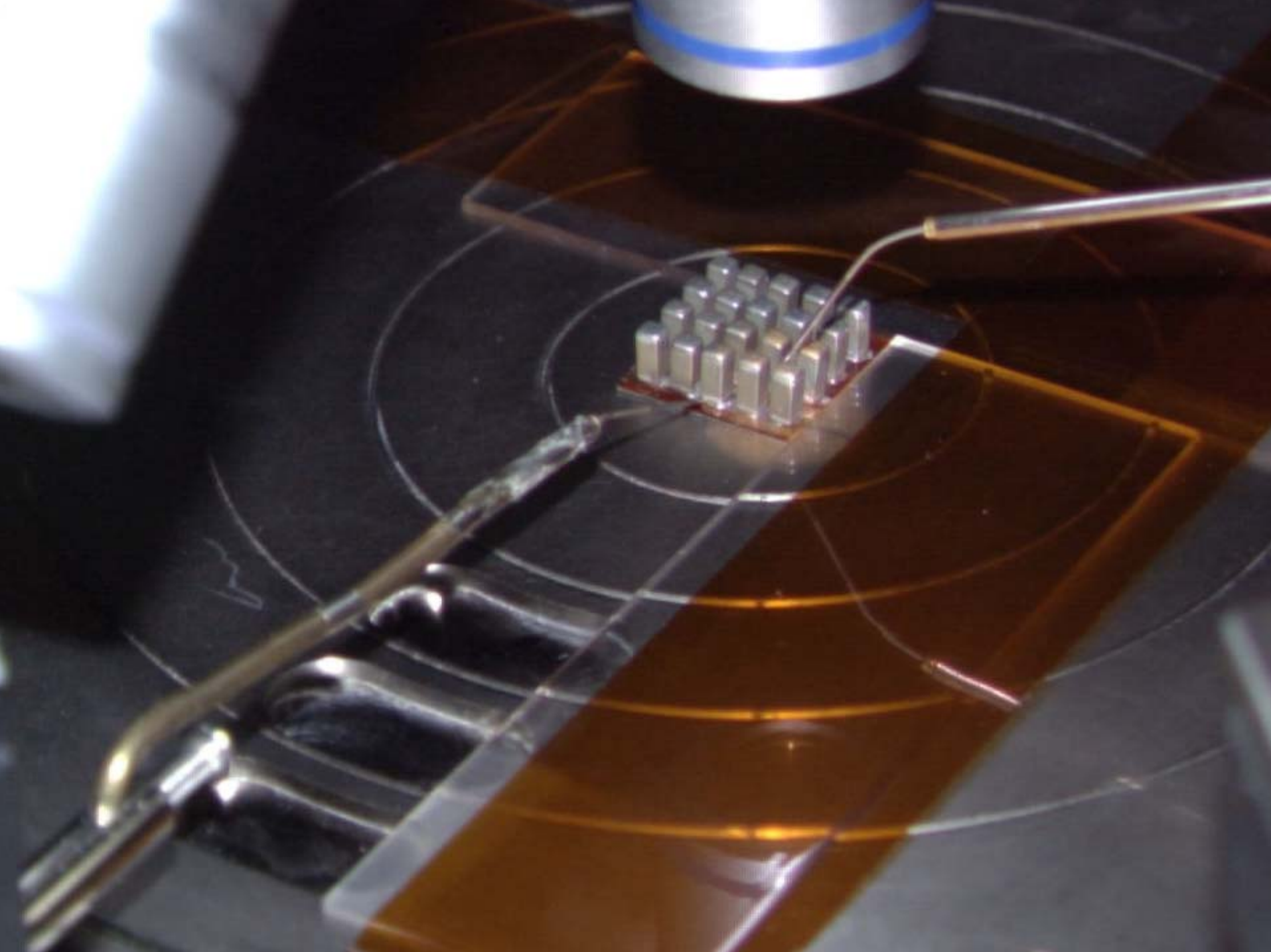
CHARACTERISTICS OF THE CAPACITORS

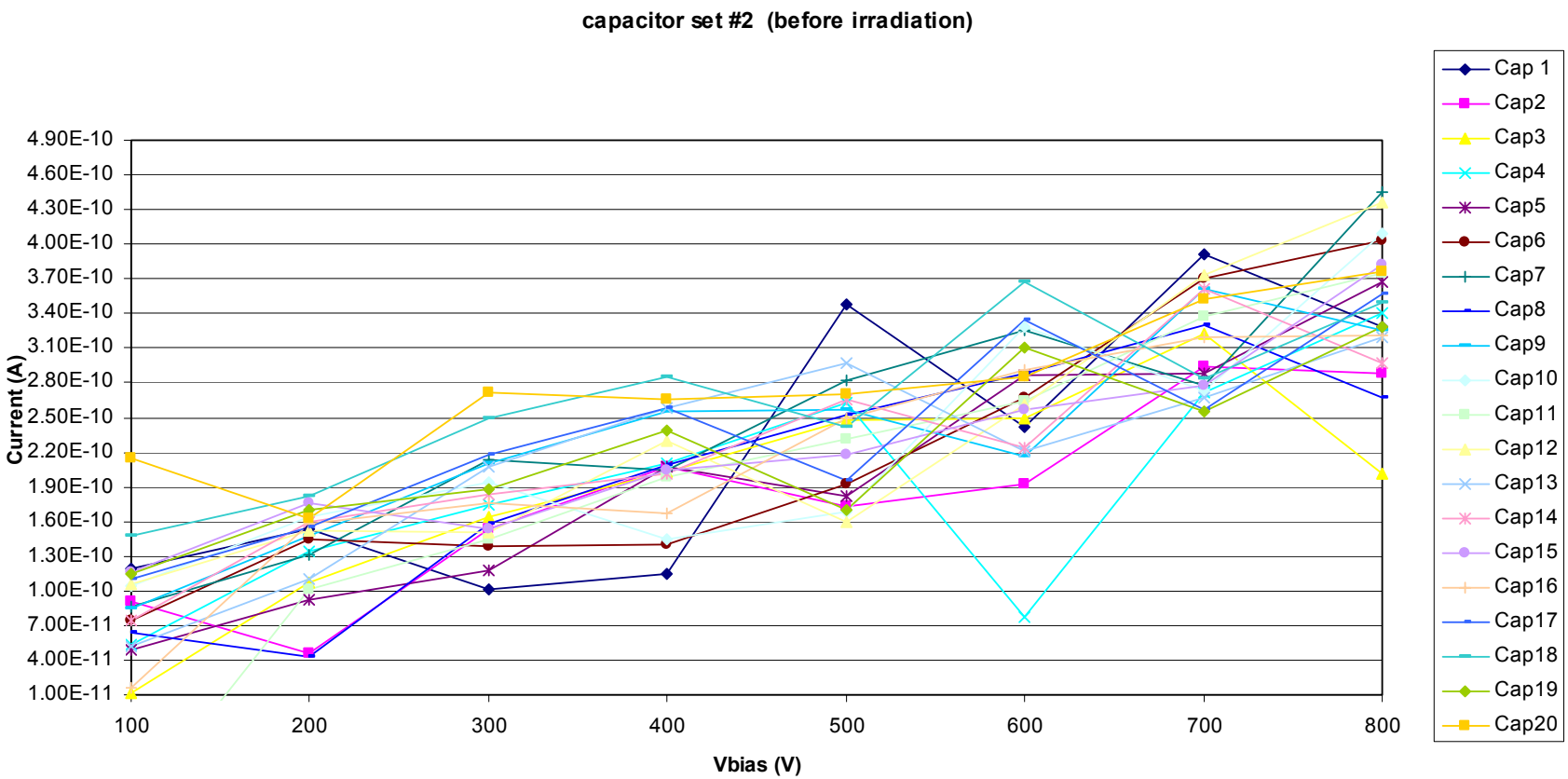
- WE HAVE TESTED SURFACE MOUNT CAPACITORS PRODUCED BY TWO DIFFERENT COMPANIES: JOHANSON DIELECTRICS AND NOVACAP CO.
- JOHANSON:
- 1nF, 4x2.5x2mm NPO multilayer capacitors,
- Leakage currents were measured as a function of the HV before and after a fluence of $5x10^{14}$, 200 MeV protons. They were rated at 1keV dc voltage.
- NOVACAP:
- 1nF, 4.6x2x2 mm NPO multilayer capacitors,
- They were rated at 2keV volt dc.

SURFACE MOUNT CAPACITOR BANK

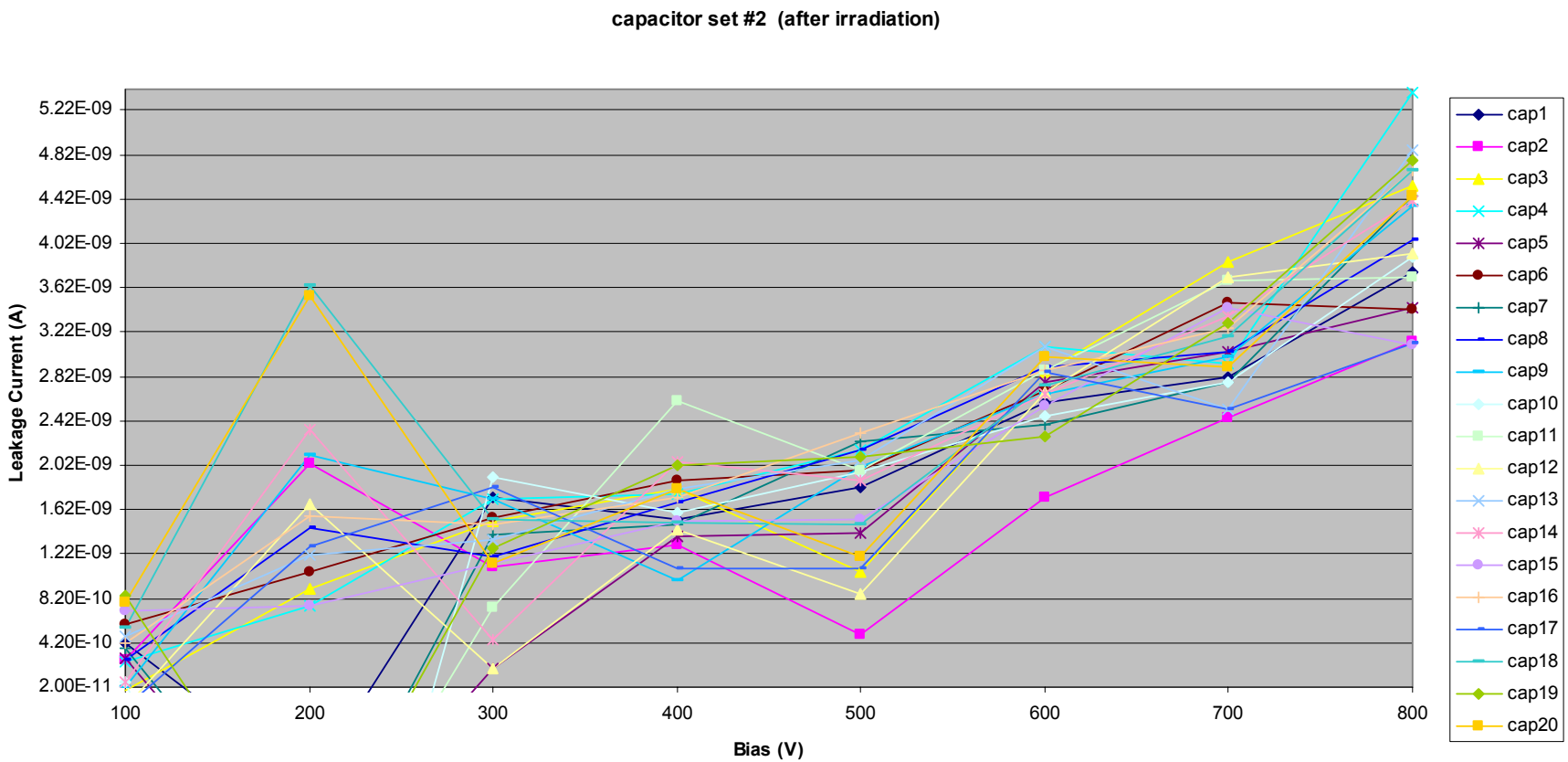
The surface mount capacitors were soldered on .2 micron thick copper on 12 micron thick Kapton and glued to silicon wafer for the measurements using touch probes semiautomatically.

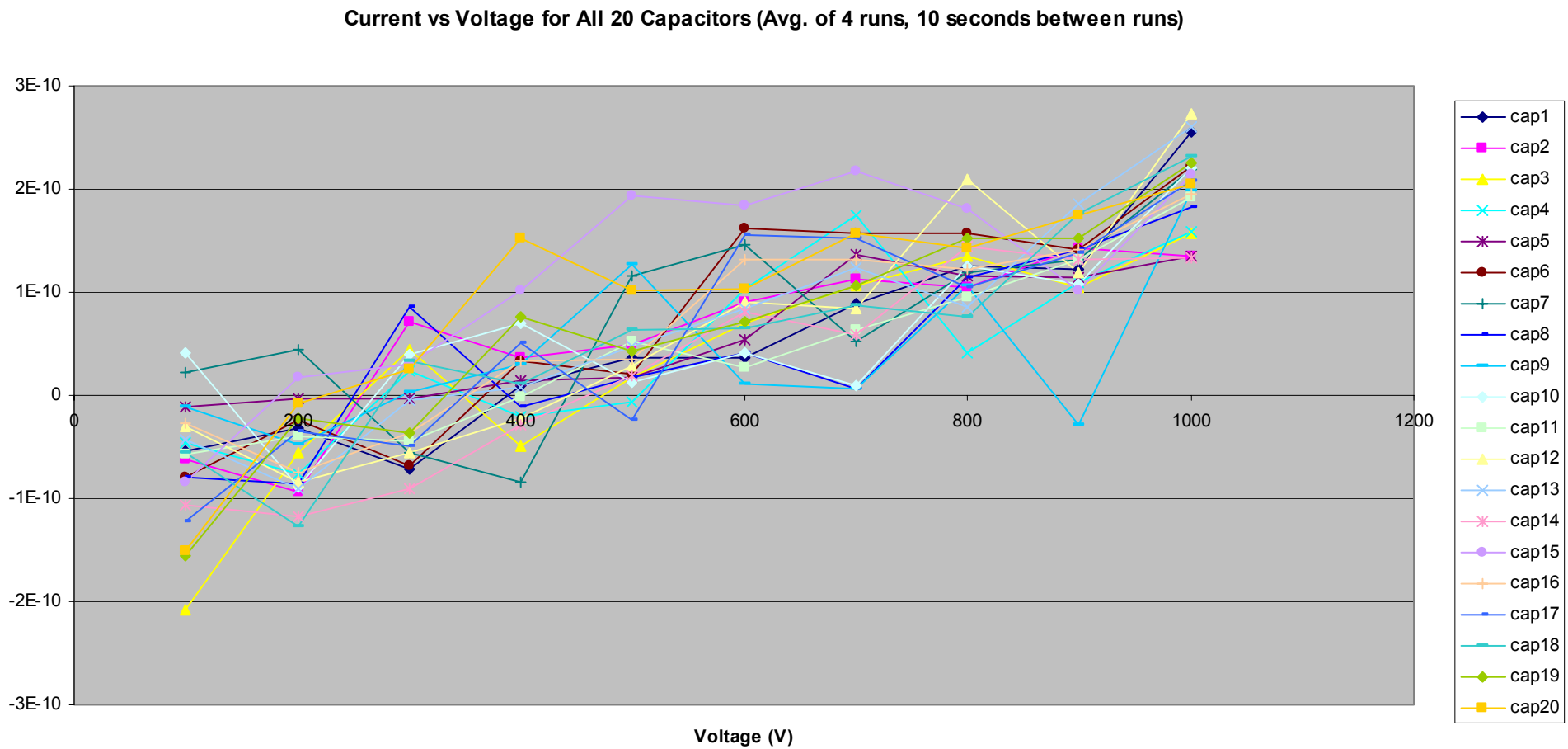


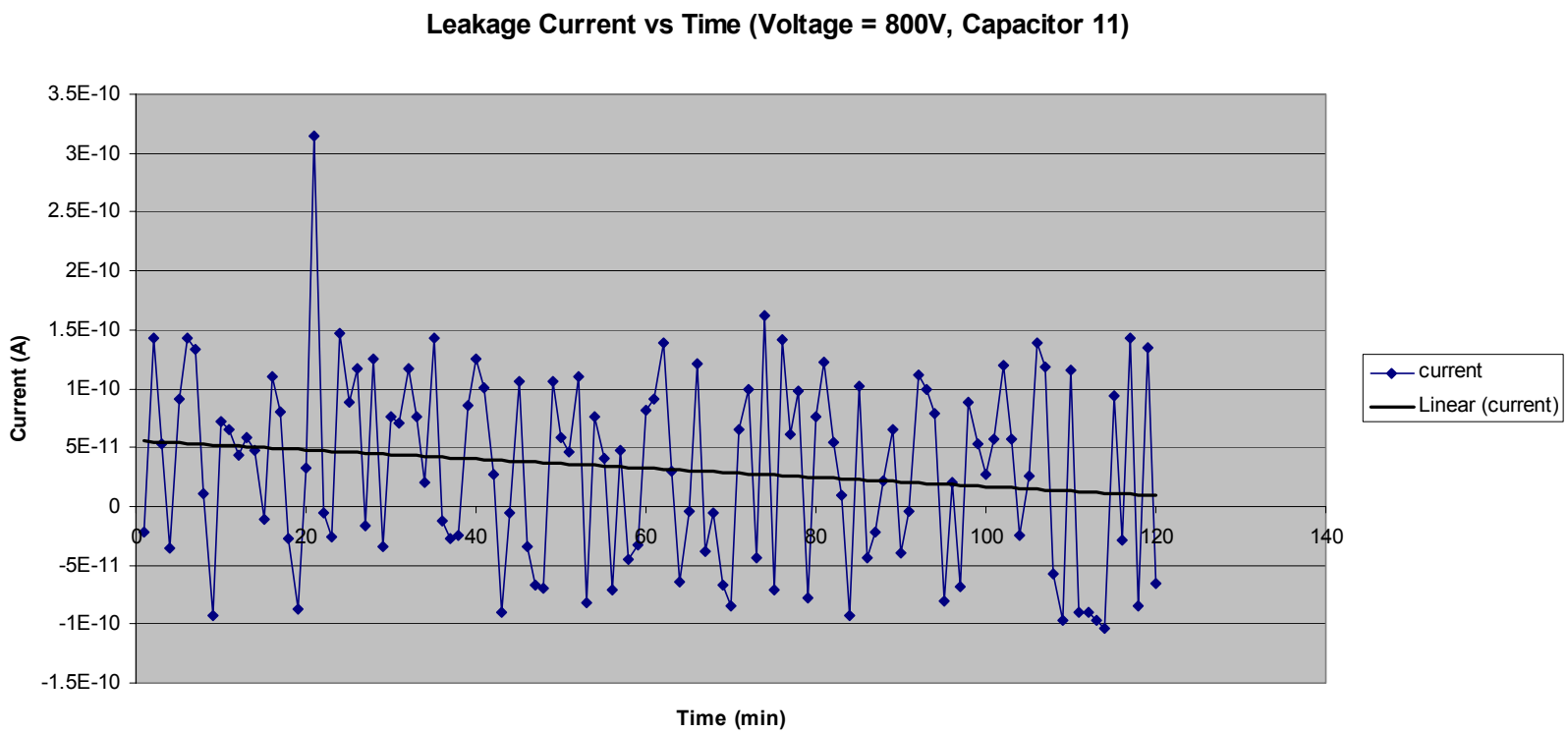


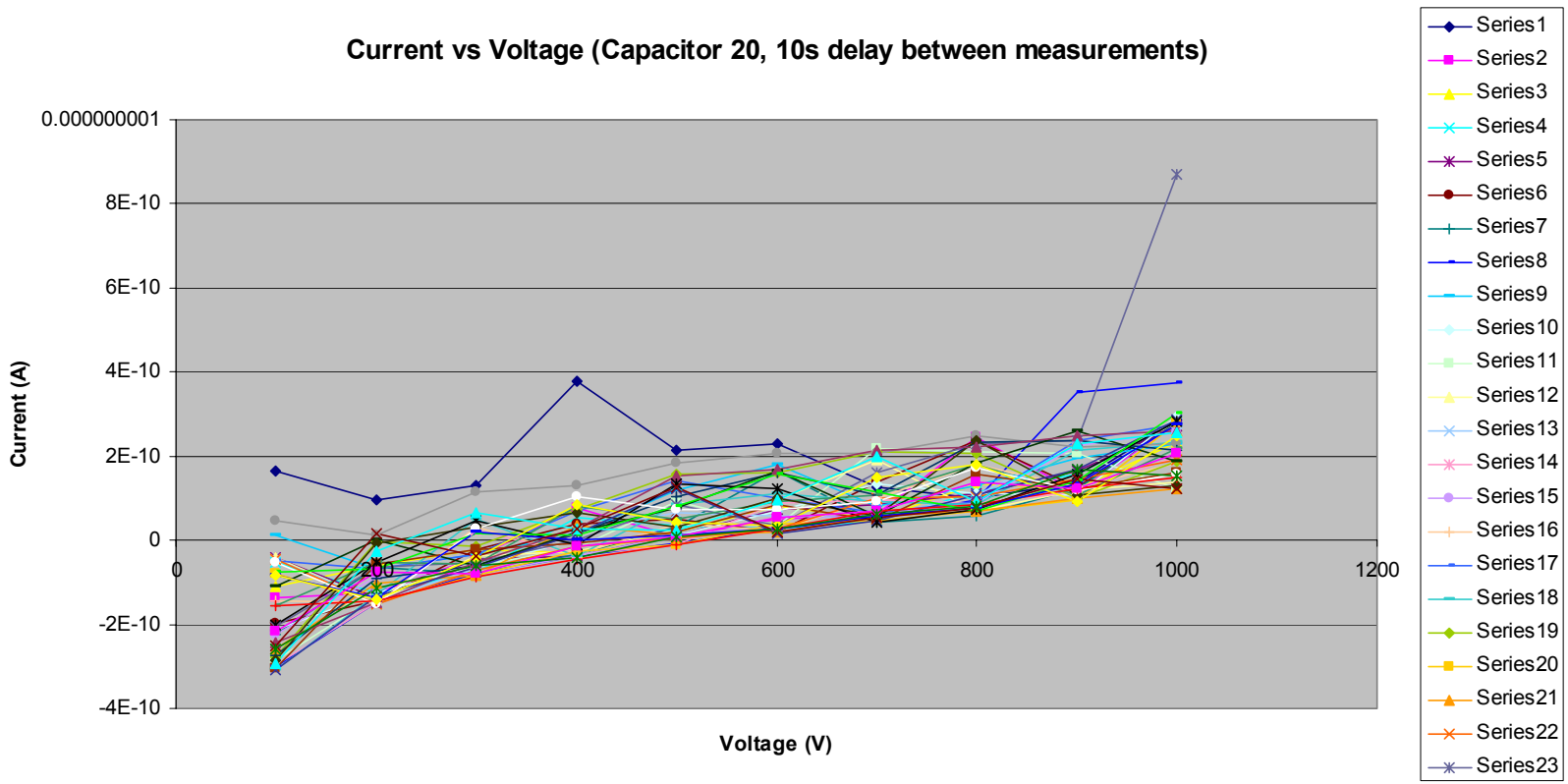


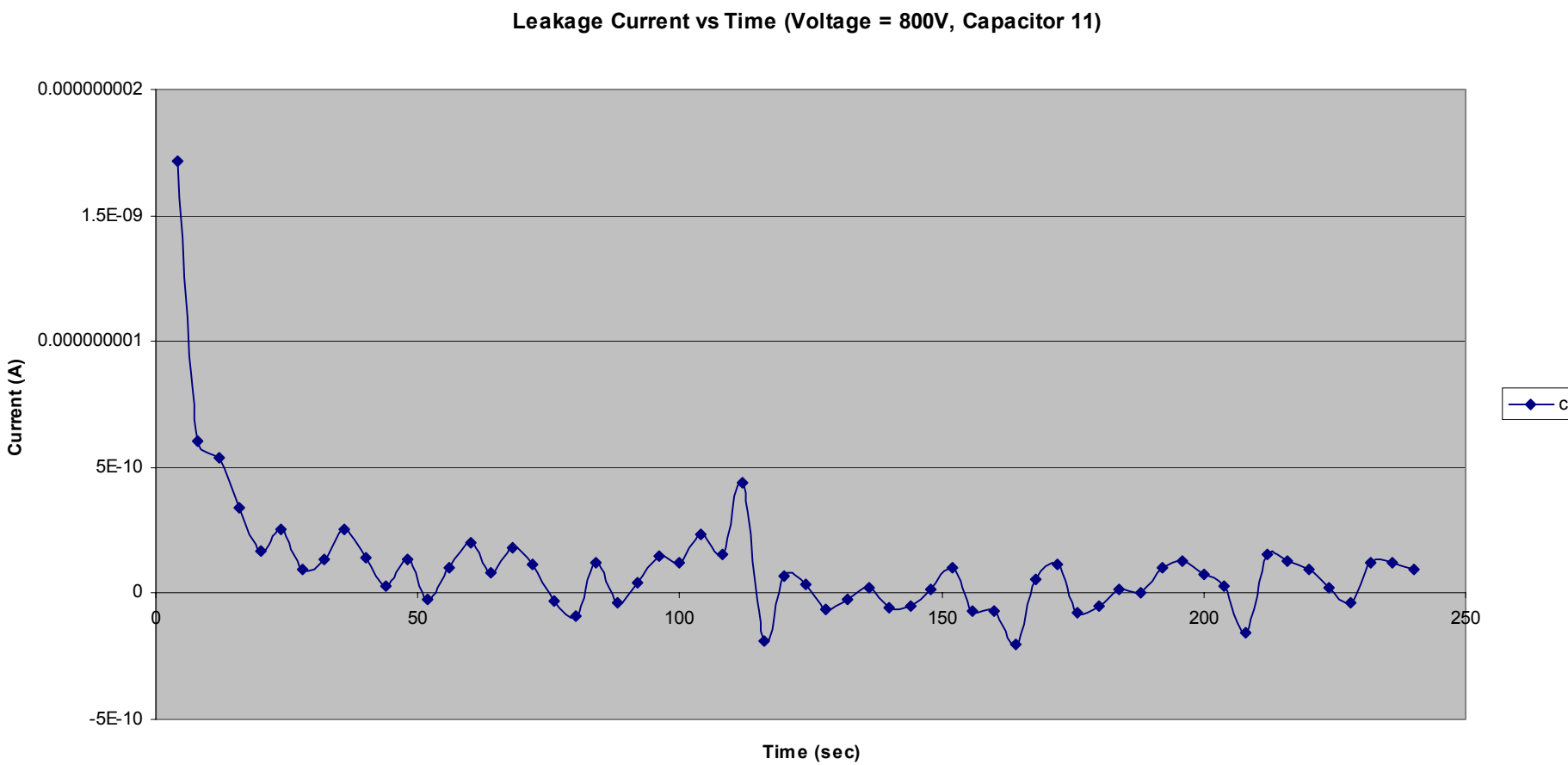
- Johanson capacitors

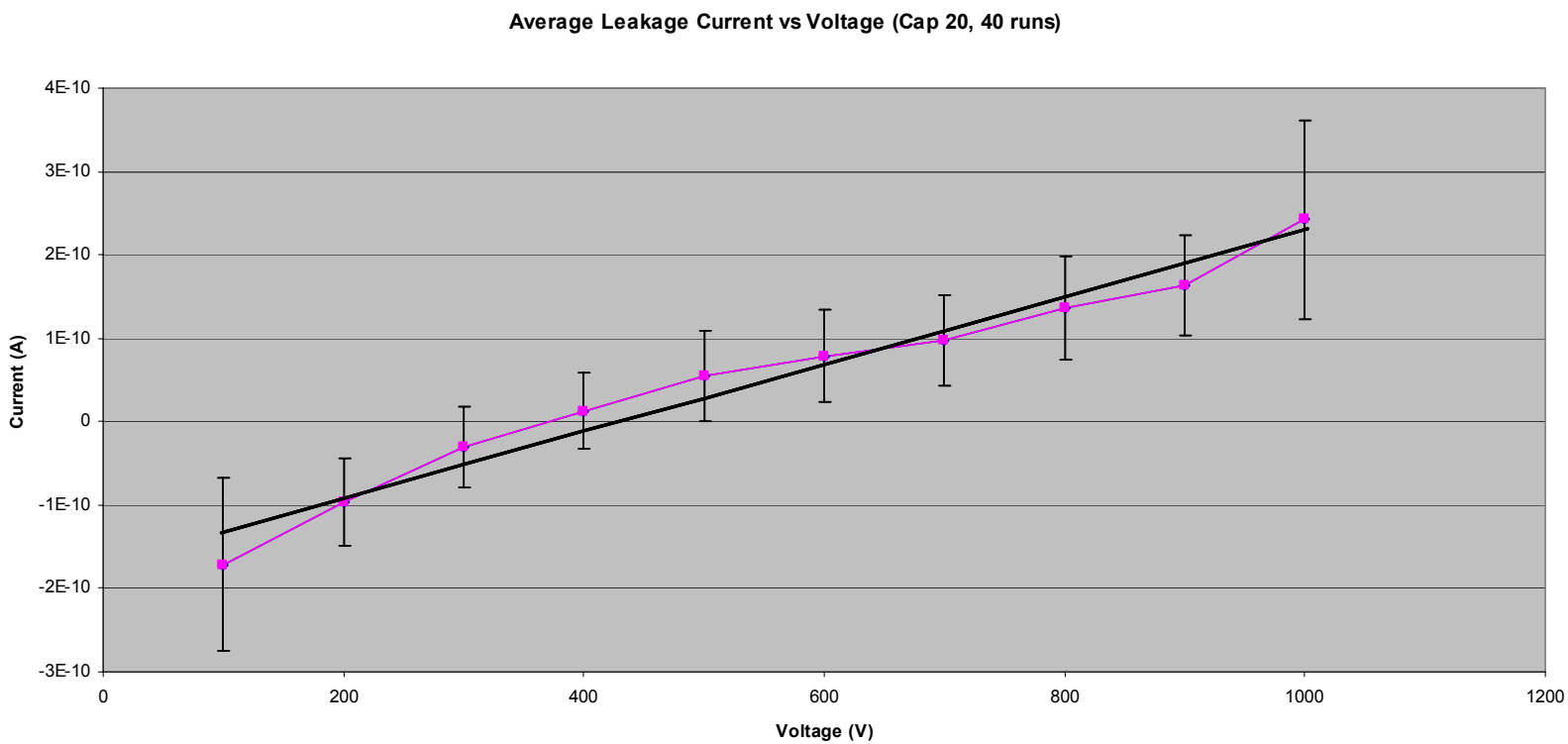

capacitor set #2 (after irradiation)
Leakage Current (A)
5.22E-09
4.82E-09
4.42E-09
4.02E-09
3.62E-09
3.22E-09
2.82E-09
2.42E-09
2.02E-09
1.62E-09
1.22E-09
8.20E-10
4.20E-10
2.00E-11
100
200
300
400
500
600
700
800
Bias (V)
cap1
cap2
cap3
cap4
cap5
cap6
cap7
cap8
cap9
cap10
cap11
cap12
cap13
cap14
cap15
cap16
cap17
cap18
cap19
cap20

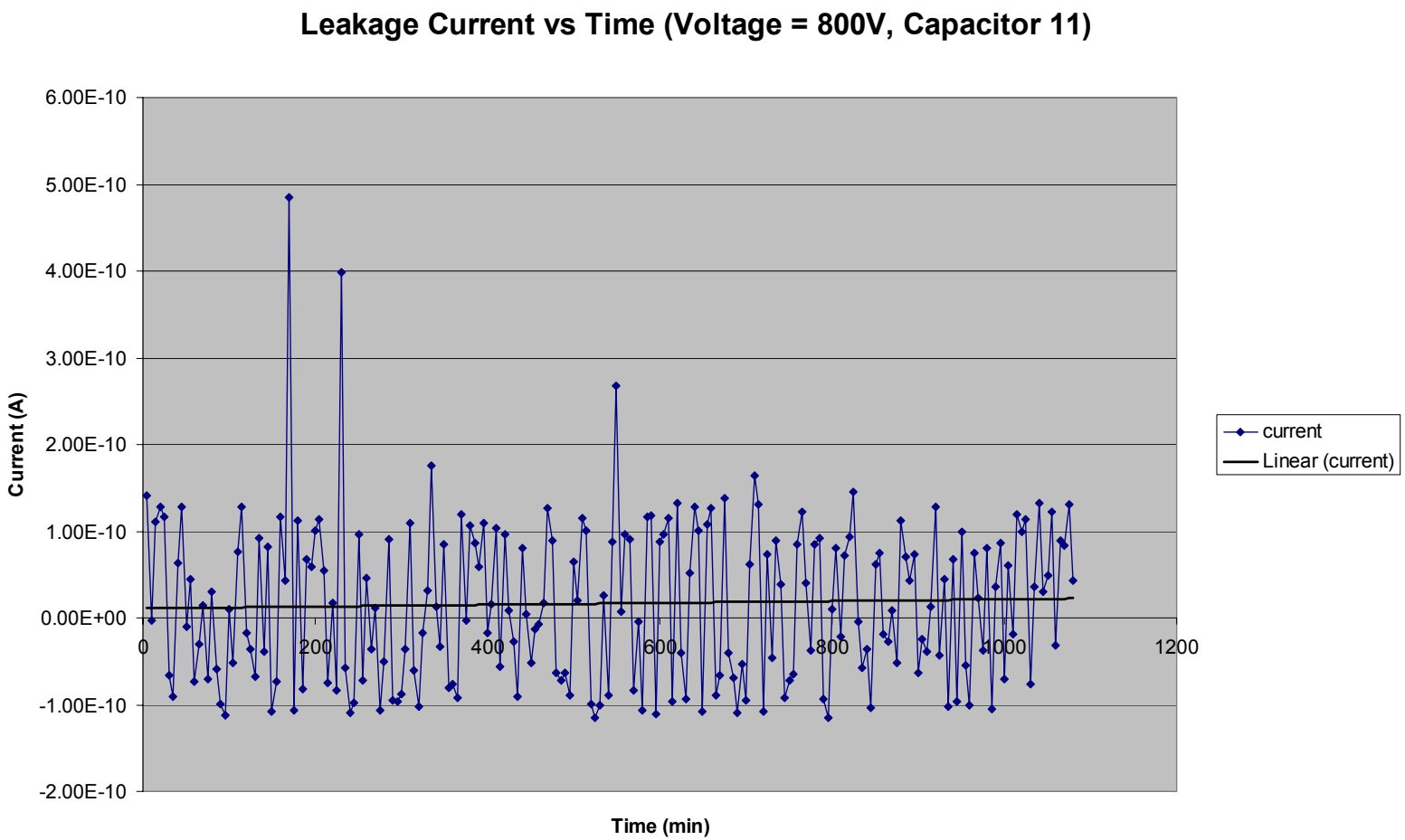

Current vs Voltage for All 20 Capacitors (Avg. of 4 runs, 10 seconds between runs)
3E-10
2E-10
1E-10
0
-1E-10
-2E-10
-3E-10
0
200
400
600
800
1000
1200
Voltage (V)
cap1
cap2
cap3
cap4
cap5
cap6
cap7
cap8
cap9
cap10
cap11
cap12
cap13
cap14
cap15
cap16
cap17
cap18
cap19
cap20


Leakage Current vs Time (Voltage = 800V, Capacitor 11)
3.5E-10
3E-10
2.5E-10
2E-10
1.5E-10
1E-10
5E-11
0
-5E-11
-1E-10
-1.5E-10
Current (A)
0
20
40
60
80
100
120
140
Time (min)
current
Linear (current)

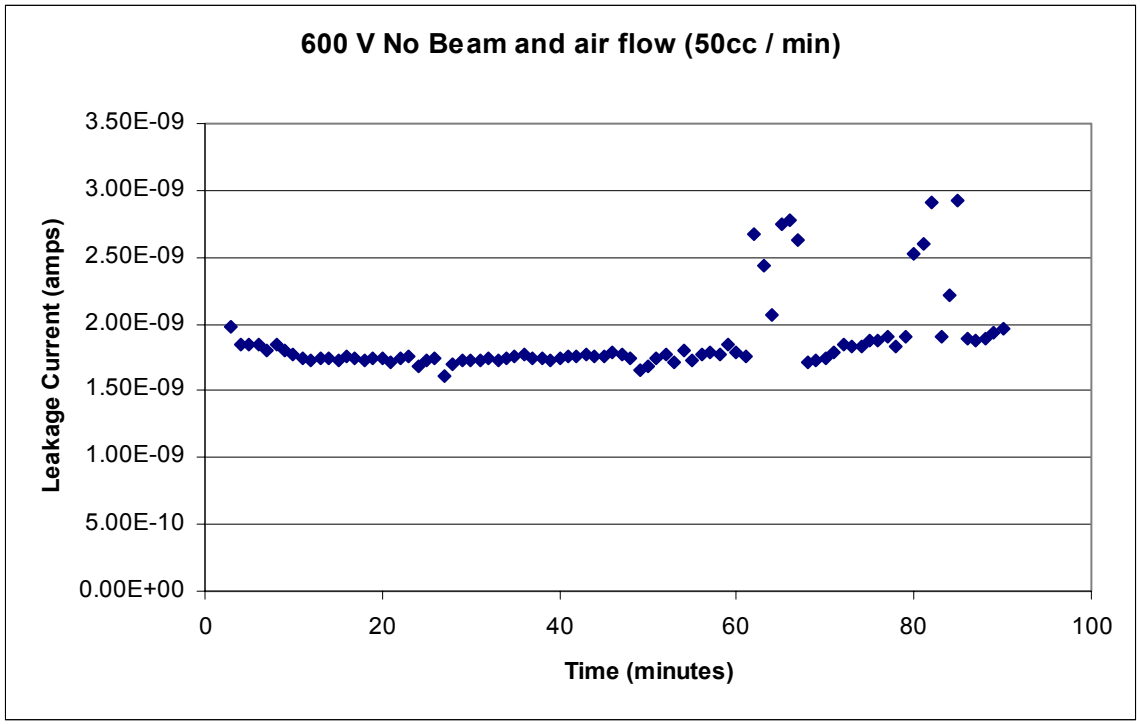

Current vs Voltage (Capacitor 20, 10s delay between measurements)
Current (A)
0.000000001
8E-10
6E-10
4E-10
2E-10
0
-2E-10
-4E-10
0
200
400
600
800
1000
1200
Voltage (V)
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9
Series10
Series11
Series12
Series13
Series14
Series15
Series16
Series17
Series18
Series19
Series20
Series21
Series22
Series23

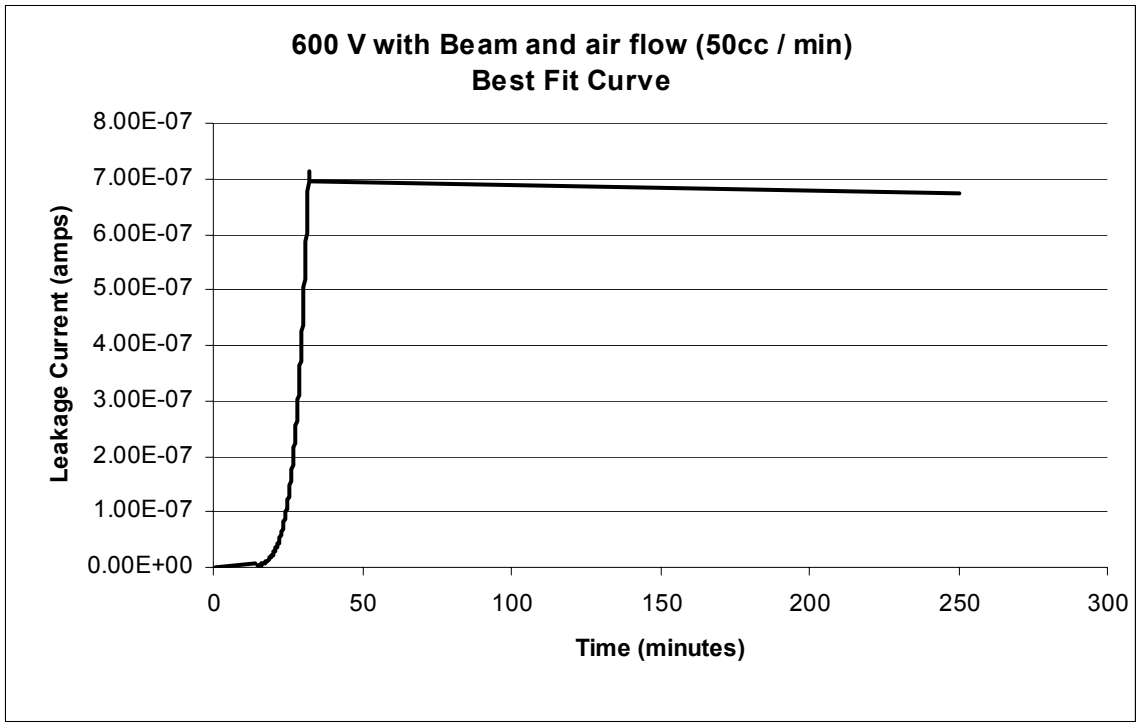

Leakage Current vs Time (Voltage = 800V, Capacitor 11)
0.000000002
1.5E-09
0.000000001
5E-10
0
-5E-10
Current (A)
0
50
100
150
200
250
Time (sec)
c

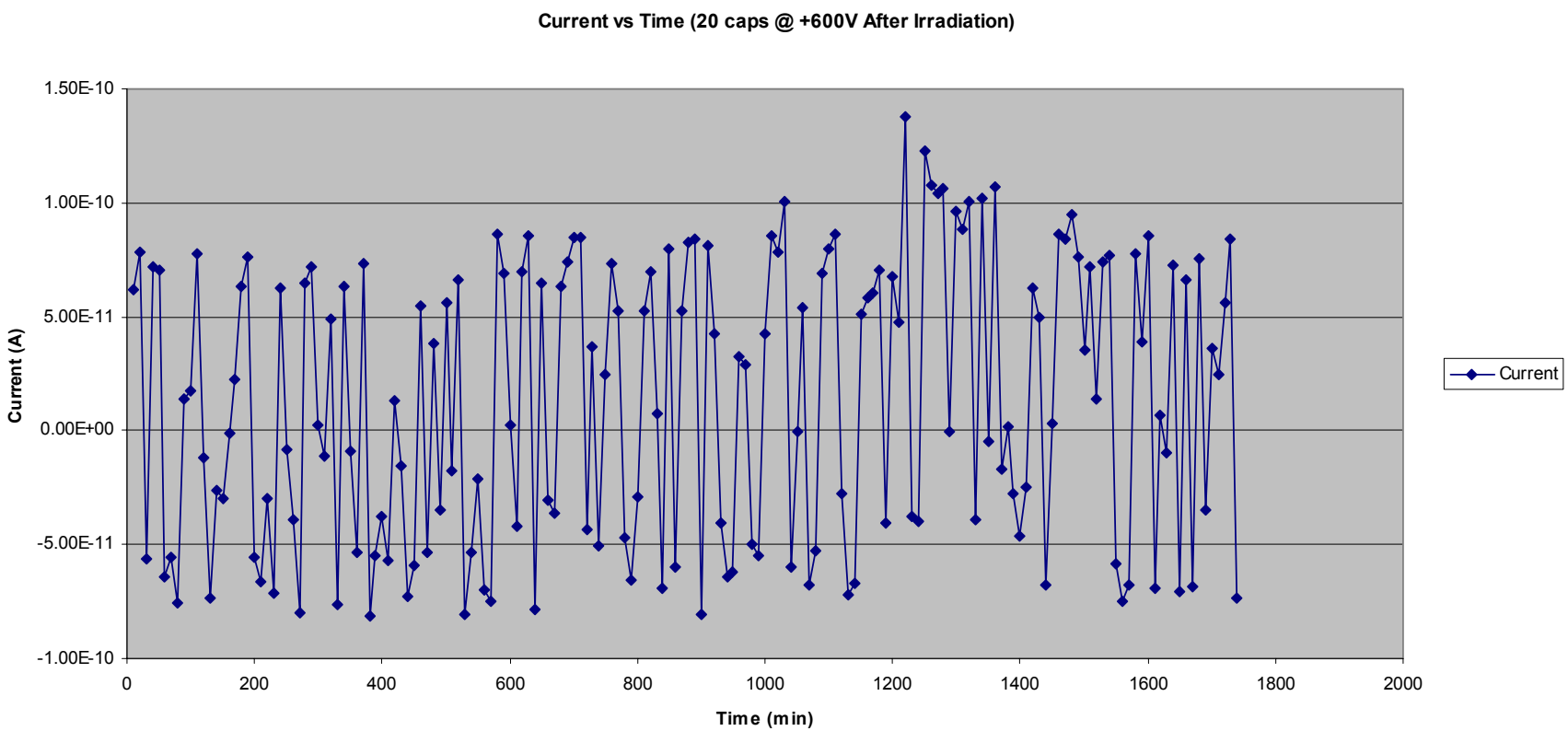

Average Leakage Current vs Voltage (Cap 20, 40 runs)
4E-10
3E-10
2E-10
1E-10
0
-1E-10
-2E-10
-3E-10
Current (A)
0
200
400
600
800
1000
1200
Voltage (V)


Leakage Current vs Time (Voltage = 800V, Capacitor 11)
6.00E-10
5.00E-10
4.00E-10
3.00E-10
2.00E-10
1.00E-10
0.00E+00
-1.00E-10
-2.00E-10
Current (A)
0
200
400
600
800
1000
1200
Time (min)
current
Linear (current)

Novacap capacitors leakage current measurements at IUCF




600 V with Beam and air flow (50cc / min)
Best Fit Curve
Leakage Current (amps)
8.00E-07
7.00E-07
6.00E-07
5.00E-07
4.00E-07
3.00E-07
2.00E-07
1.00E-07
0.00E+00
0
50
100
150
200
250
300
Time (minutes)


Current vs Time (20 caps @ +600V After Irradiation)
1.50E-10
1.00E-10
5.00E-11
0.00E+00
-5.00E-11
-1.00E-10
Current (A)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Time (min)
Current