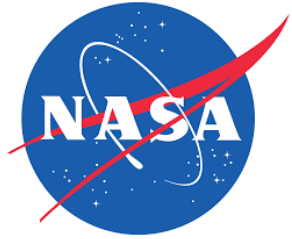
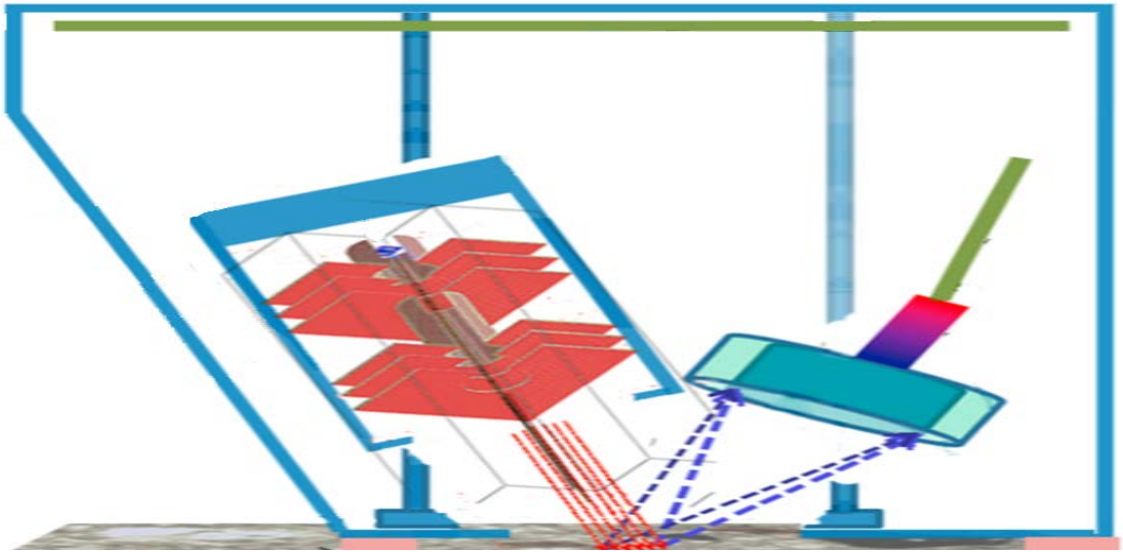
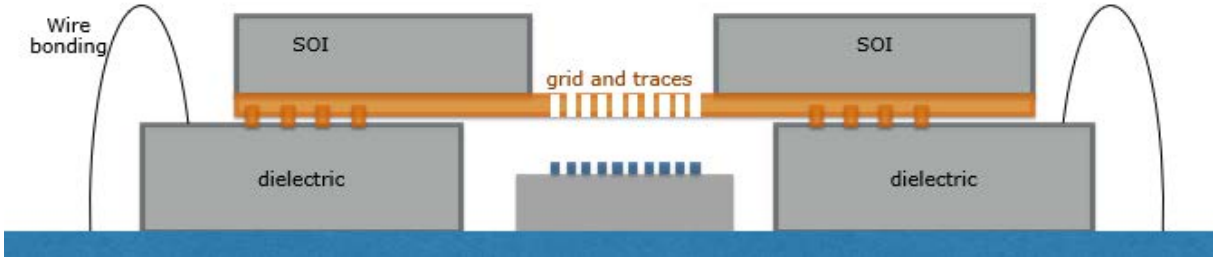


Characterization of Carbon Nanotubes for Field Emission: MiniEPMA Project

Collin Flynn
2018 NASA GSFC Intern

What is the MiniEPMA?

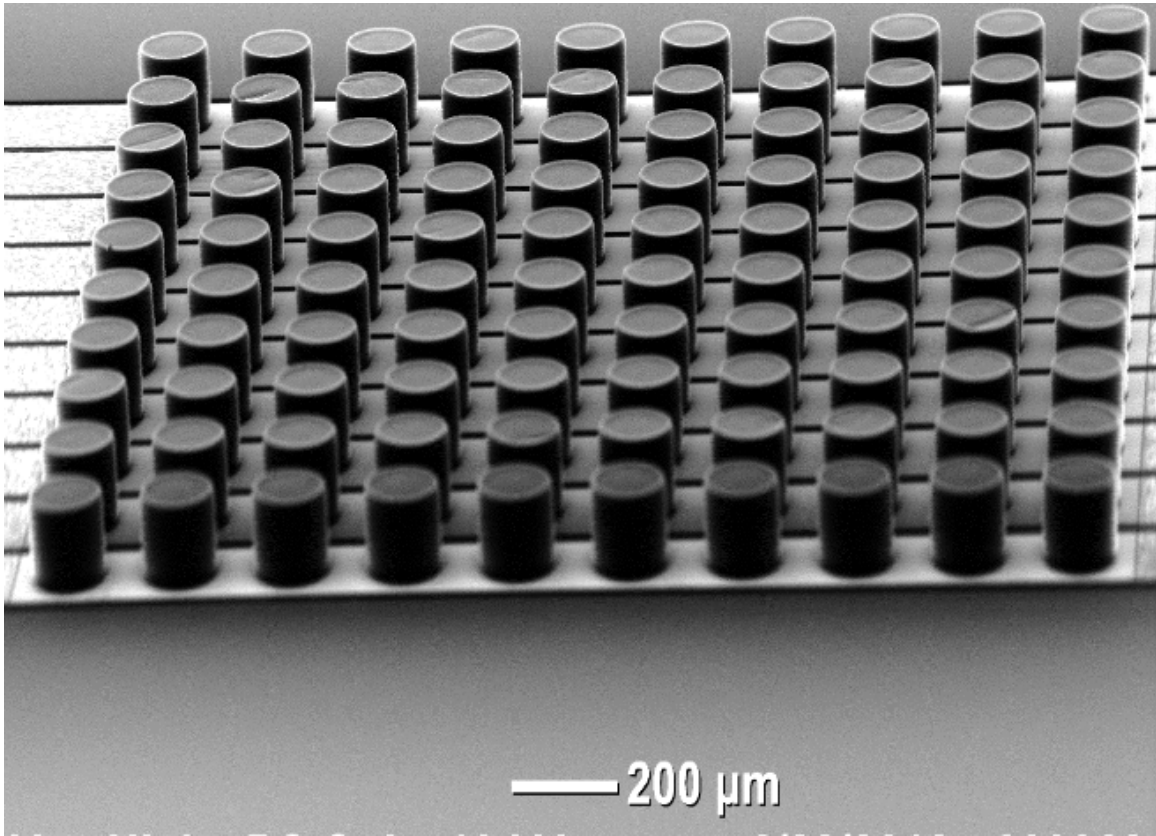




Carbon Nanotube (CNT) Pillars

- Not all the same
- See different emission characteristics from different CNT arrays

- Different growth characteristics:
  - Catalyst type
  - Catalyst thickness
  - Growth conditions

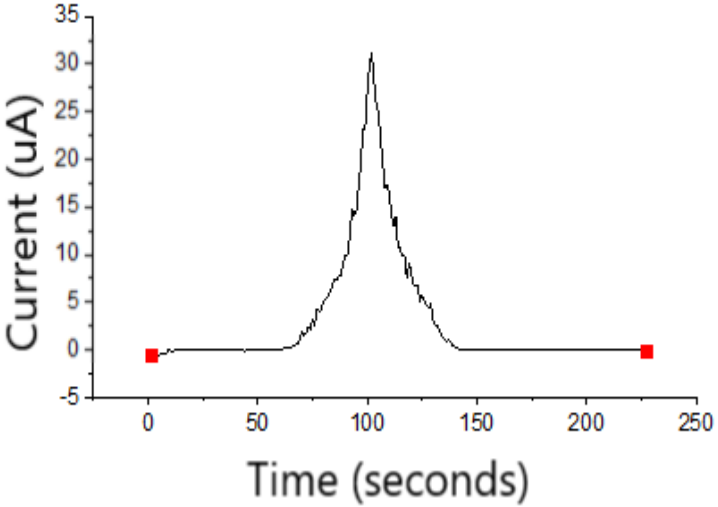


So this begs the question...

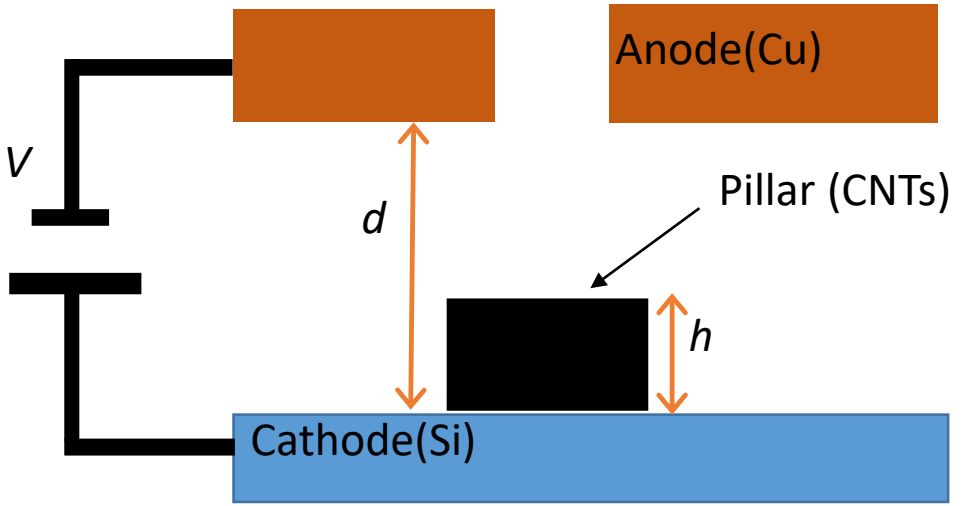
What makes a “good” CNT array?

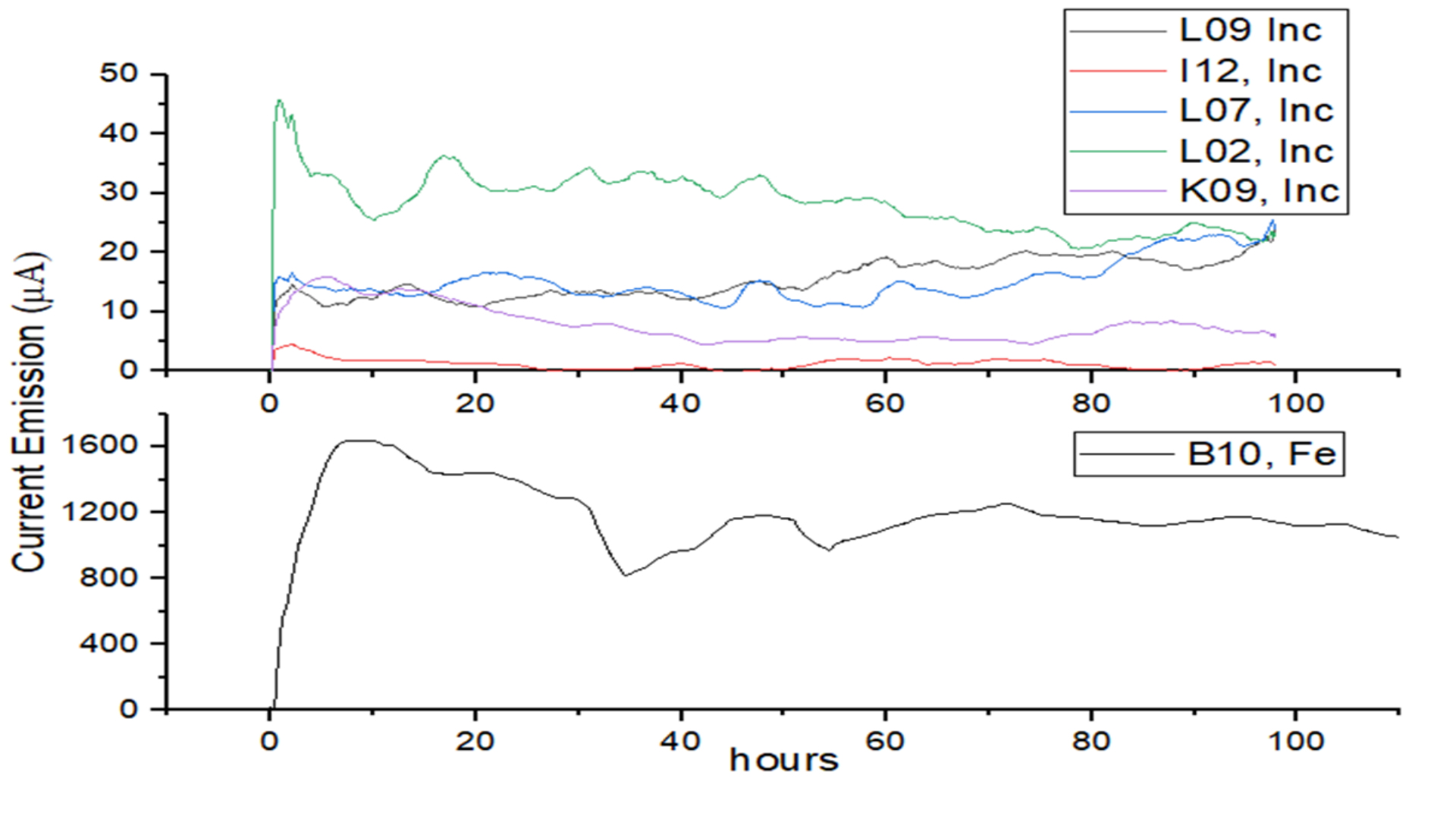
Test Zero

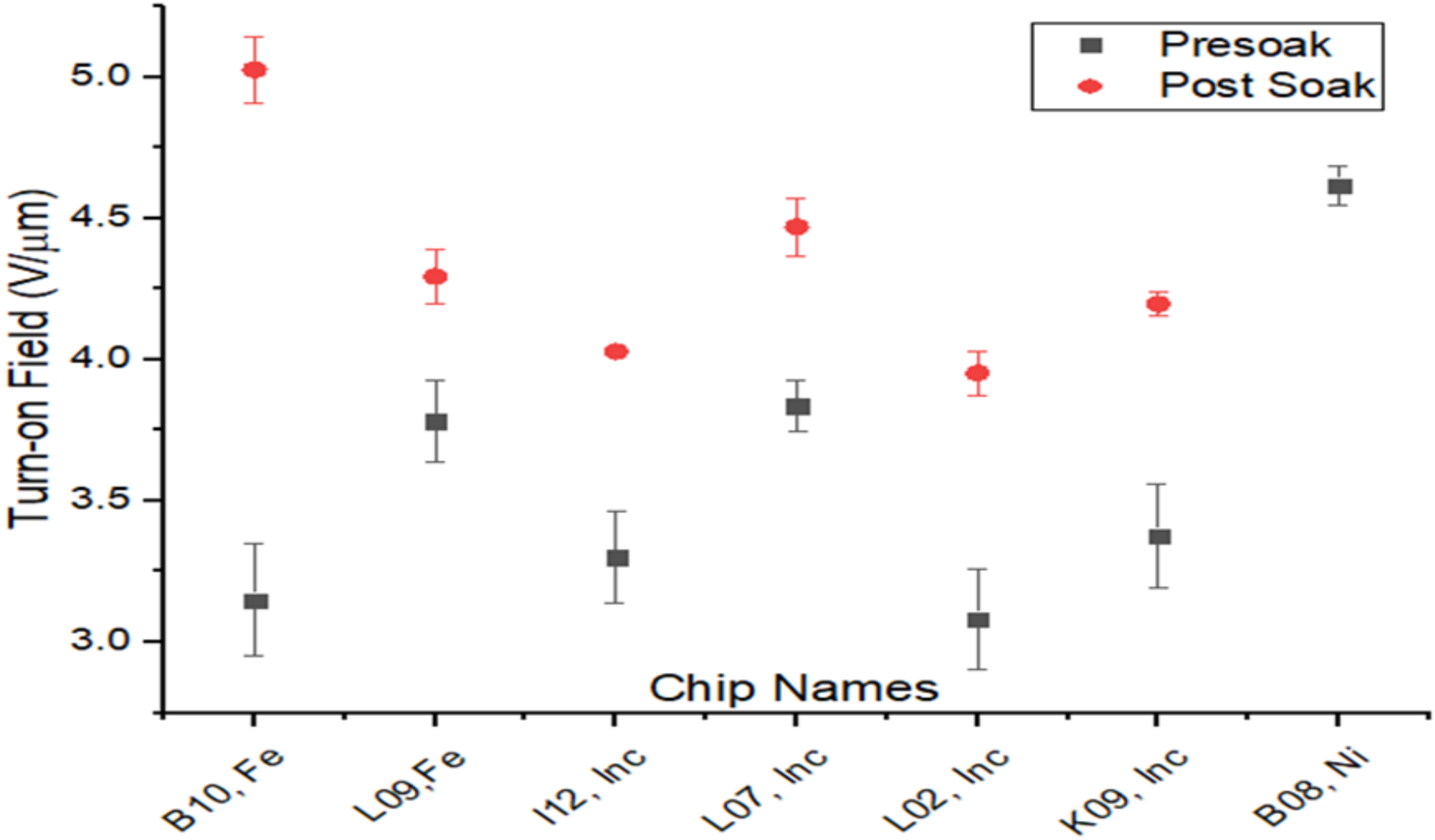
- Current emission
- Longevity/low variability

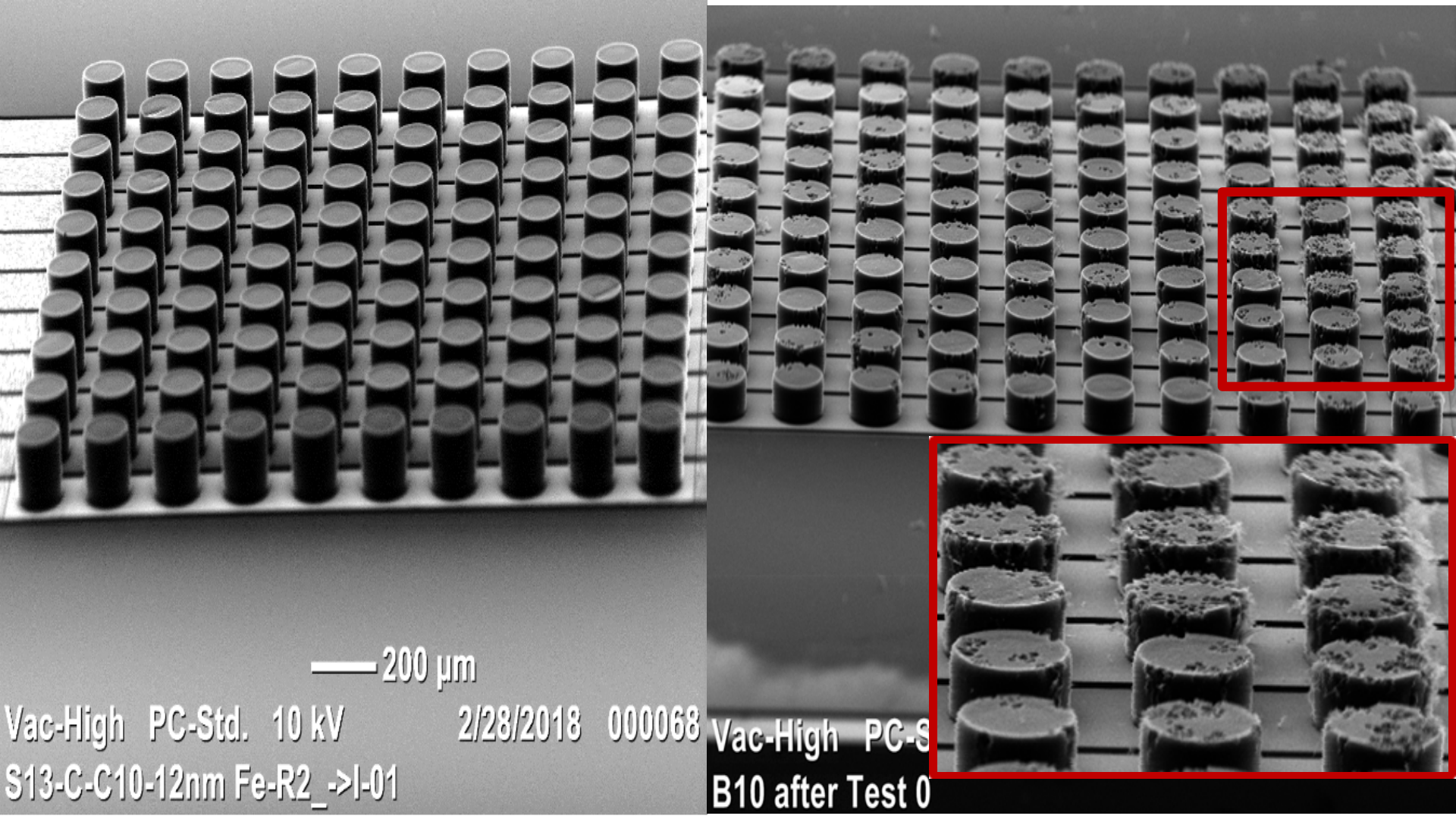


$$Turn\ on\ Field = \frac{V}{d-h}, when\ current\ emission = 1\ \mu A$$



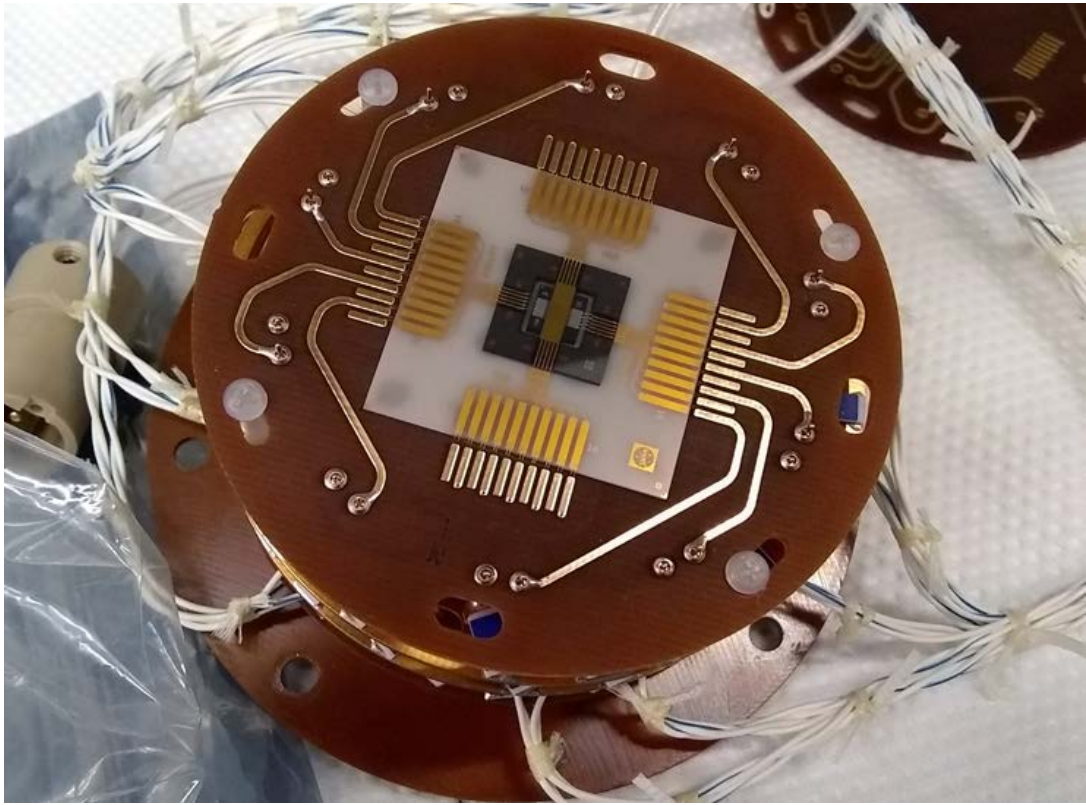

L09 Inc
I12, Inc
L07, Inc
L02, Inc
K09, Inc
B10, Fe
Current Emission (μA)
hours
0
10
20
30
40
50
400
800
1200
1600
0
20
40
60
80
100

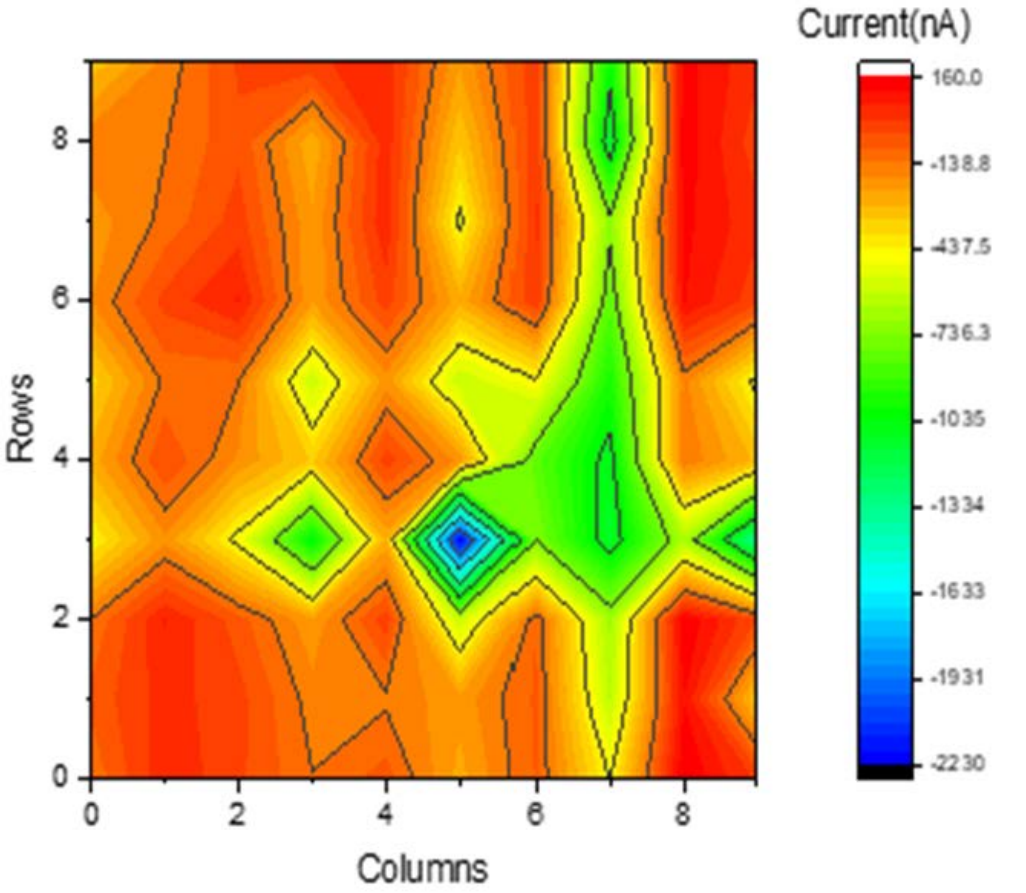

Presoak
Post Soak
Turn-on Field (V/μm)
5.0
4.5
4.0
3.5
3.0
Chip Names
B10, Fe
L09,Fe
I12, Inc
L07 , Inc
L02, Inc
K09, Inc
B08, Ni

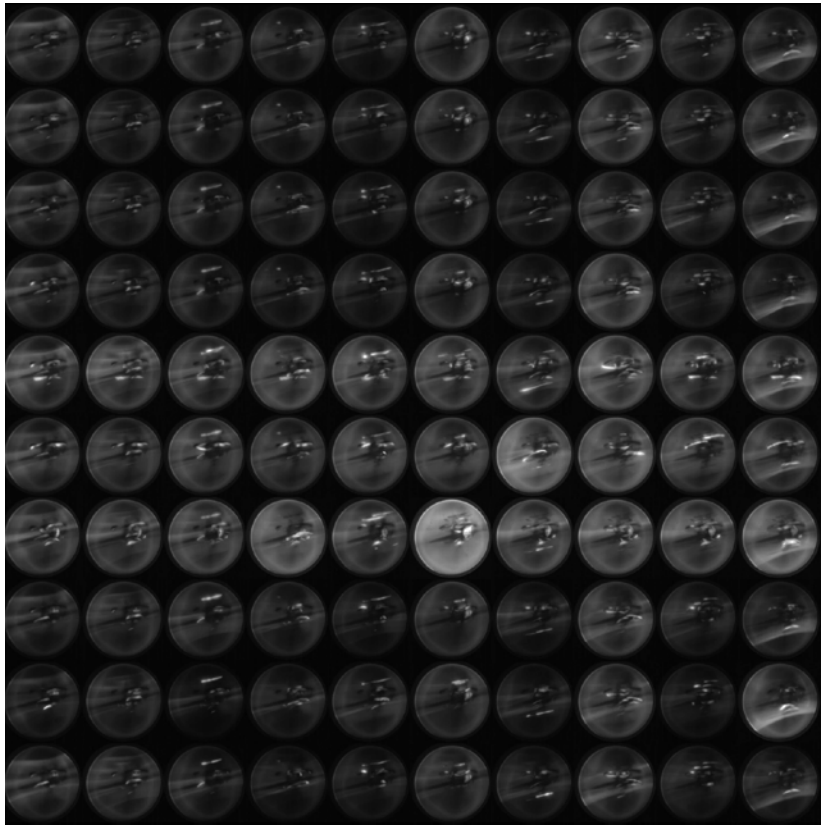

200 µm
Vac-High PC-Std. 10 kV 2/28/2018 000068
S13-C-C10-12nm Fe-R2_->I-01
Vac-High PC-S
B10 after Test 0

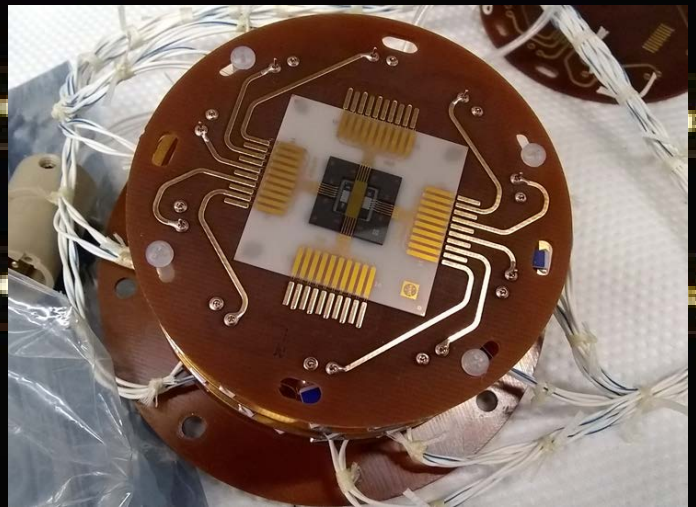
Test One

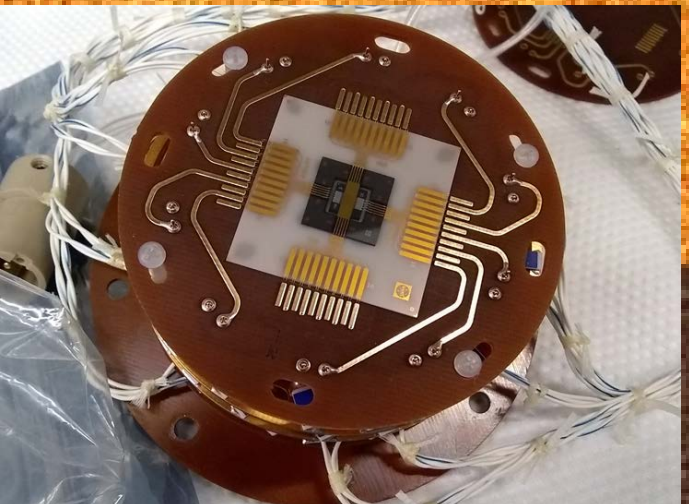
- Testing to see:
  - Are the electronics working
  - Do we have uniform current emission pillar to pillar

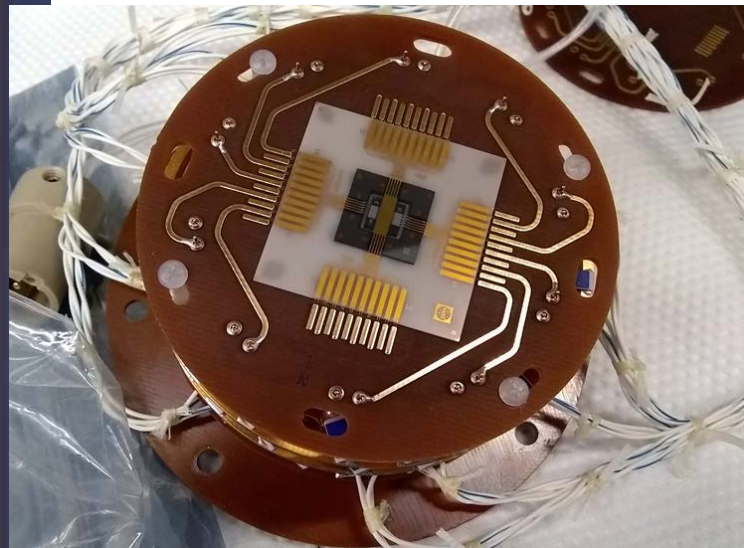


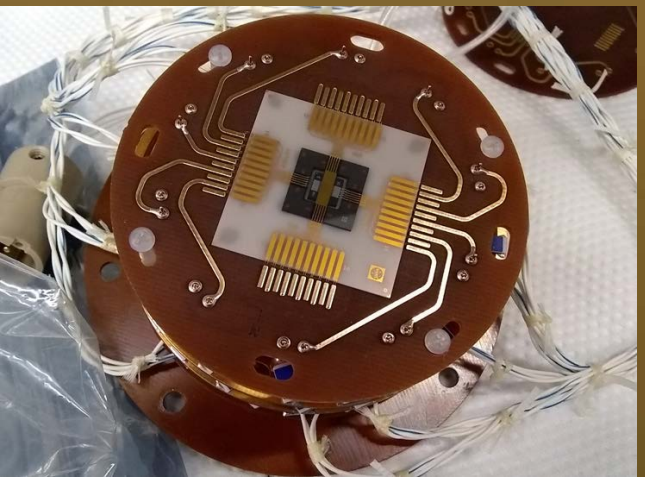

Current(nA)
160.0
-138.8
-437.5
-736.3
-1035
-1334
-1633
-1931
-2230
Rows
0
2
4
6
8
Columns
0
2
4
6
8











Future Work

- Test current emission as a function of the catalyst age and the growth conditions the CNTs underwent
- New source for Test 1
- Use alternate substrate materials to improve the robustness and to planarize the overall structure
- With luck, move from Test 1 to Test 2, where we will generate X-rays

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