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Sandia National Laboratories

Conductance of Carbon Nanotubes

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U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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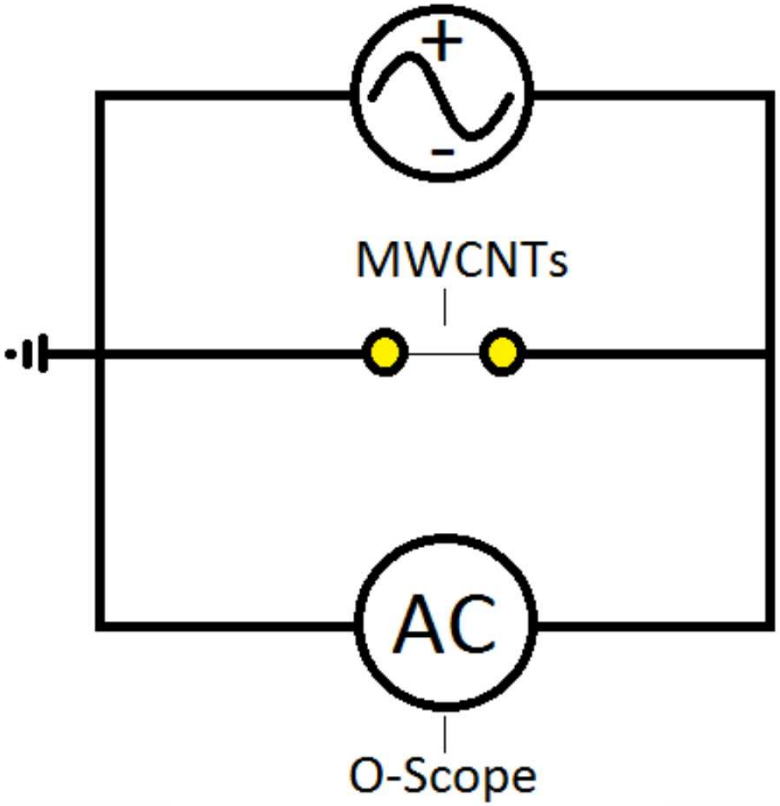
Why

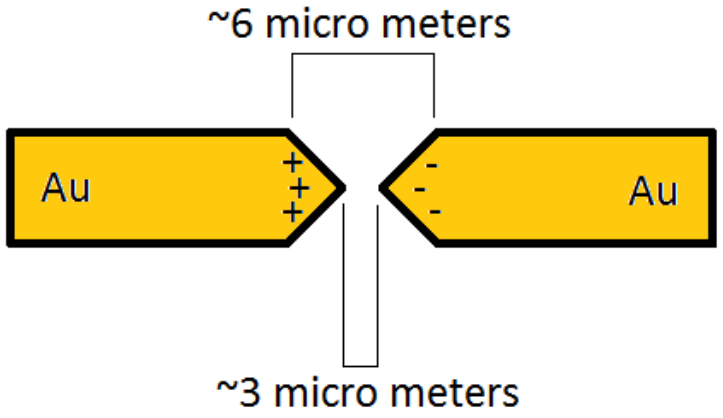
- Sandia interested in CNT composite materials
  - Latex composites (CNT properties + latex paint spray)
- Optimize conductivity in CNT composite films
- Optimizing conductivity begins at the junctions
- We have devised a method in which we can analyze the junctions of CNTs

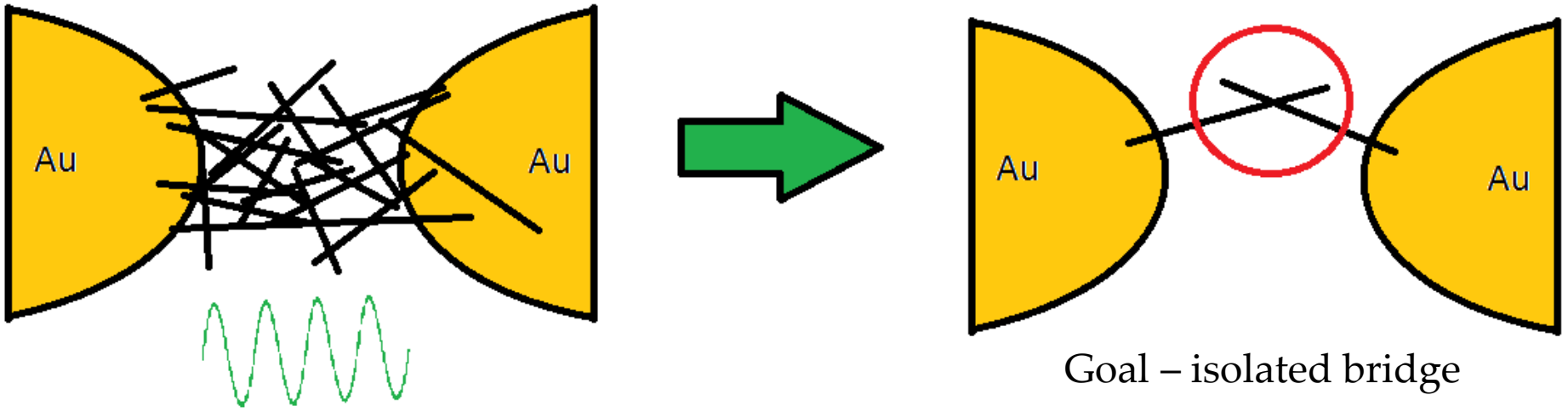
How

- Dielectrophoretic Capture (DEP); CNT Deposition



How – Dielectrophoretic Capture (DEP)

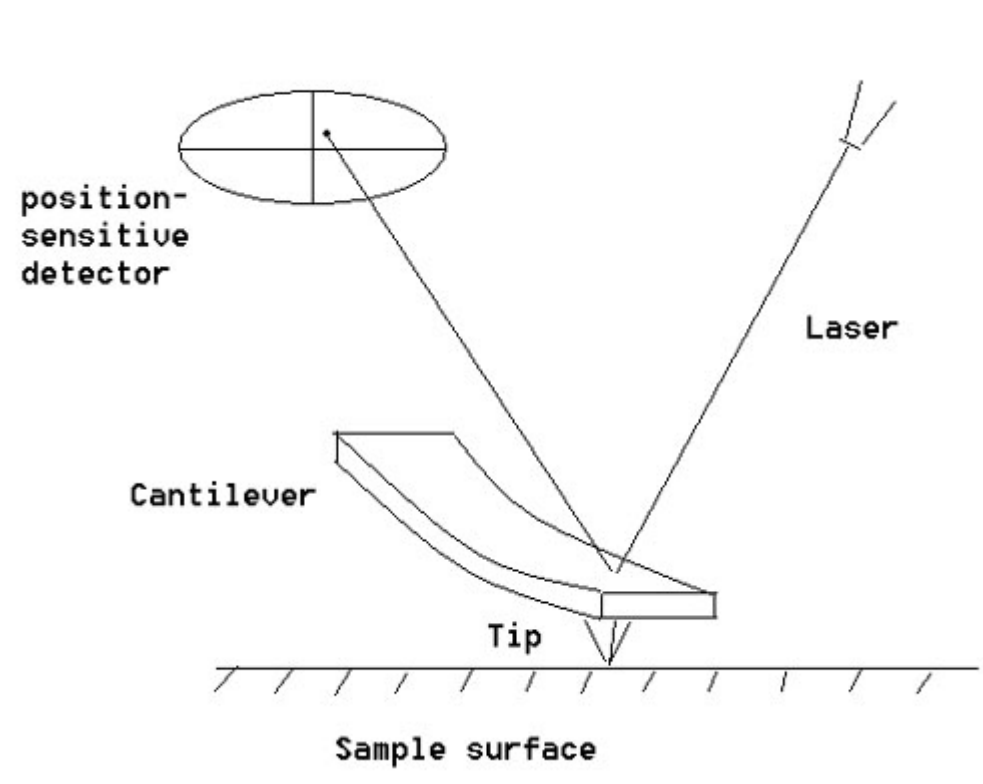


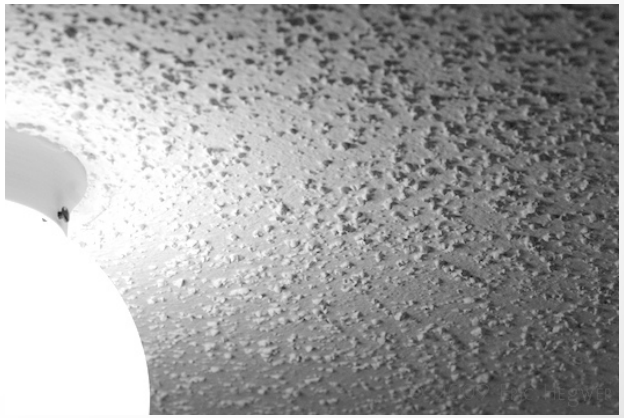


Goal – isolated bridge

How to view microscopic samples

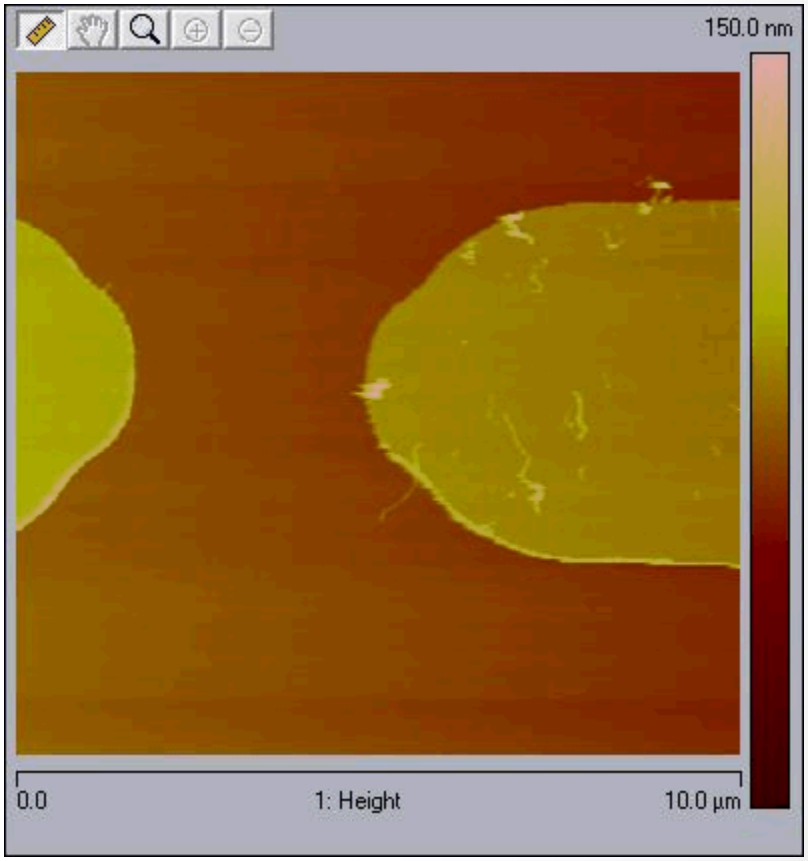
- Atomic Force Microscopy



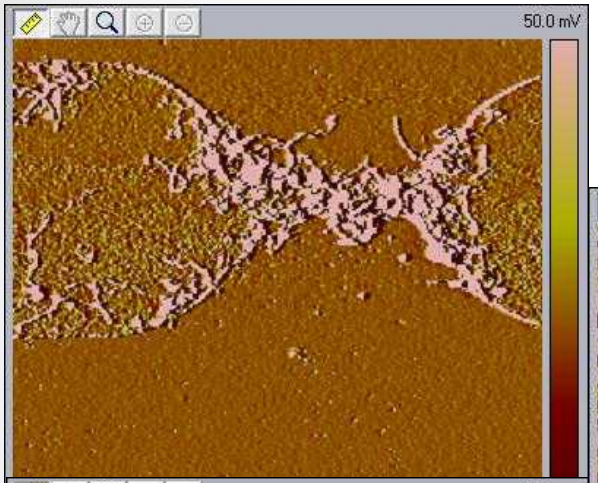


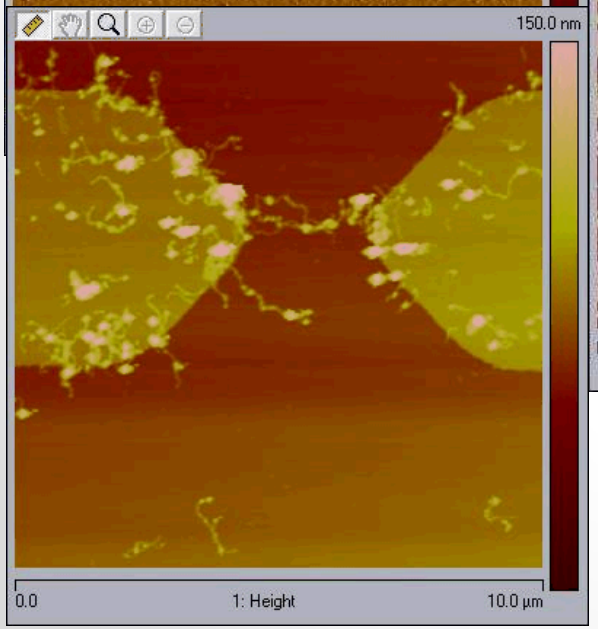
DEP is not easy…

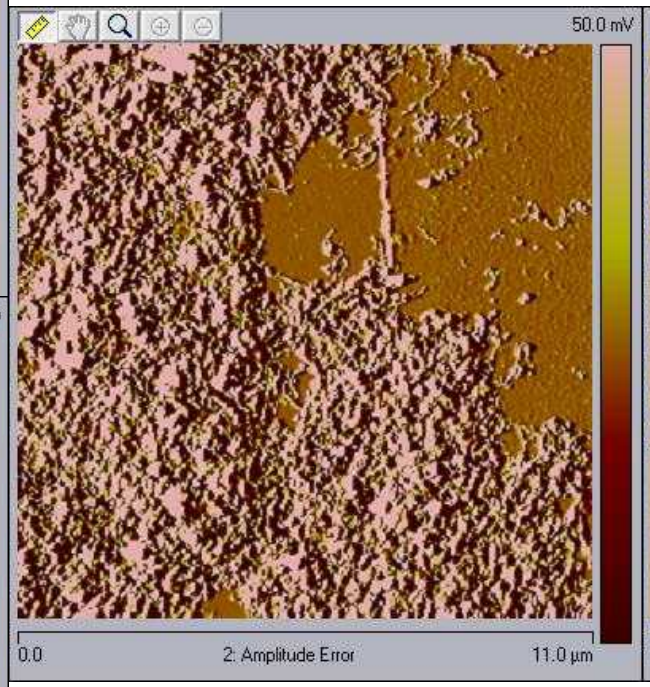
- Variables to get right:
  - Time of applied field
  - Strength of electrical field
    - Frequency of AC field
    - Voltage
  - Solution concentration
  - Solvent used (NMP, IPA, DIW)
  - Sonication periods
  - Rinsing procedure
- Still very random

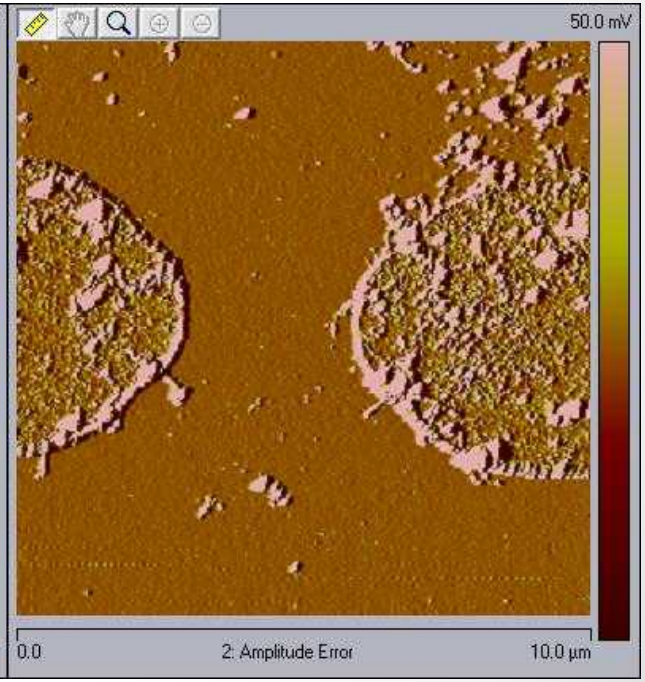


It took a very long time…





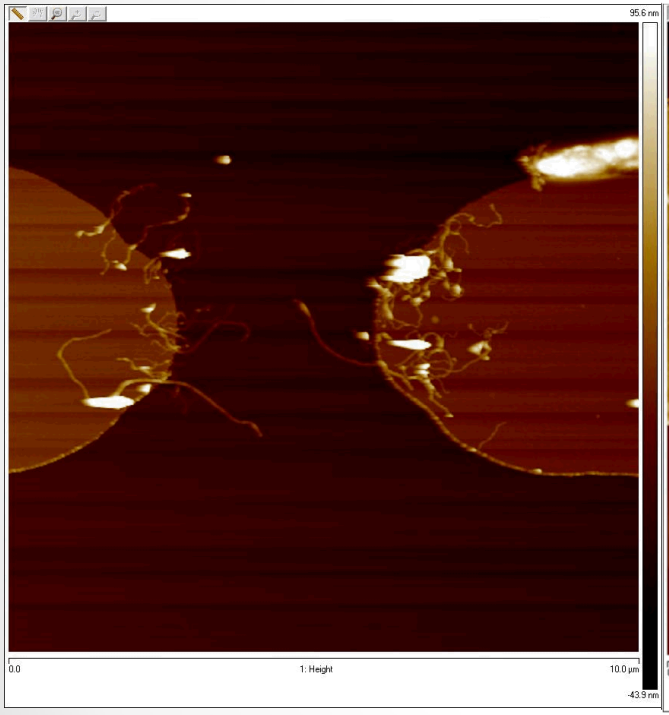


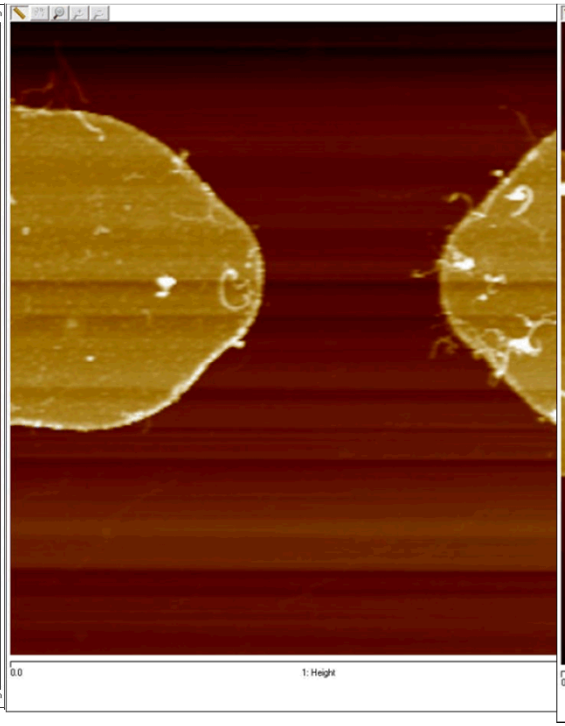


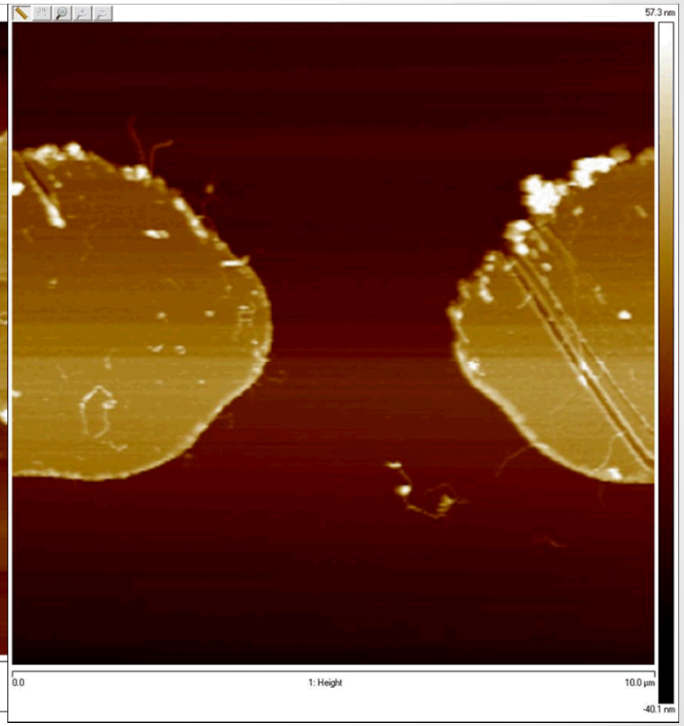
Results

- Noticing a trend
  - Lower frequencies yielded better results than higher frequencies
  - This trend simply helps with finding a more accurate process for CNT deposition
  - 50kHz and 100kHz consistently yield better results than, say, 300kHz and 500kHz

Results – Lower Frequency Leads to More CNT Deposition







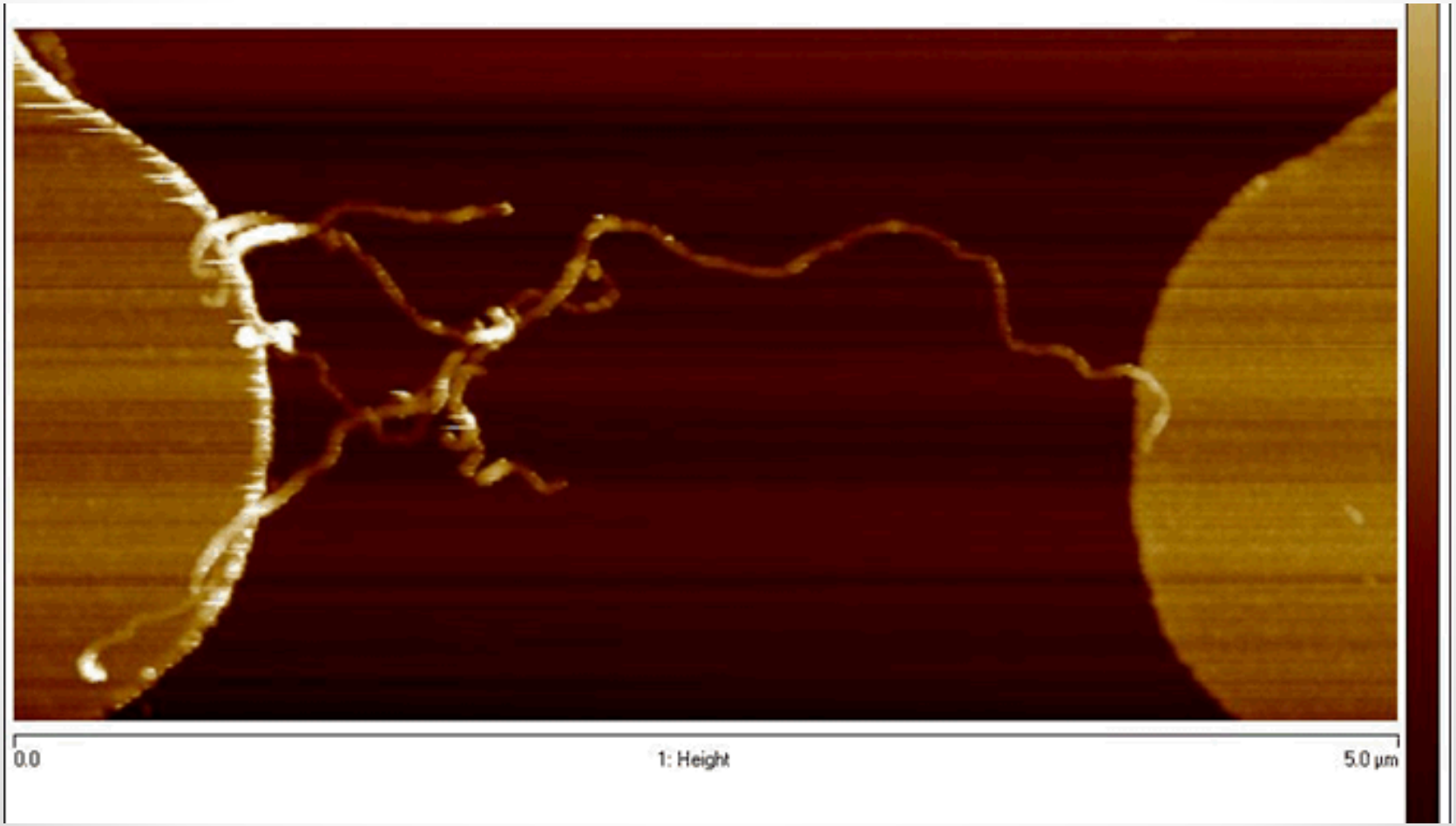
50 kHz

300kHz

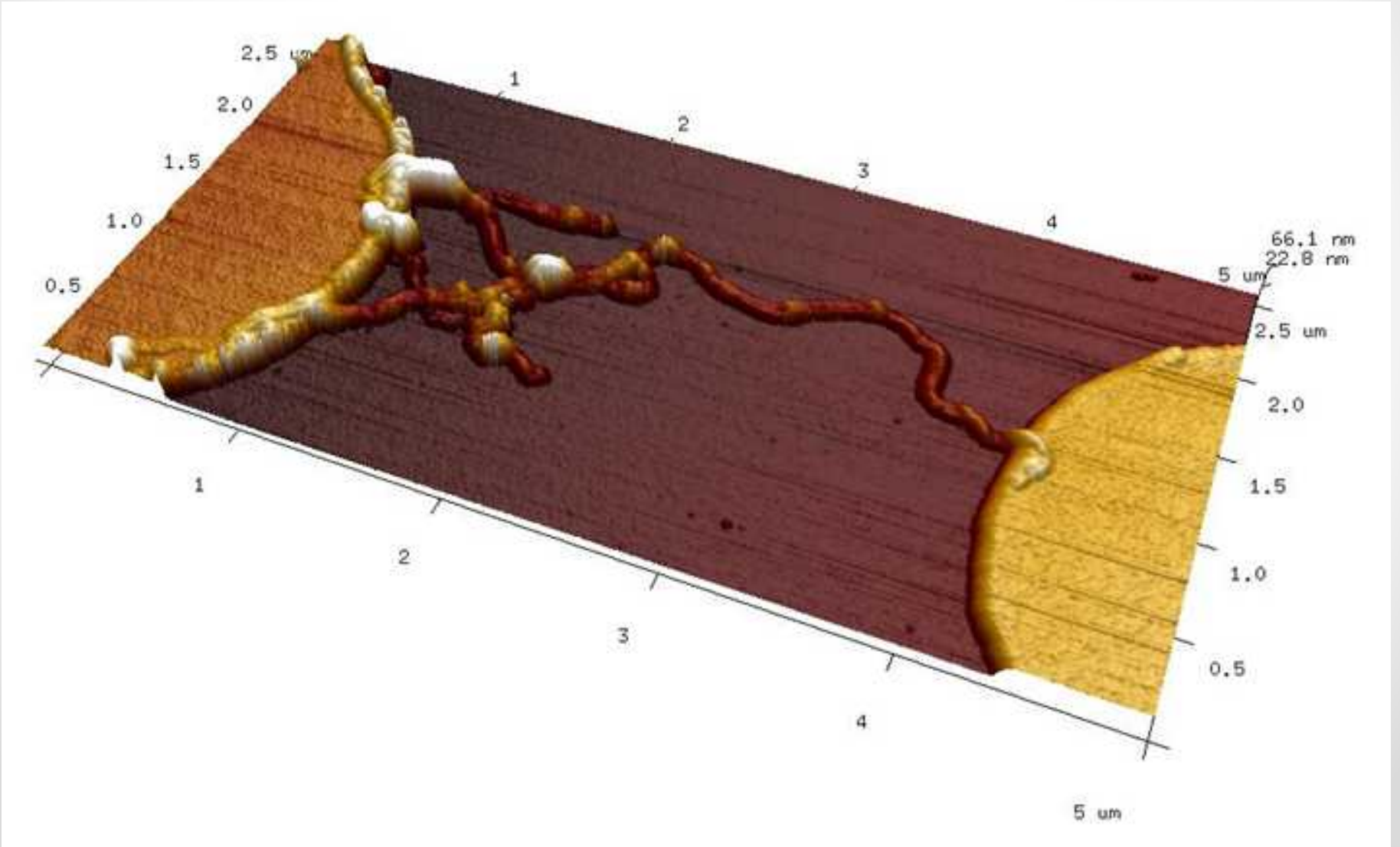
500kHz

Results – Single Strand CNTs

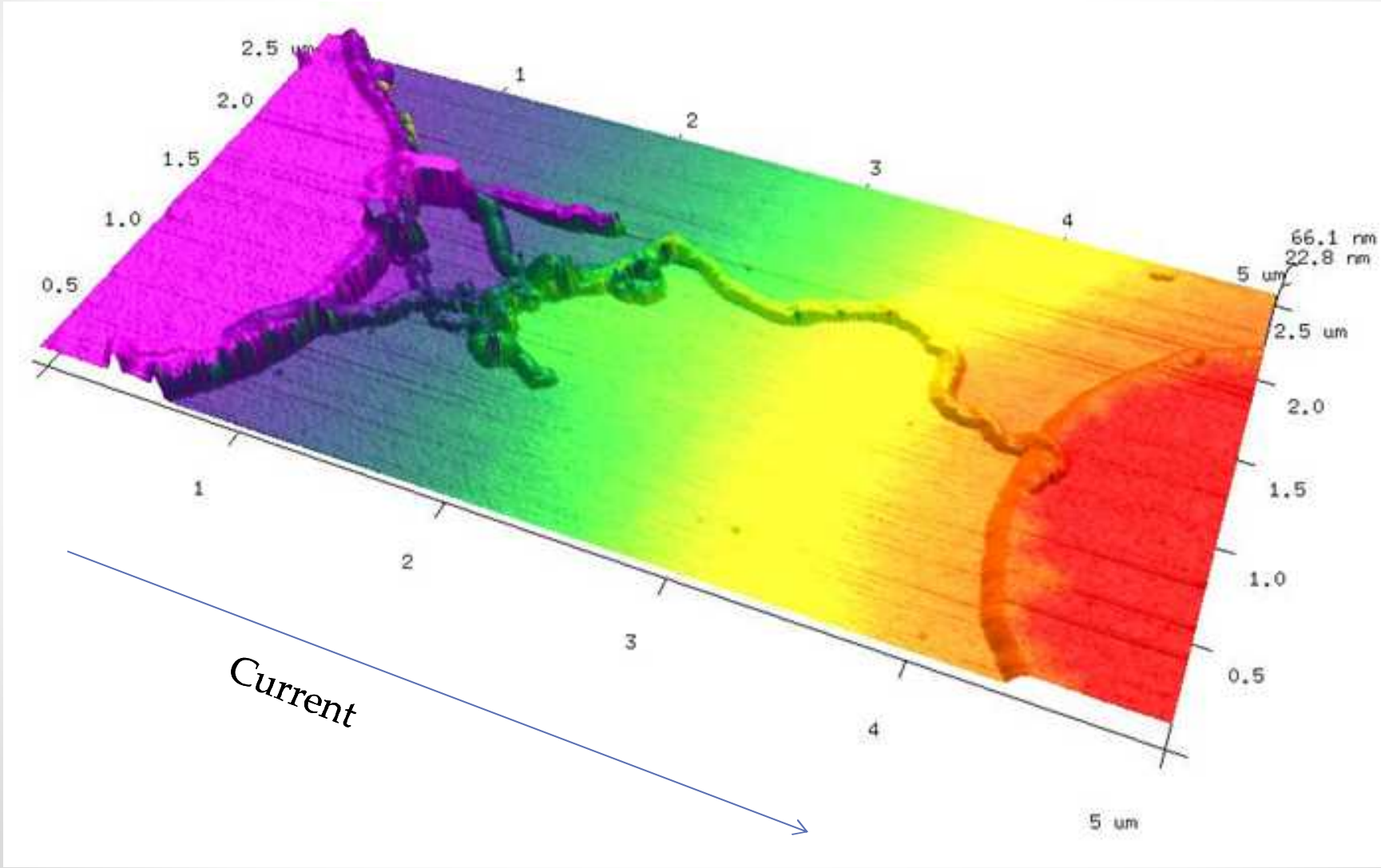
- V = iR; series connections



Results – AFM Image



Results – Potential Mapping via AFM



Conclusion

- We investigated an approach Carbon Nanotube deposition known as Dielectrophoresis
- The success of capturing a single bridge of CNTs is dependent on many variables... It is hard
- The results of my project will be used to create future devices for mapping resistance in Carbon Nanotube junctions

HAPPY
B-DAY
GRANT

Questions?