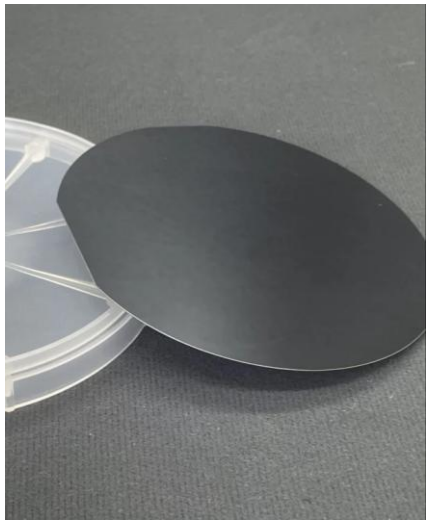
Spatially Resolved Study Of Grid Effects In Field Emission Arrays Using The CMOS Electron Detectors

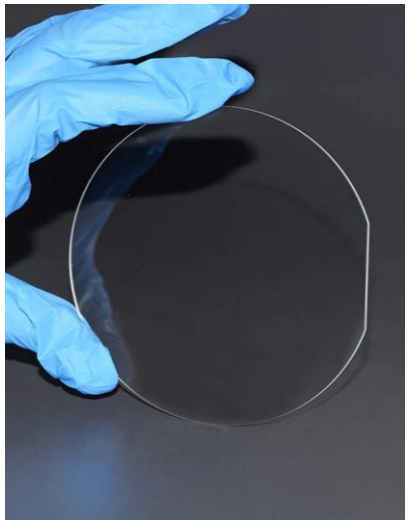
LEOS Research Group

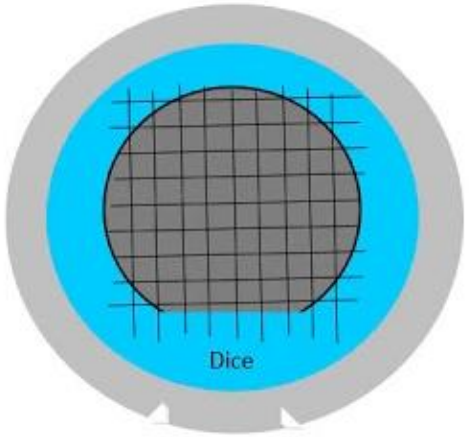
Bad Honnef 2026

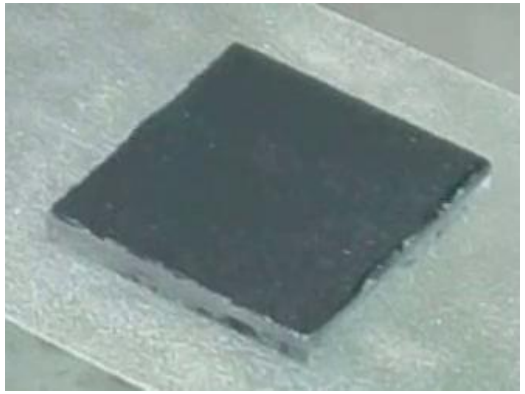
Ali Asgharzade

Preparation





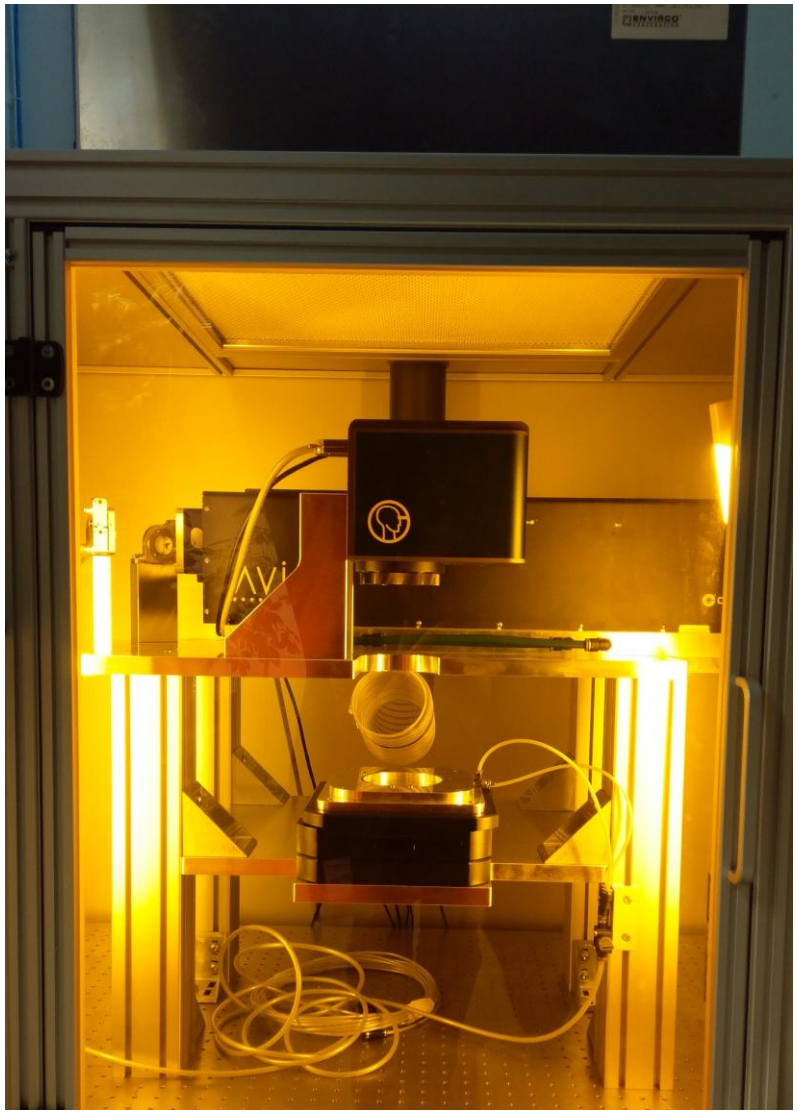


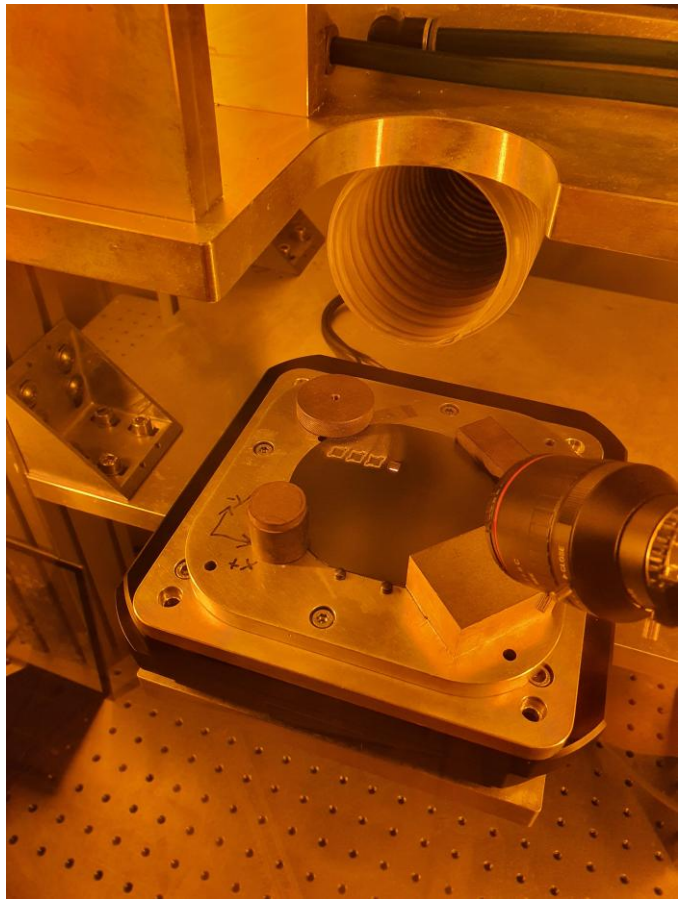


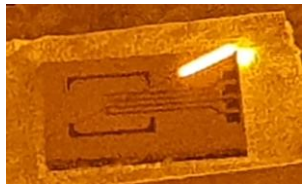
Manufacturing emitters using laser system

Coherent AVIA-355-10 laser system

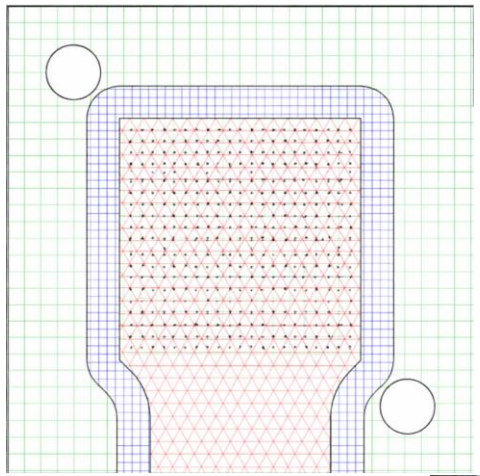
- 355 nm
- 10W
- 25 µm spot
- 35 ns pulses
- 53 kHz repetition rate

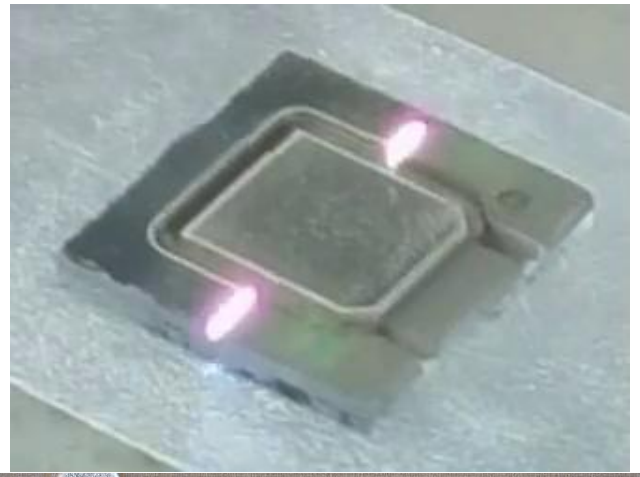


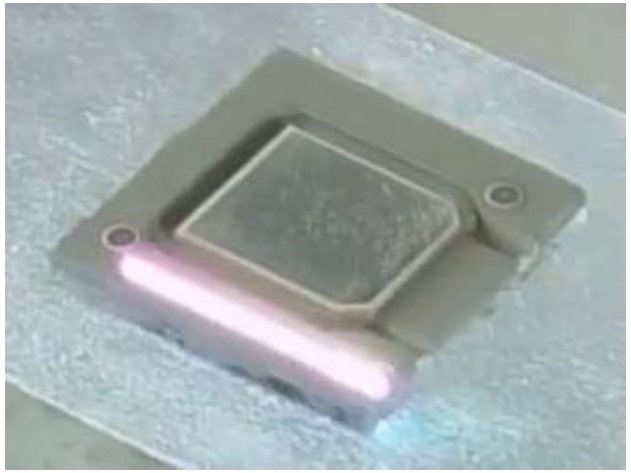


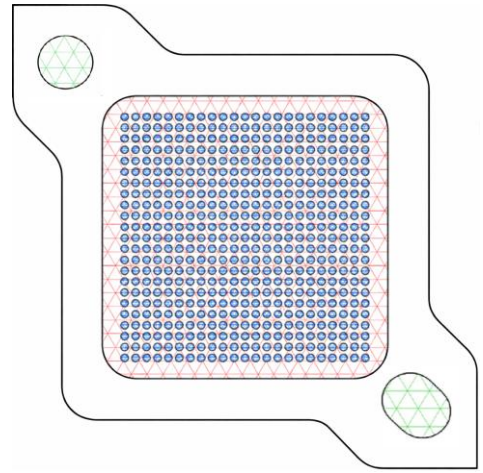


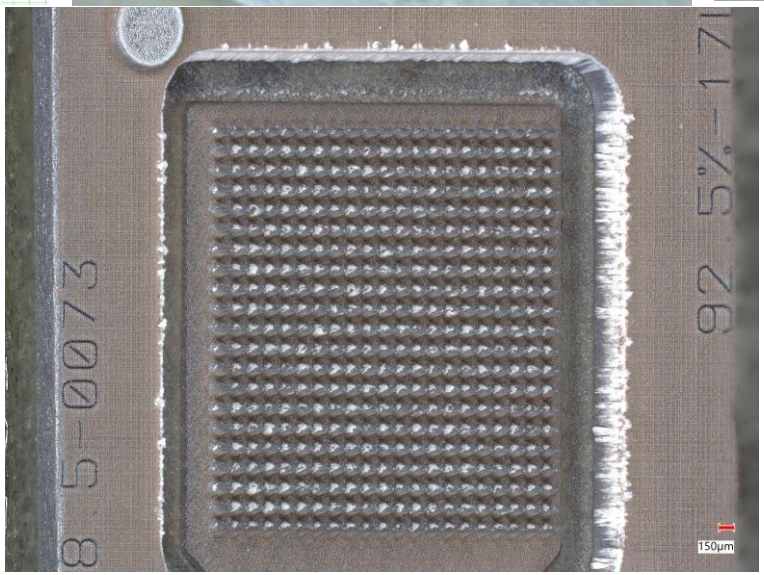
Emitter and Grid Design

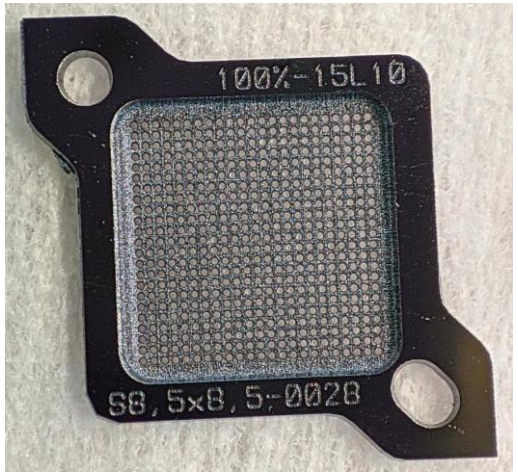




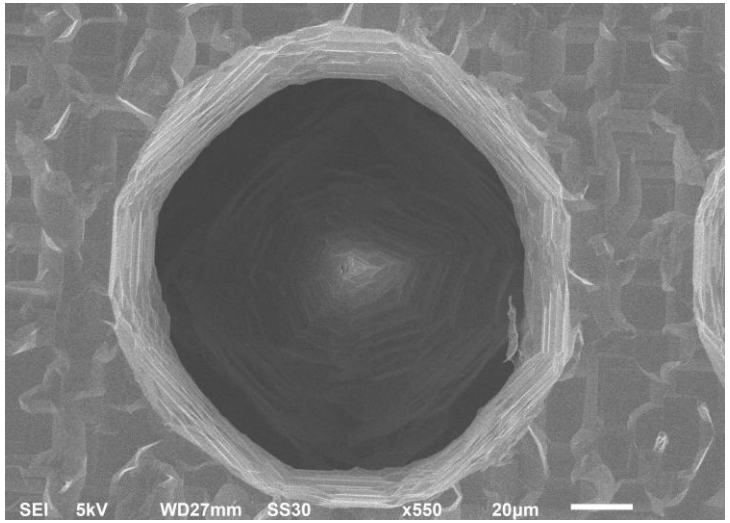


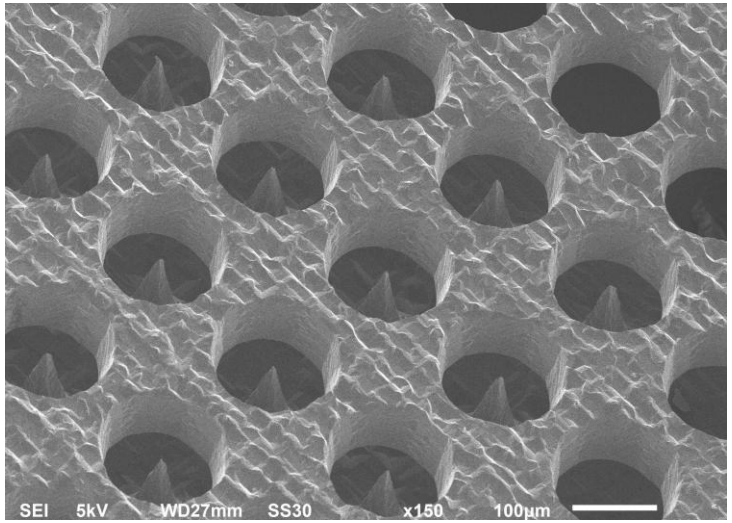


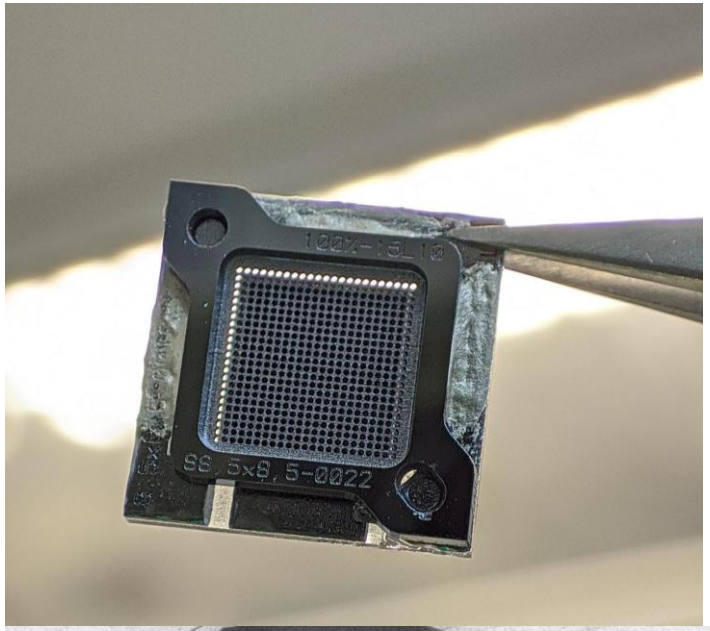


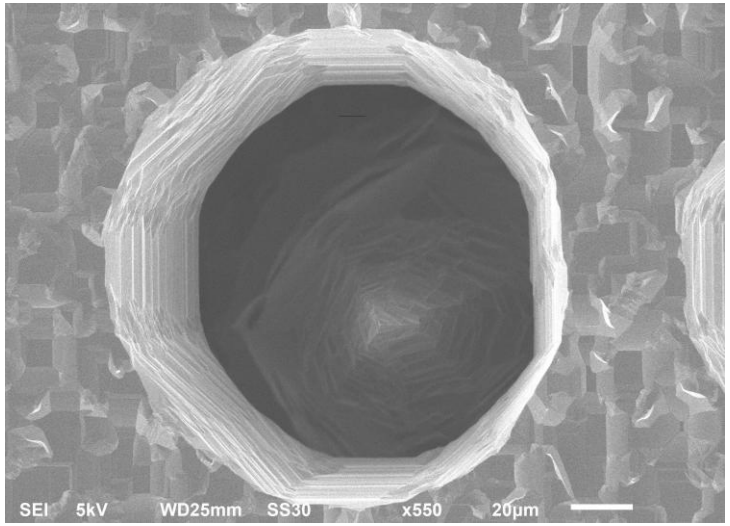


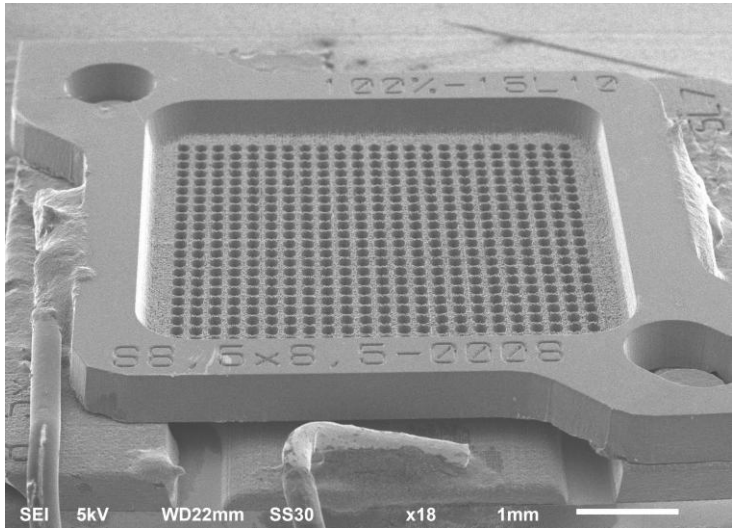
Mounting, securing, challenges, connection and types

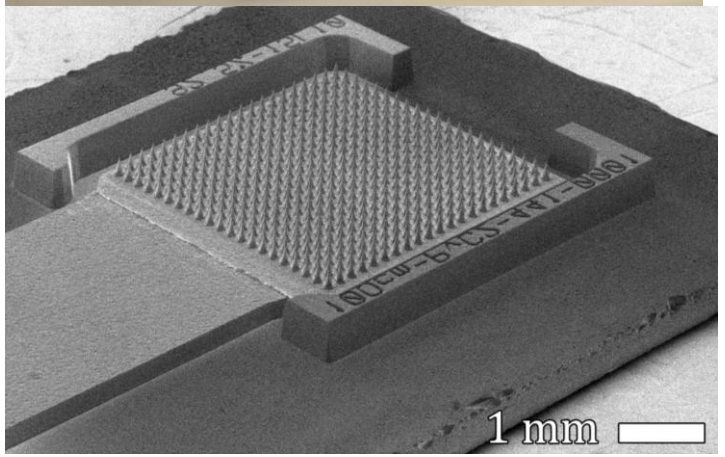




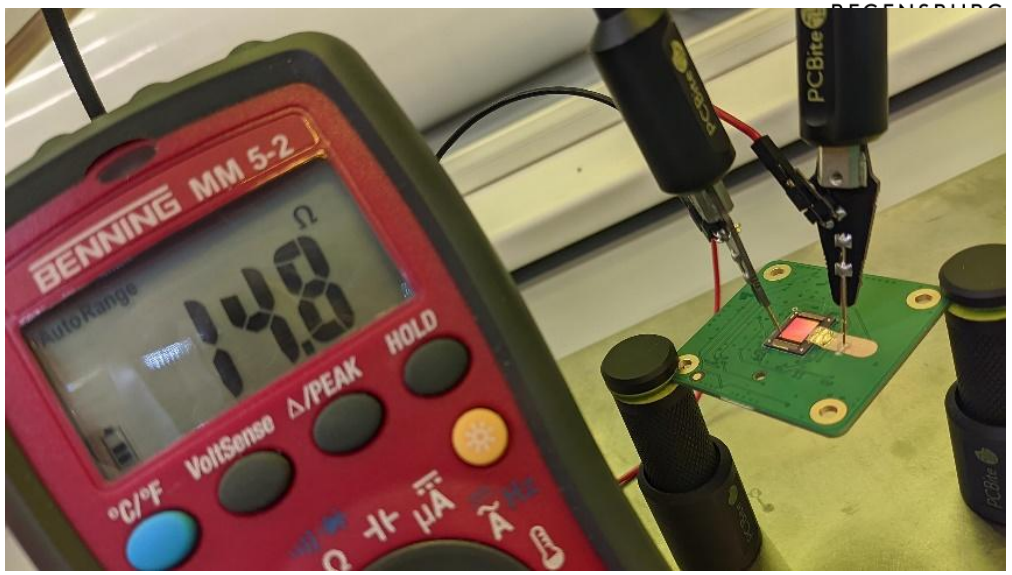


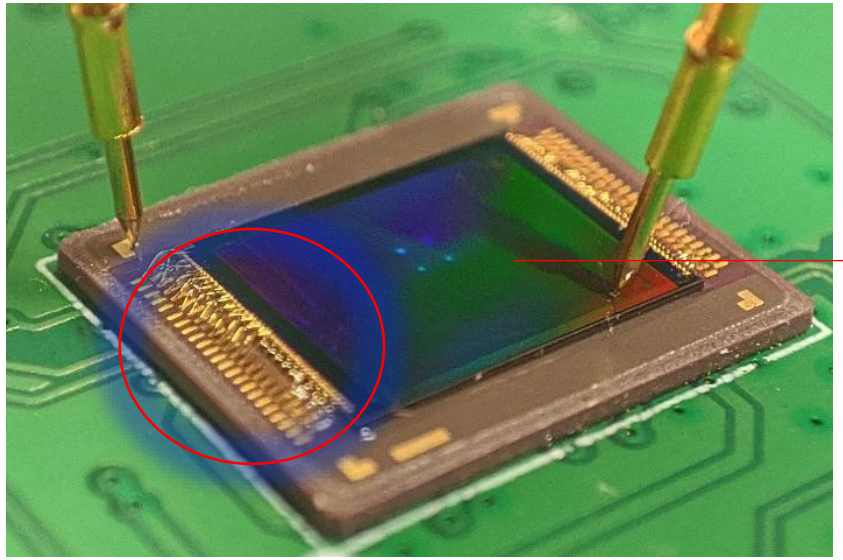


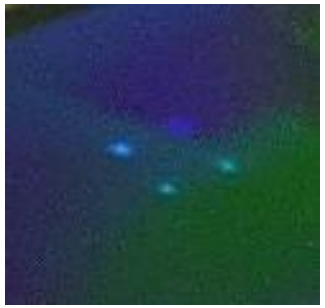


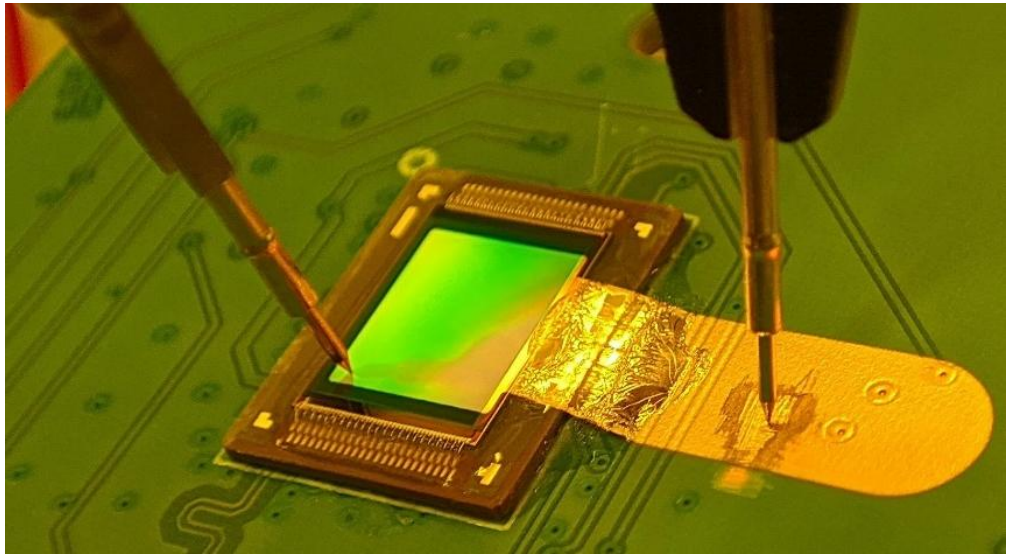


CMOS sensor and more explanation why is coated



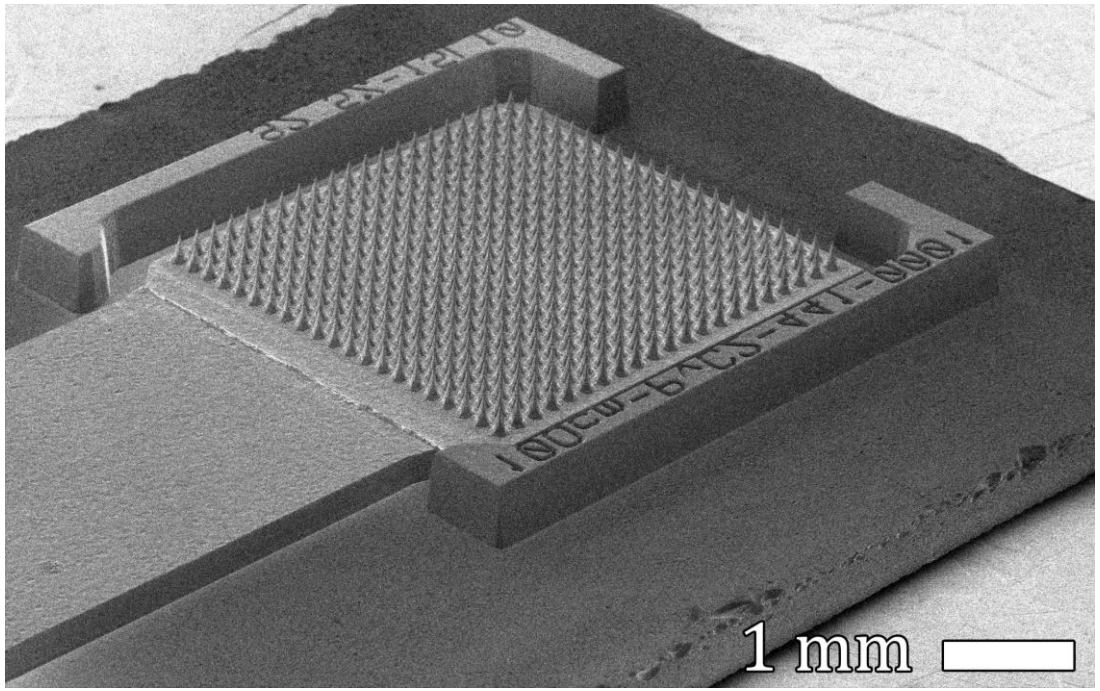


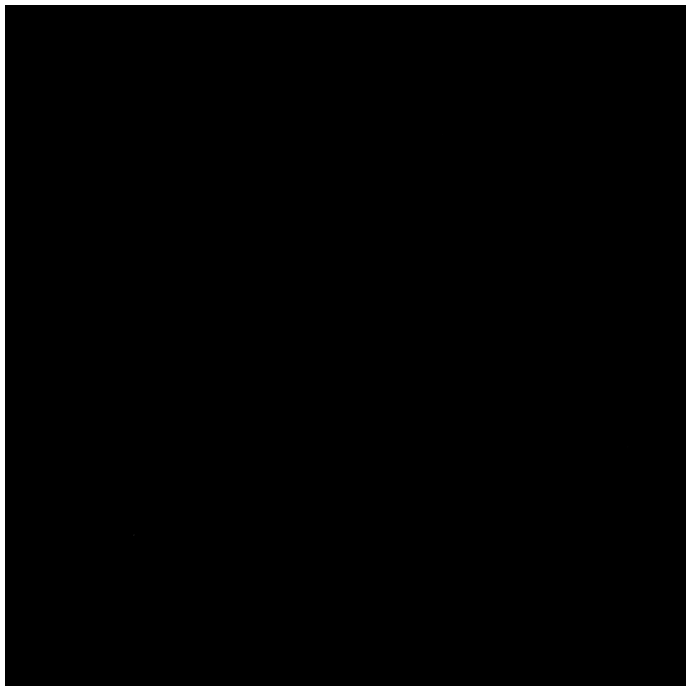


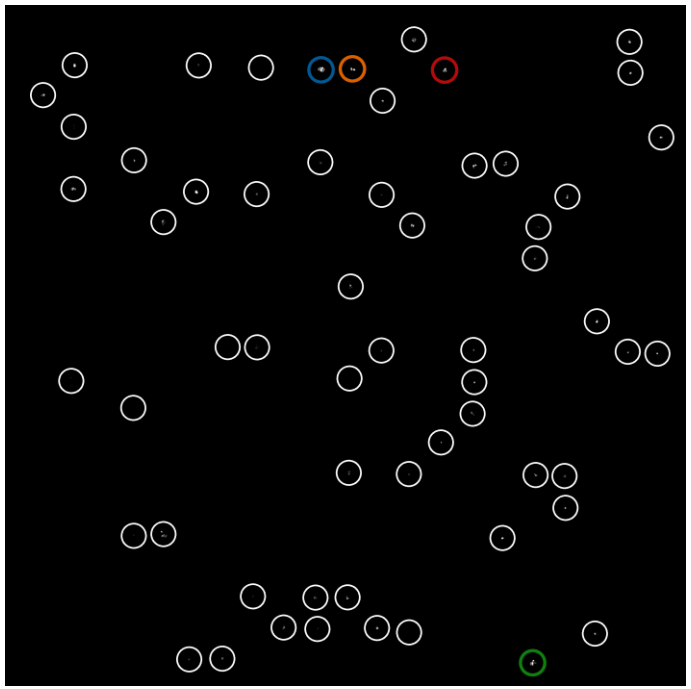


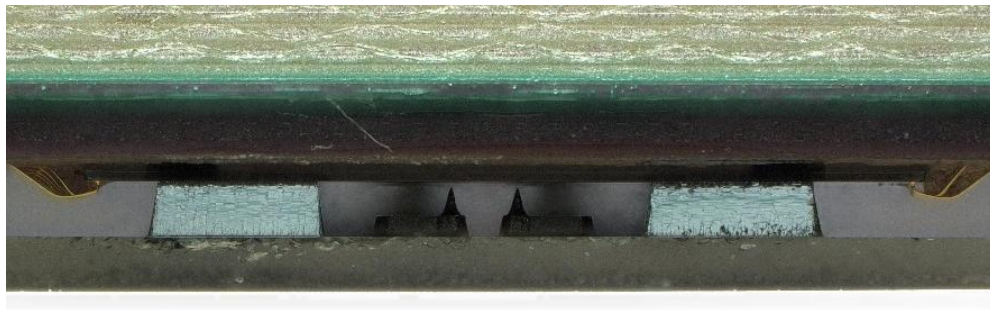
Emission spots are highlighted – 150nm copper-coated cmos acts as Anode

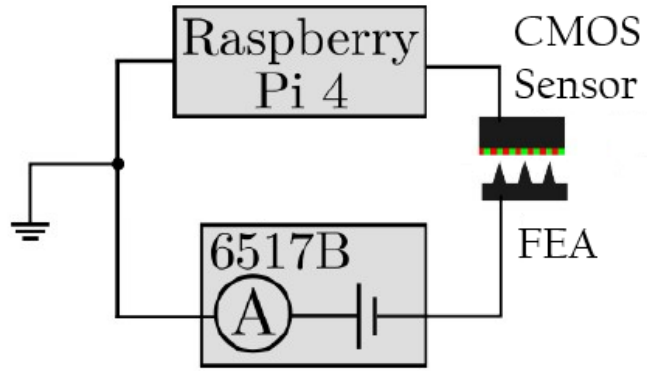
Video of emission during whole experiment with playback-speed approximately x100 faster







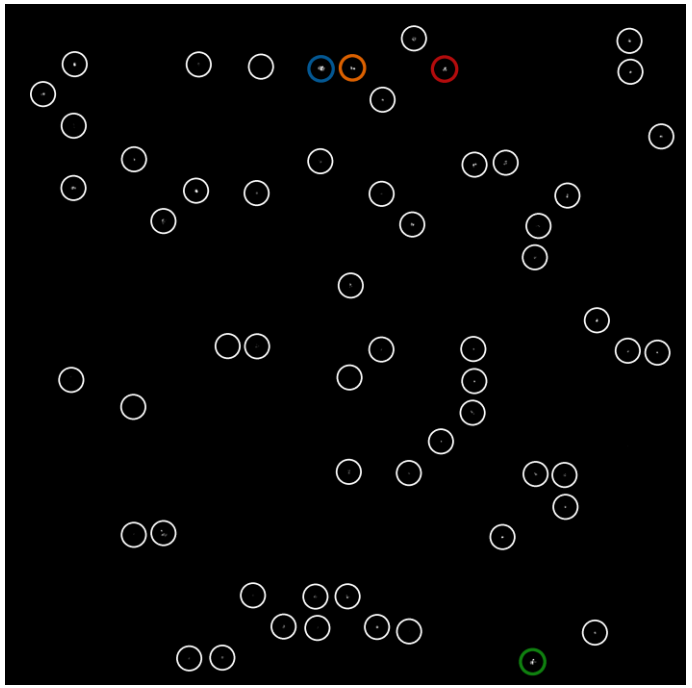




[1] M. Hausladen et al., "Measurement of field emission array current distributions by metal-coated CMOS image sensors," J. Vac. Sci. Technol. B, vol. 42, no. 6, p. 062209, Nov. 2024, doi: 10.1116/6.0004074.

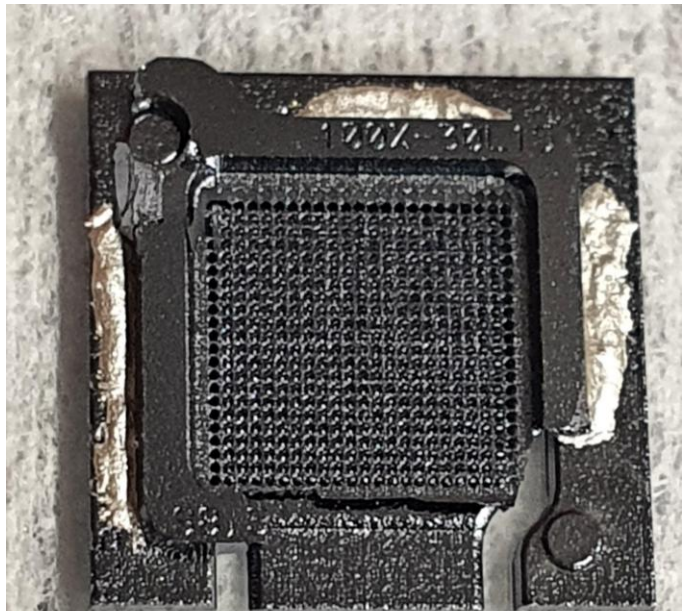
For some of our collaborations, we need homogeneity

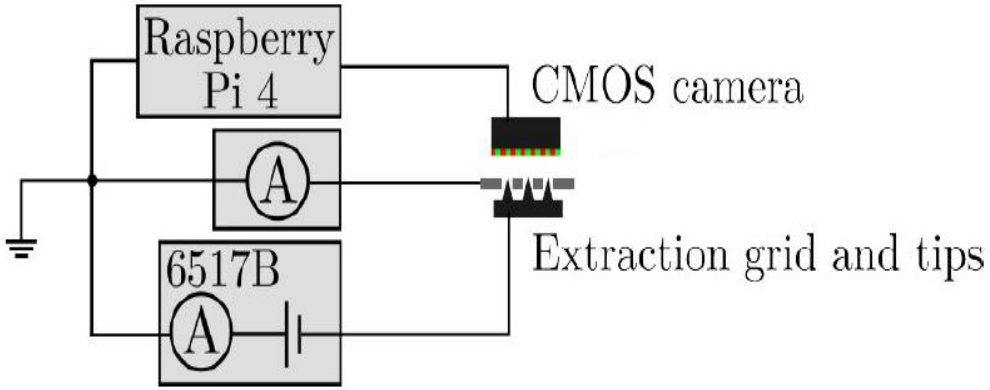
- We were so far satisfied with amount/integral emission current for both models…
- But now for some projects we need homogeneity also
- So now is the time to study FEAs with integrated Grid
- We will use our CMOS detector to achieve the goal
- Let’s see…

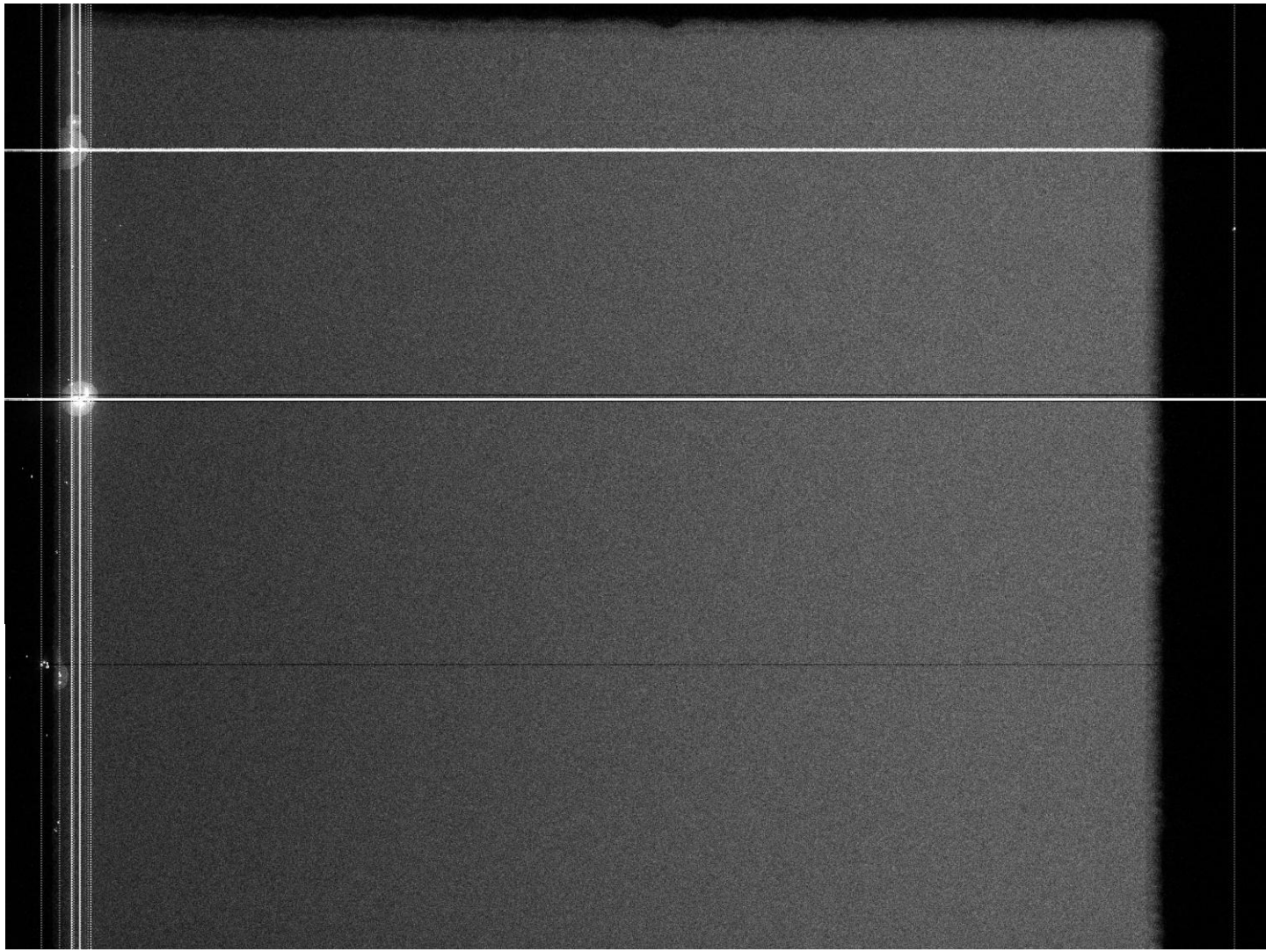


FEA modification and mounting on Coated Cam

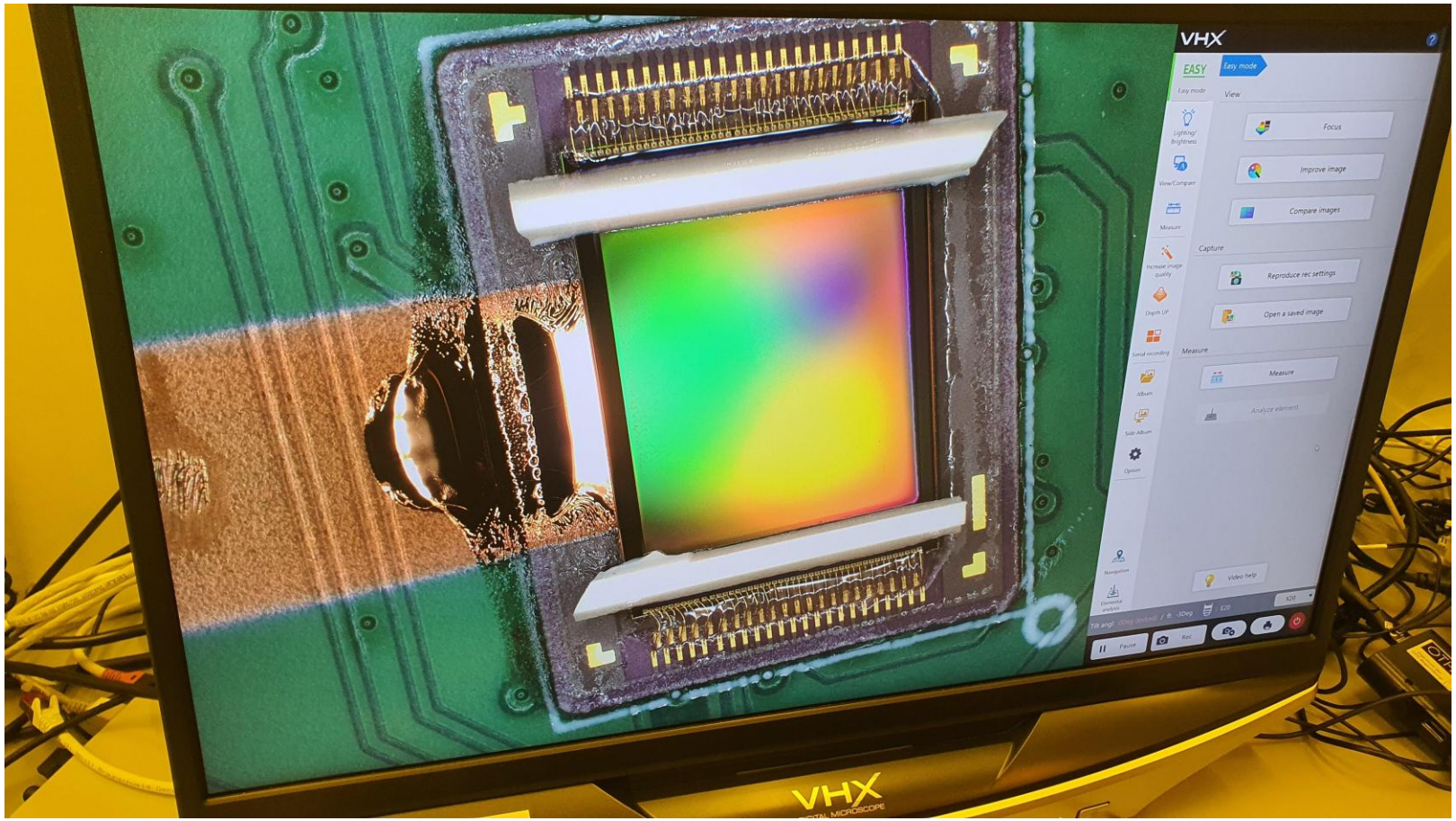
- Remember wire-bonds?

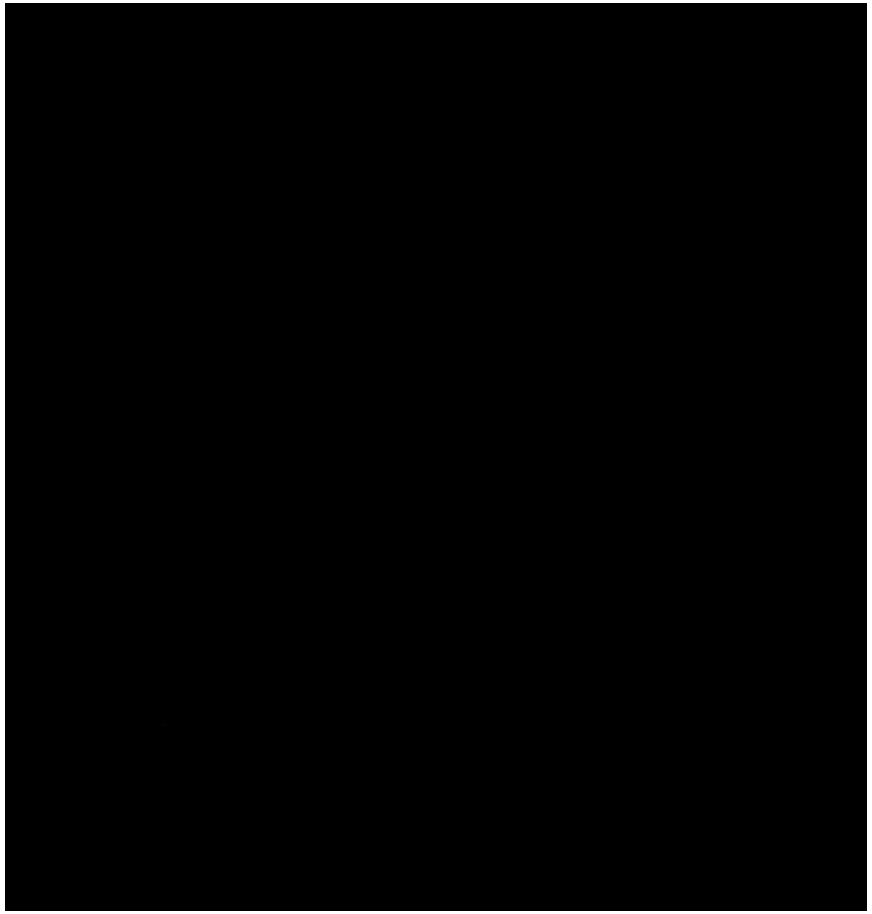






New FEA and mounting on Coated Cam with Isolator Spacers (CU thickness!)

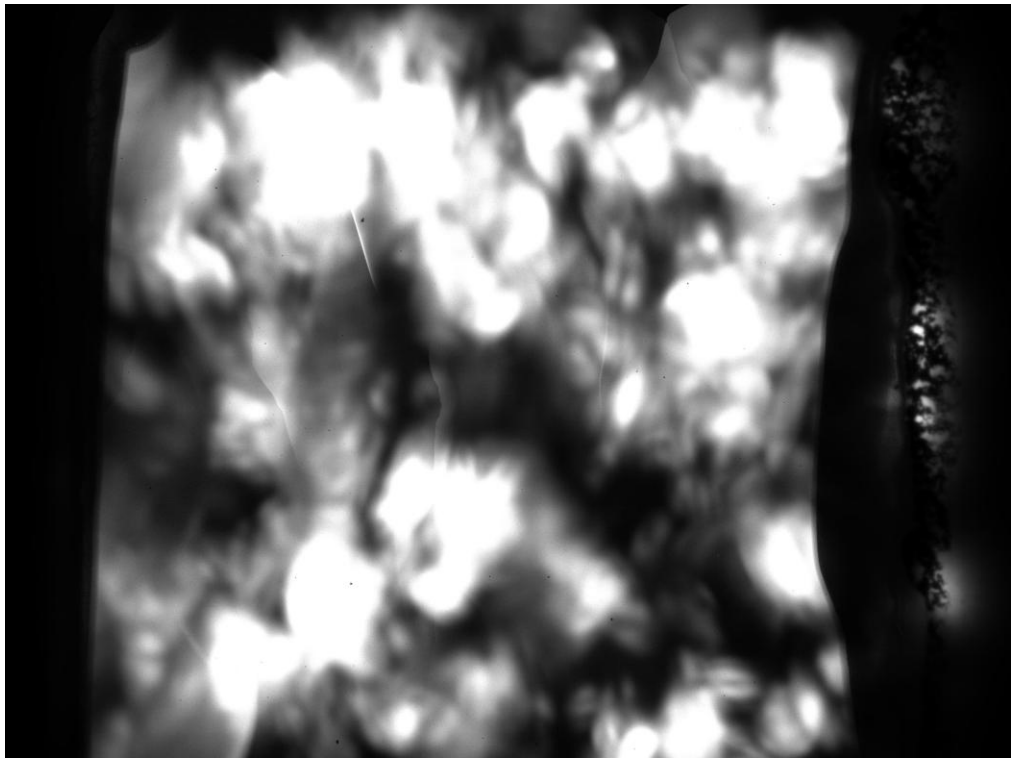




Recap from older Experiment (why colorful signal?)

New FEA and mounting on Un-coated Cam with isolator spacers

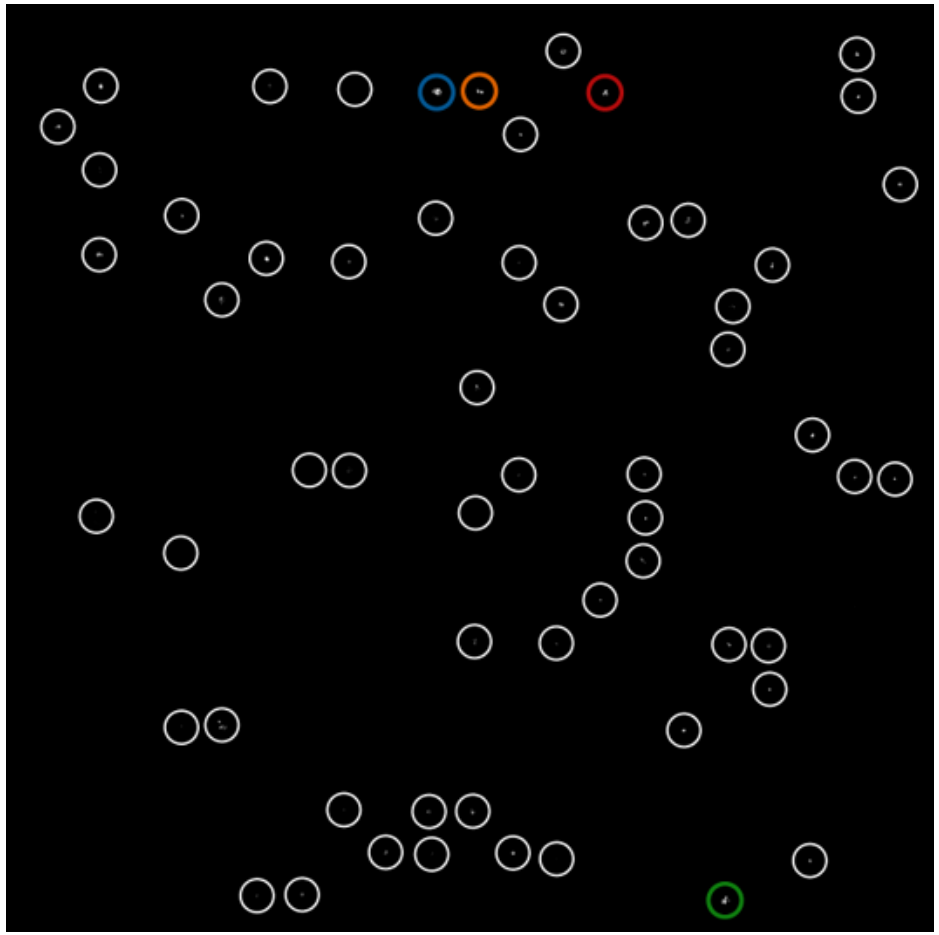
Mention Points: non-conductive cmos surface and emission flowing in the grid



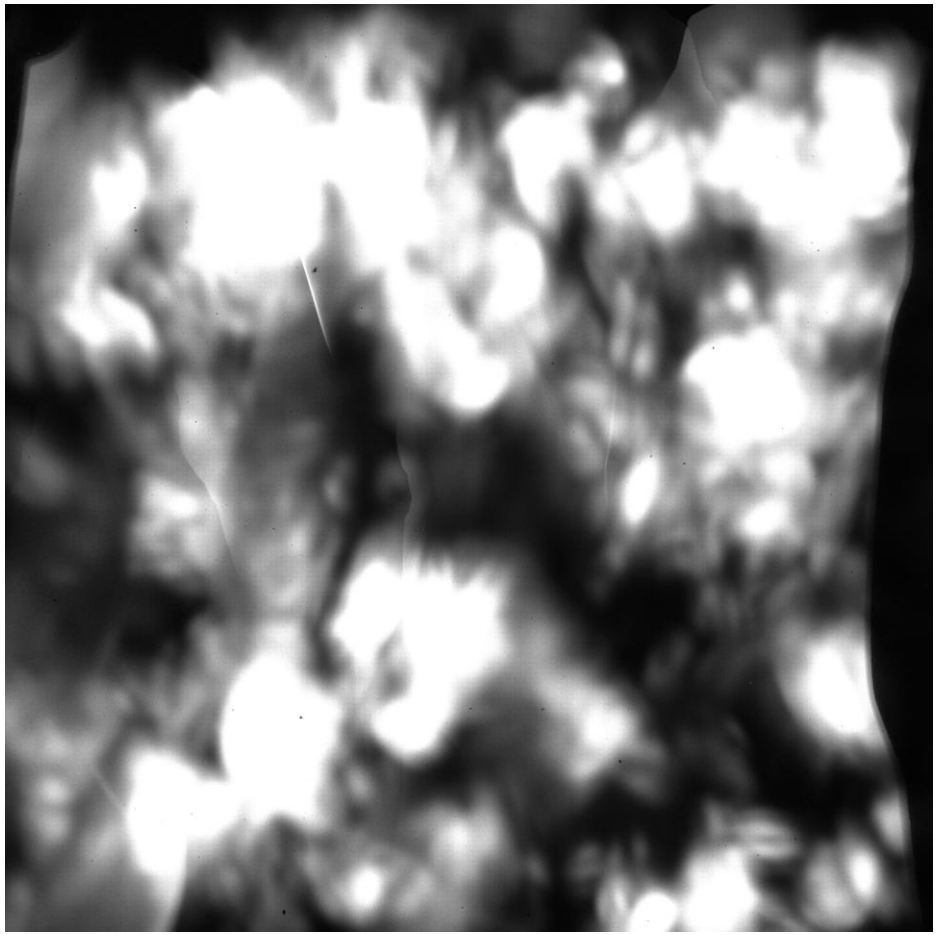
Video of emission during whole experiment with playbackspeed approximately x1000 faster

Comparison between results and Conclusion

Don’t forget differences: Coating and distance



59 emission spots out of 441 means 13.4% tip share



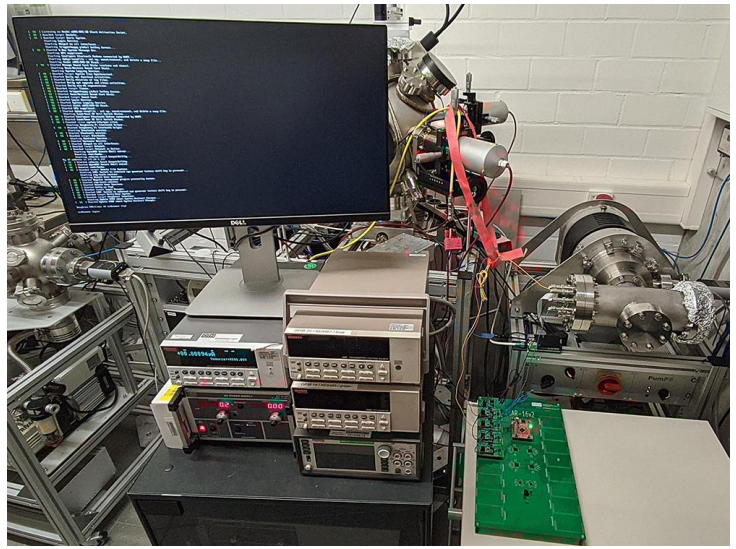
70% of the Photo is covered by emission spots

Future optimizations

- Better 1 to 1 comparison if lower distance with coated sensor (same situation)
- Thinner coating would be beneficial for this experiment
- Different coating material could help more variety of experiment with same parameters
- Updating to Picosecond laser should yield in more uniform tips which should lead to more emitter/tip share that brings more homogeneity

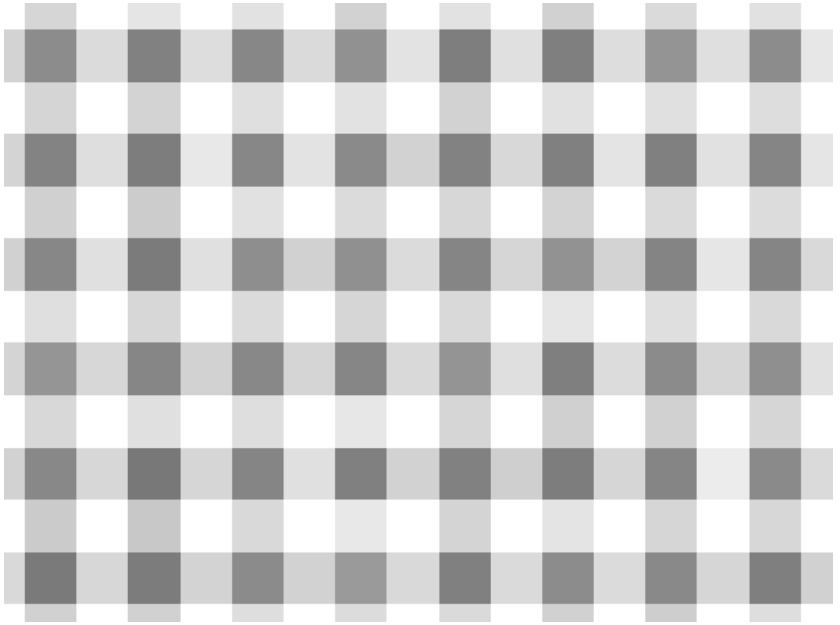
Thank you for your Attention

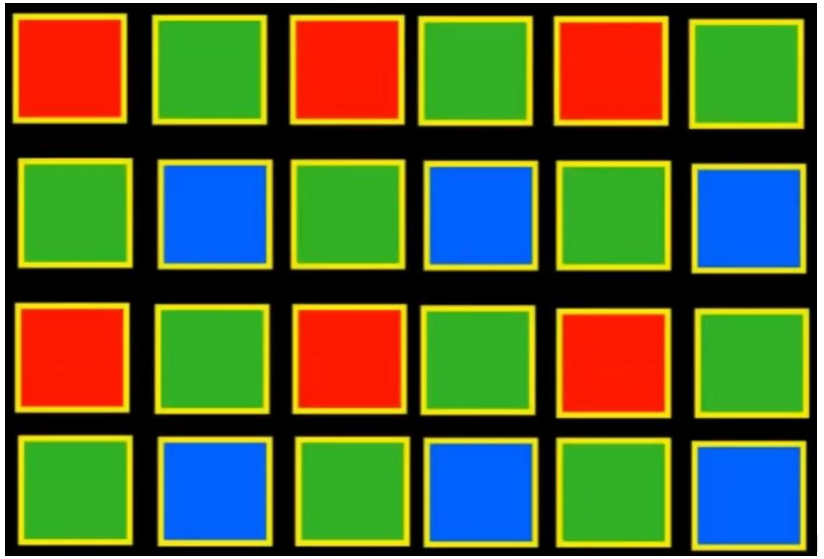
Pleasure to hear your questions



Any Questions?

Why SEM video was kind of colorful signal?





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