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FET-BASED CHARGE SENSOR FOR ORGANS-ON-CHIP WITH IN-SITU ELECTRODE DECORATION

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3rd – 4th December 2020

Cell culturing in petri dishes

Retrieved from https://www.dfg.de/download/pdf/dfg_im_profil/geschaeftsstelle/publikationen/tierversuche_forschung_en.pdf

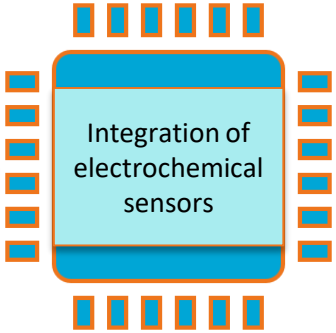
Animal Models

Retrieved from https://www.shutterstock.com/image-photo/culturing-cells-tissue-culture-plates-216981568

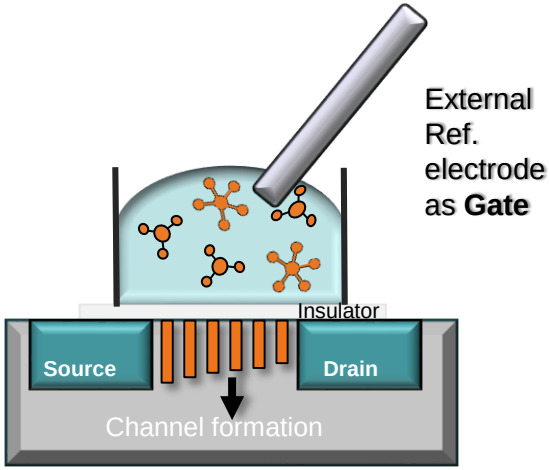
Organs-on-Chip

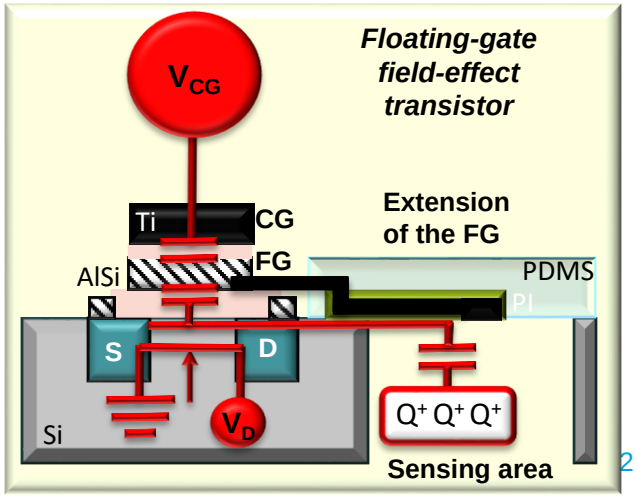
Dynamic tissue culturing devices mimicking human (patho)physiology

Source: Wyss Institute at Harvard University



Ion-sensitive FET



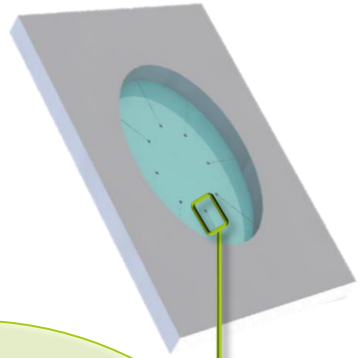


Silicon-Polymer hybrid OoC device

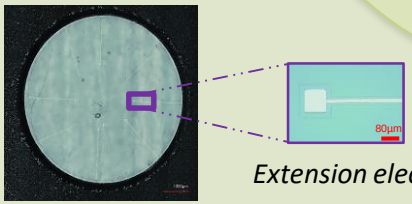
- X External ref. electrode
- ✓ Control-Gate
- ✓ CMOS-compatible
- ✓ Transparent
- ✓ Bio-compatible
- ✓ Electrical performance

Front side

Back side

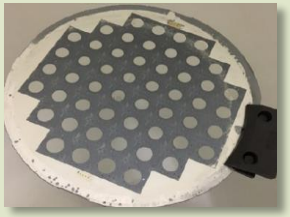


CMOS-Compatible Fabrication



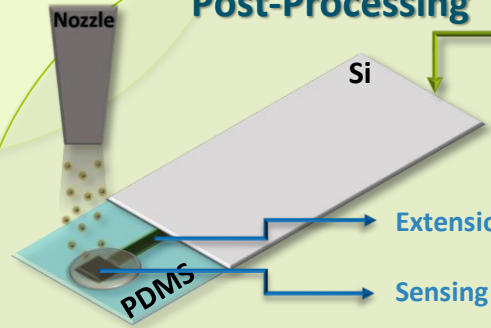
Back side of 1 chip

Extension electrode



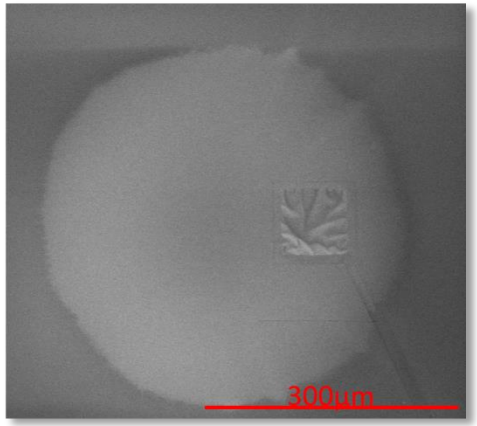
Wafer-scale fabrication

Post-Processing



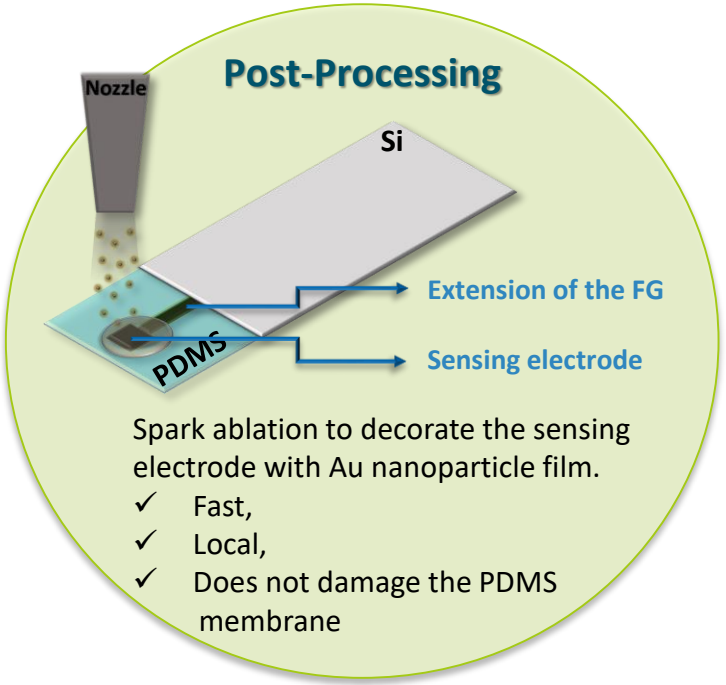
Spark ablation to decorate the sensing electrode with Au nanoparticle film.

- ✓ Fast,
- ✓ Local,
- ✓ Does not damage the PDMS membrane

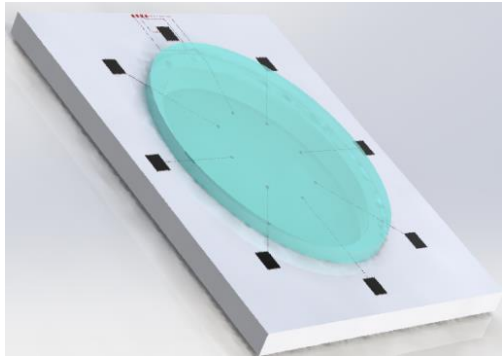


SEM micrograph of the locally deposited Au film of one of the sensing electrodes.

- Up to **3-fold better sensitivity** for poly-l-lsine compared to electrodes without Au decoration.



Conclusion



- **A novel and extremely compact FG-FET-based electrochemical sensor for OoC applications** [1]:
  - No need for external reference electrode
  - Combines benefits of silicon and polymers
  - Ability to work as a biosensor
- **Spark ablation successfully amplified the surface of the sensing electrodes with thin nanoporous Au films**
  - Fast post-processing
  - Spatially-selective patterning
  - No need for lithography
  - No damage to the polymer membranes (tissue culturing area)

[1] H. Aydogmus et. al., In IEEE Sensors 2020, 2020.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Thank you!
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