DIGIPREDICT

DESIGN AND SIMULATION OF A CNT STRAIN SENSOR WITH LOW MECHANICAL CROSS-SENSITIVITY

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Motivation

- Use of individual, suspended carbon nanotubes in a transistor-like structure as strain sensor
- Measuring skin strain to monitor respiration activity
  - High sensitivity and high gauge factor
  - Ultra- miniaturized size potentially reducing motion artefacts
- Requirements for the mechanical design
  - Allows only one directional strain detection
  - Allows dry transfer of ultra-clean CNTs
  - Enables appropriate handling

Design & Concept

- Defined preferred direction to measure uniaxial strain with help of springs
- Suppress unwanted movements to ensure low mechanical cross-sensitivity

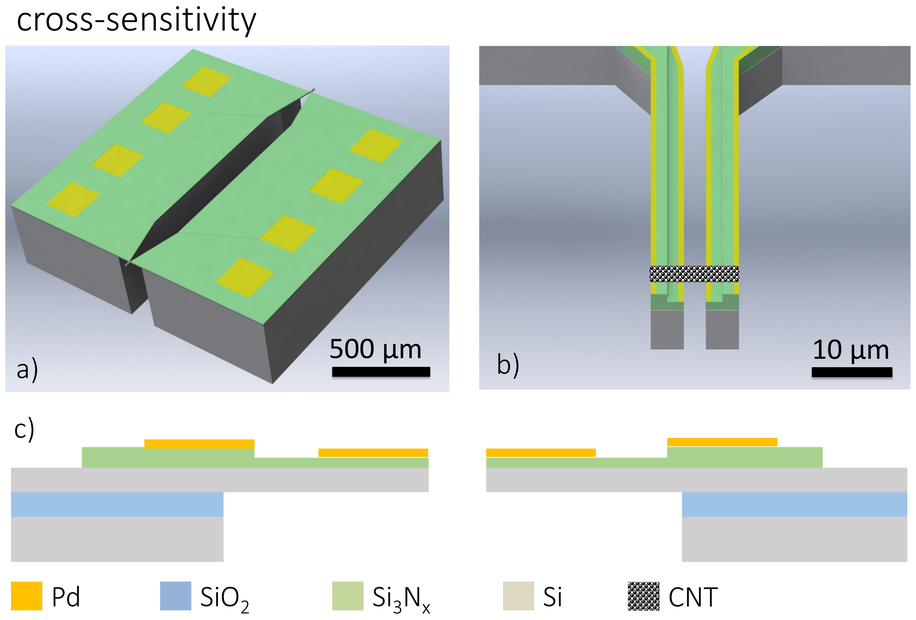

Figure 1 a) CNT strain sensor device (spring design not shown); b) finger-like electrodes; c) scheme cross-sectional view

- Displacement between electrodes induce strain in suspended CNT
- Structuring according to bulk-micromachining
- Transfer of Si device with suspended CNT onto PDMS to transduce skin-strain into CNT

Simulation

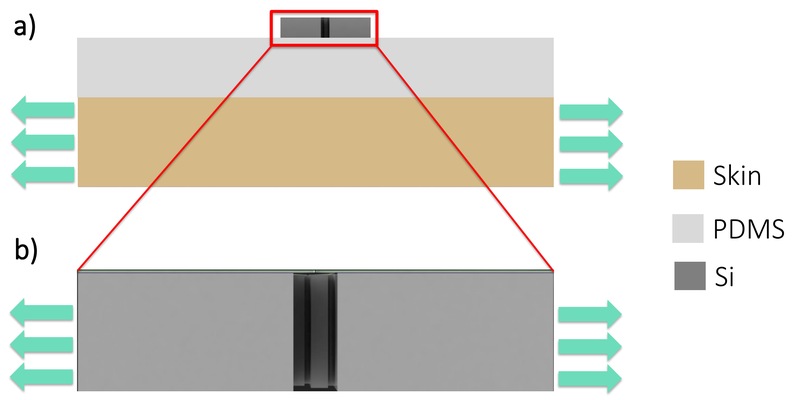

Figure 2 a) Model with Si device attached to PDMS on skin; b) Magnification of Si device with strain direction

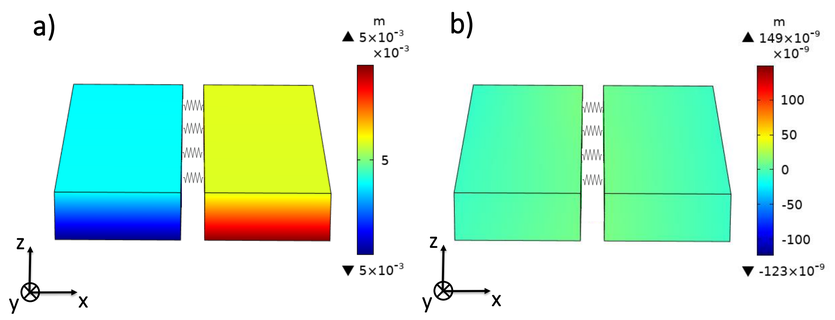

Figure 3 Displacement of the silicon base a) in x-direction and b) in y-direction induced by skin strain

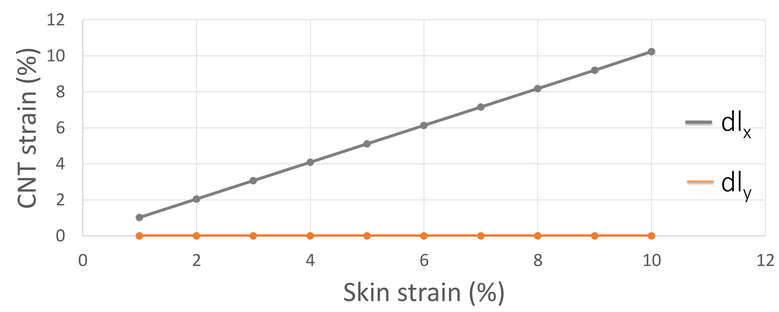

Figure 4 Induced CNT strain according to applied skin strain

Conclusion

- Design heavily suppress displacement in y direction
- According to the current simulation model the skin strain is effectively transduce into CNT strain
- CNT strain effectively controllable with spring geometry and orientation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017915 (DIGIPREDICT).

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