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3D-SensTex | NTF

FNSNF

3D – Large Scale Integration of Sensors into Smart Textile

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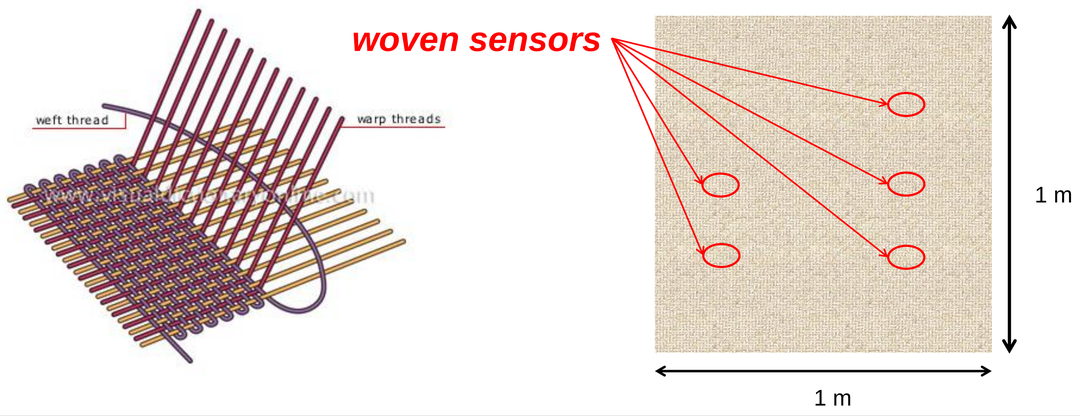
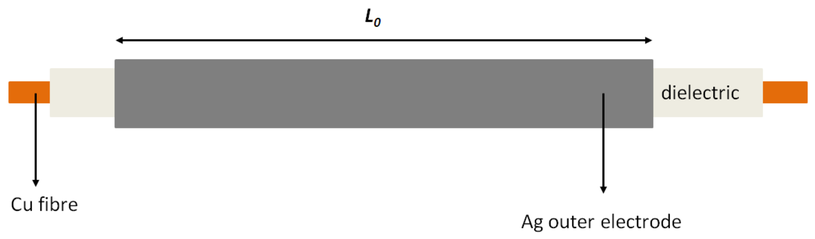
Textiles with integrated mechanical sensors

*large – area textile for mechanical stimuli detection: sensors and TFTs fabricated on cylindrical fibres either by **cleanroom technology** or by **printing techniques***



1st typology of sensors: capacitive sensors

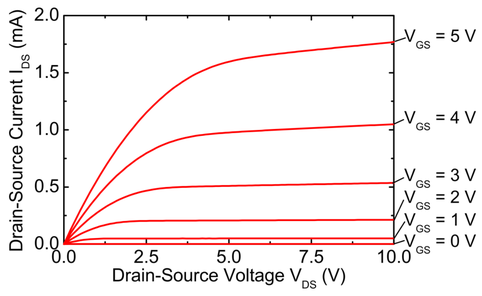
- **Substrate**: PET fibres (200 µm)/Cu fibres (60 µm)
- **Dielectric**: parylene-C (2 µm)
- **Outer electrode**: IP Ag electrode around the fibre
- **Inner electrode (PET core fibres):** IP Ag electrode around the fibre

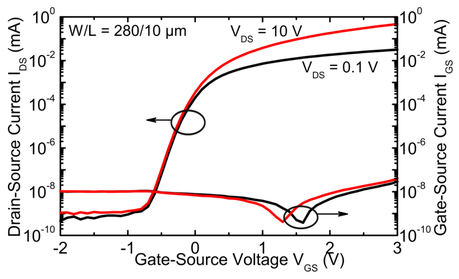


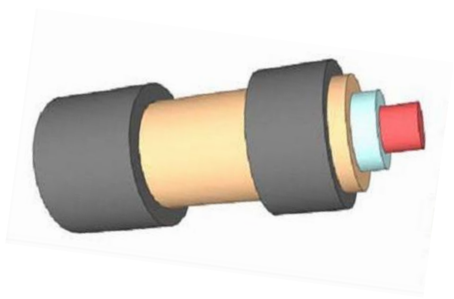
top view | cross section

2nd typology of sensors: cylindrical FETs

- **Substrate**: conductive fibre (50 µm)
- **Gate dielectric**: ALD Al_2O_3, parylene or PMMA (~ 30 nm)
- **Semiconductor**: a-IGZO or ZnO (~ 15 nm)
- **Source and drain electrodes:** 10 nm Ti + 60 nm Au
- **Functions:** mechanical sensing but also switches to address woven sensors

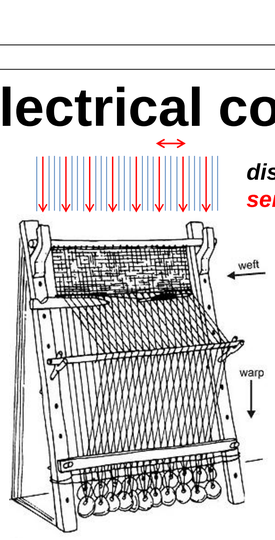






Conductive cylindrical fiber 50um as diameter (Gate)
Dielectric (ALD Al_2O_3, parylene, PMMA)
Sputtered IGZO, ZnO
Shadow mask Metal evaporation (Source-Drain)

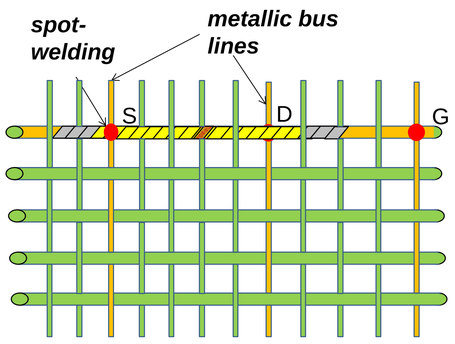
Weaving process and electrical connections



distance between two adjacent sensorised fibres: 10 cm

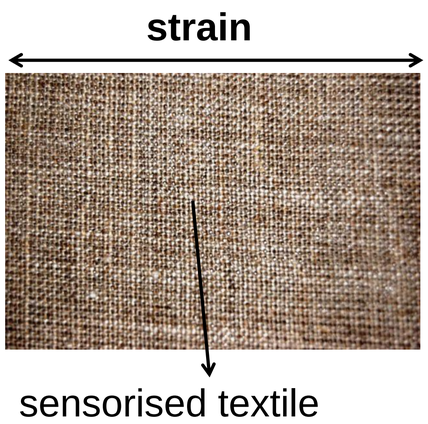
optimal position of sensorised yarns within the textile

- ***sensorised yarn***
- ***normal yarn***

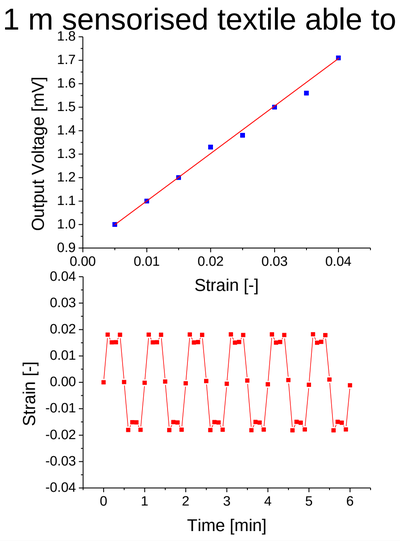


Demonstrator

The final goal of this project is the production of a 1 m X 1 m sensorised textile able to detect mechanical strain:



read-out electronics

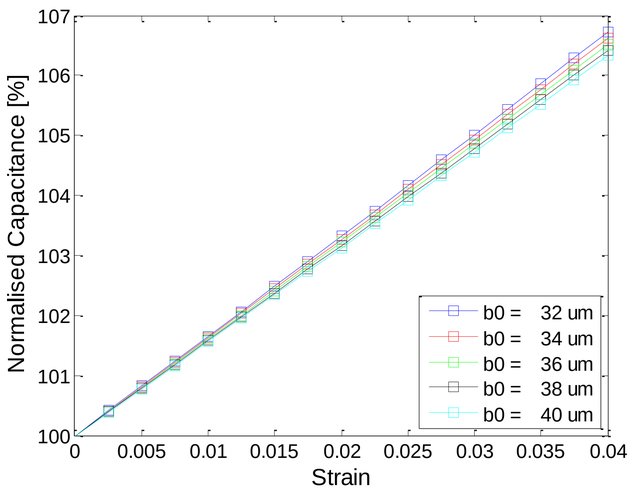


Devices simulation: capacitors

Capacitance vs Strain

Normalised capacitance variation vs strain for a coaxial cable having the following geometrical and physical parameters:

- **a_0 (inner radius) = 30 µm**
- **L_0 (fibre length) = 10 cm**
- **b_0 (outer radius) = variable**
- **$b_0 – a_0$ (dielectric thickness) = variable**
- **ε_r (permittivity of dielectric) = 3.1**



Conclusions

The goal of the 3D-SensTex is the fabrication of a large area (1 m x 1 m) sensorised textile for the detection of mechanical stimuli. Two typologies of sensors are being fabricated to achieve this goal, namely cylindrical capacitors and Field Effect Transistors (FETs). Both types of devices are realised on high length (10 m), small diameter (50 to 200 µm) cylindrical fibres, perfectly suitable for the weaving process and capable to assure good mechanical properties, in terms of flexibility and bendability, to the final textile. Possible fields of application of the sensorised textile include, but are not limited to, wearable computing, sensor networks, healthcare and automotive systems.