3D – Large Scale Integration of Sensors into Smart Textile

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3D-SensTex NTF

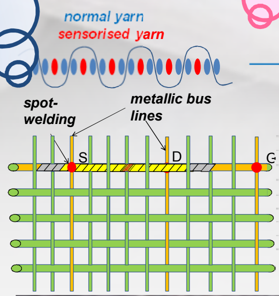
Hi, our project is called 3D-SensTex and our goal is to integrate sensors and electronics into textile on large scale. Look what we can do...we have integrated array of sensors and transistors into a 1x1m² woven textile! If you have 5 minutes we will explain you why, how and what we have done so far.

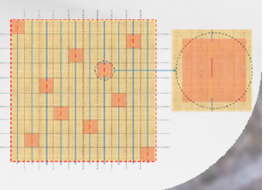
We know you want to ask: why electronics into textile? Well the answer is because textiles are everywhere and «smart textiles» can be used for health and environmental monitoring. But then why 3D? And what 3D means?

«Electronic textile» are flexible and preserve all the comforts of fabrics

At present, «electronic textiles» are usually handcrafted and require tedious and serieal procedures. How scale-up such technology? To successfully integrate electronic components into the large area processes of textile industry it is important to adapt to their technology. Our work starts from one simple observation: textile fibers posses cyindrical geometry. So why make components which are flat and planar?

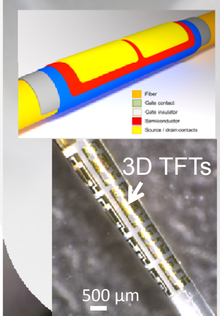
This is why we decided to start making electronics and sensors on long cylindrical fibers (10m long and 100µm in diameter). However, while this approach facilitates the production of large piece of textiles it poses challenges from the single electronic fiber standpoint. How to make sensors and transistors on a fiber?

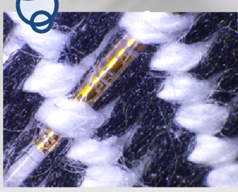


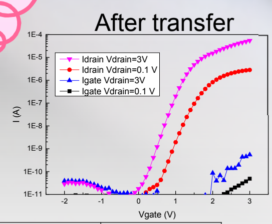


We have succesfully fabricated high performance and thin IGZO-based TFTs in cleanroom and then transferred them on the plastic fibers. Such TFTs continue to work even when bent around a human hair without any significant change in performance.

In parallel we are also trying to fabricate transistors directly on top of the fibers. Shadow mask, e-beam evaporation and RF sputtering are the techniques used to realize the devices. At present the roughness of the fibers and the low resolution are the main obstacles towards high performance TFTs.





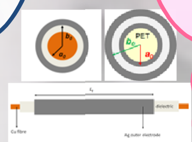


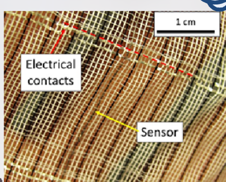
TFT	Ion/Ioff	Vth(V)	µ (cm²/Vs)
Before	2e6	0.92	7
after	2e7	0.86	7.2

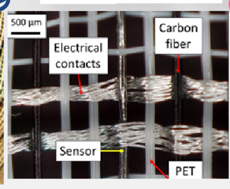
Capacitive strain were instead realized by inkjet printing. The sensor consists in a stack configuration made of inkjet printed silver electrodes (sub-µm in thickness) with in-between a parylene layer (2 µm-thick) used as dielectric. When axial deformation occurs, the dimensions of the capacitor are changed resulting in a sensor response.

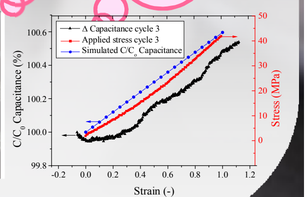
Fibers were covered on the whole circumference with silver using inkjet printing. After the thermal annealing of the ink, parylene was deposited on the fiber. Instead of protecting the contact areas, the selective laser etching of parylene can be used to open windows. A second silver layer was then inkjet printed and sintered to form the stack capacitor.

..once we have our 10m long fibers we can make our electronic t-shirt ☺ (THE END)









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