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An ultra-thin and ultra-conformable all solution-processed organic transistor for tattoo/wearable electronics

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1. Introduction to the style guide, formatting of main text, and page layout

The continuous advancements in the field of electronics have paved the way to the development of new applications, such as wearable or tattoo electronics, where the employment of ultra-flexible and ultra-conformable devices is required [1-2]. One of the main strategies to improve the device mechanical flexibility and conformability is the reduction of its total thickness, of which the substrate usually represents the biggest contribution [3]. To this end, organic materials can be considered enablers, owing to their advantageous mechanical characteristics, not achievable with inorganic counterparts, and to the possibility to obtain films with thicknesses at the nanometric scale at low temperature even from solution. Yet, with available processes, challenges are faced in obtaining operating devices when scaling thickness below a few hundreds of nanometers, apparently setting a limit. Moreover, most methods require physical deposition techniques [4-5-6].

In this work [7] we have successfully fabricated ultra-flexible, **143 nm-thick all-organic field-effect transistors**, which is the thinnest transistor ever fabricated, based on an ultra-thin solution processable dielectric bi-layer, adopting only solution based techniques, such as spin-coating and inkjet printing. **The devices can operate at low voltages** and, thanks to their very low thickness, can conform to human skin in an imperceptible way **and sustain bending radii as low as 0.7 µm**, without significant variations in their electrical performance, thus setting a new limit in thickness and flexibility. Moreover, this is the first demonstration of ultra-thin (< 1 µm) fully solution processable transistors, including the substrate. The electrical characterization showed a very good reproducibility, demonstrating the solidity of the proposed fabrication process, and the stability test in air make the devices in principle **compatible with single-day, disposable usage**. Moreover, the employed materials and their very low thickness guarantee a high transparency of the device, which **exceeds the 80% in the visible regime**. Besides providing an alternative and valid technological solution for the cost-effective integration of ultra-thin devices in more complex systems, the proposed approach can be a candidate for a plethora of possible use ranging from wearable to tattoo/epidermal electronics for sensing, healthcare or biomedical applications where conformability, ultraflexibility and transparency are necessary.

2. References

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