High-precision material printer for fast-prototyping of 2DM-based electronic devices

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Printable electronics is one of the fields where 2D materials could be an enabling technology, especially if adopted for flexible and wearable applications. The main point of strength of this technology is related to the fast and cost-effective way of fabricating and prototyping electronic devices, e.g., field effect transistors (FET), compared to traditional lithographic techniques. Unfortunately, one of the current main challenges is concerned with the difficulty in achieving both high resolution and accuracy in printing conductive lines, which are fundamental for the definition of the channel lengths and widths of FETs[1].
Our work focuses on the development of a high-resolution material printer, which can achieve resolutions of a few micrometres, way beyond what currently achievable by available commercial printers. It integrates a double printing system: Inkjet printing and Dip Pen Nanolithography[2]. In Figure 1, we show source and drain silver contact on top of paper, where the channel length of the device is around 1 µm, with a very high degree of controllability and repeatability. In Figure 2, we show instead source and drain contacts defined through the Dip Pen technique on top of a micrometres MoS_2-flakes with PEDOT conductive line of 9 µm width. We want to stress that several other types of inks with sub-micrometric accuracy can be deposited through both printing methods, increasing the perspectives of the 2DM printable electronics range of applications.

References

[1] Yoshimura Y., Organic Electronics, 2014, 2696-2701
[2] Corletto A., Shapter J. G., J. Mater. Chem. C, 2021,9, 14161-14174

Figures

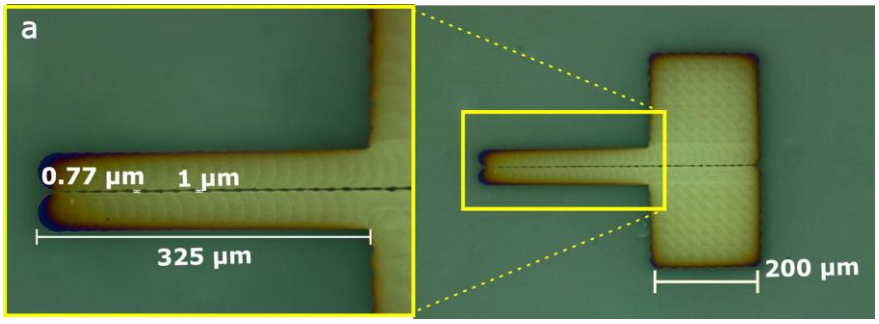

Figure 1: Inkjet printed silver parallel contacts with gap size of 1 µm;

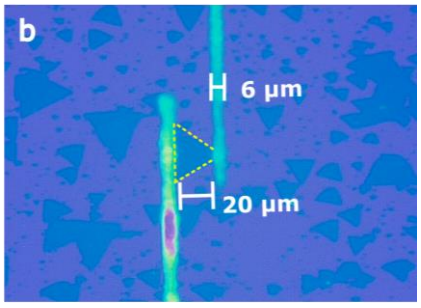

Figure 2: PEDOT: PSS conductive lines printed with DPN technique, over MoS_2 single flake.