Fully Printed Inverters using Metal-Oxide Semiconductor and Graphene Passives on Flexible Substrates

SUPPORTING INFORMATION

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SUPPORTING INFORMATION

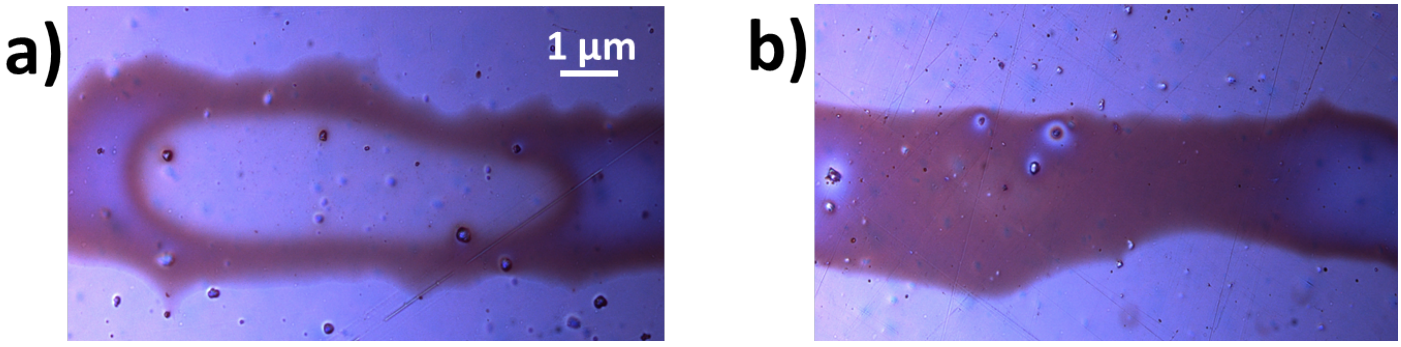


Figure 1: Printing and processing of precursor ink on a) Polyimide substrate without the cleaning step. The high surface energy of the polyimide to the formation of the so called 'coffee-ring' immediately after printing. b) Substrate treated with 4:1 isopropanol and acetone mixture after pre-heating. Dense films can be seen after printing and continues even after heating to 350 ˚C

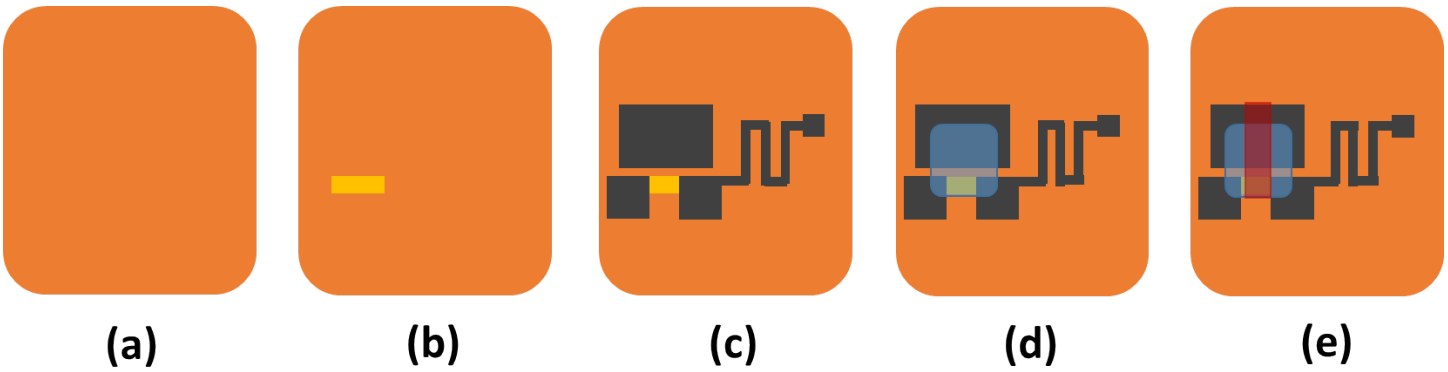


Figure 2: Steps followed in the fabrication of fully printed inverters on polyimide. a) Polyimide substrate pre-heated to 400 °C and rinsed with 4:1 isopropanol and acetone mixture. b) Precursor of In_2O_3 printed and dried at 100 °C. c) Printing of graphene passive structures (source-, drain-, gate- and resistance). d) CSPE printed across semiconductor and gate. e) Printing of PEDOT:PSS top gate

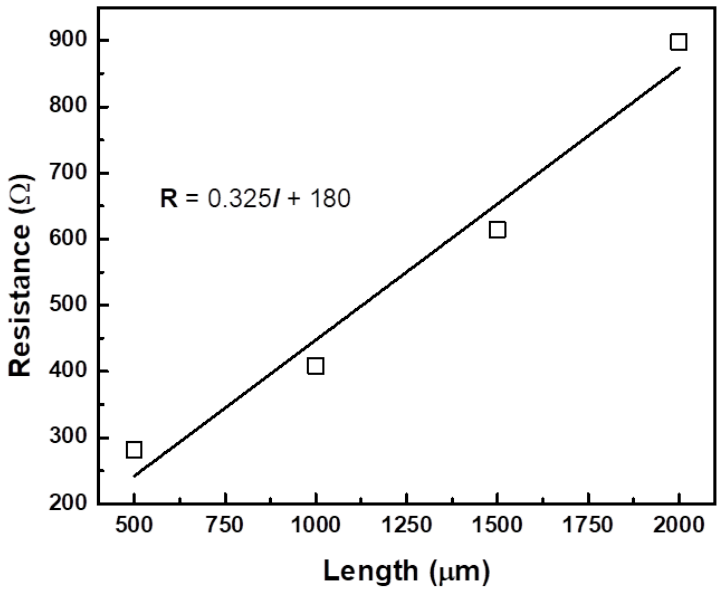


Figure 3: Resistance variation of printed graphene lines with a constant cross-sectional area, processed at 300 °C. The meander structures as seen in the inset image give rise to a resistance of 400 kΩ

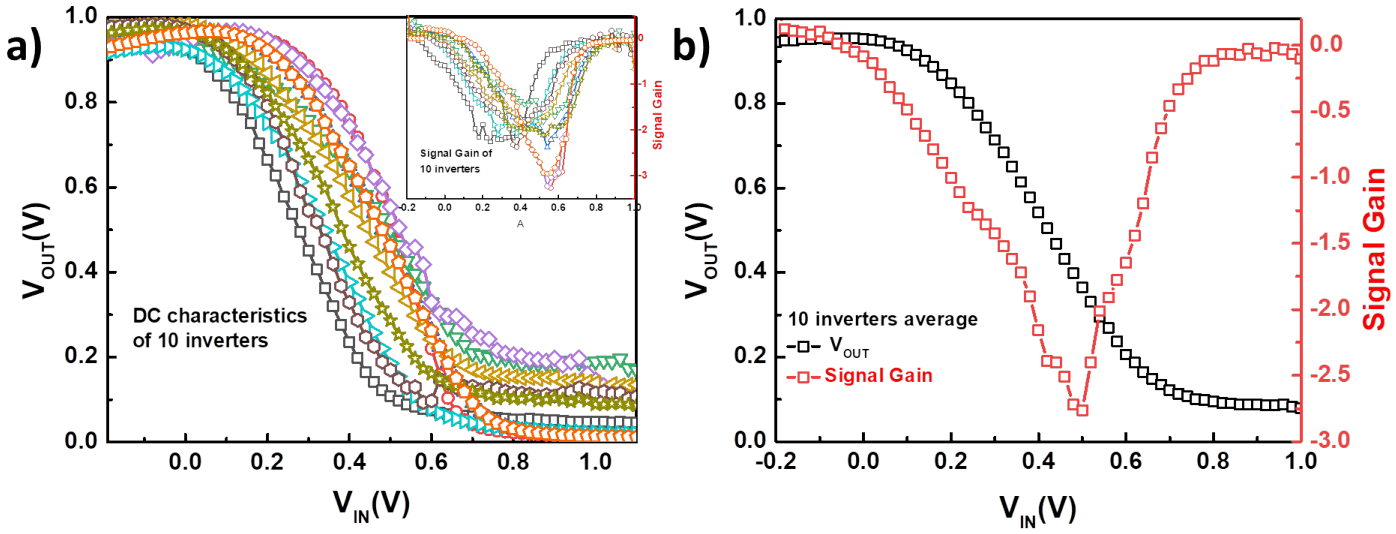


Figure 4: Statistical diagram of ten fully printed transistor-resistor logic inverters. The printed resistor values varied from 120 -250 kΩ. a) DC characteristics of the ten inverters. The range of the switching threshold is 250 - 400 mV. Inset shows the signal gain for the 10 inverters. The gain varies from 2.5 - 3.5 b) Average switching threshold and signal gain of the ten inverters are 350 mV and 3, respectively.

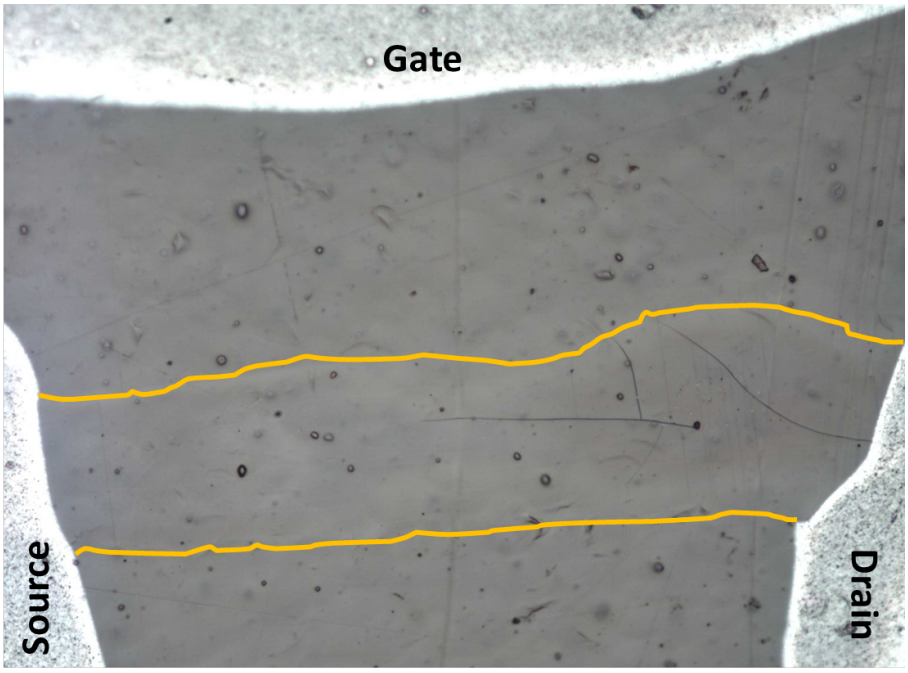


Figure 5: Tensile strength test of the oxide film before printing electrolyte. The applied strain is 1.5% and crack formation can be seen in the right top corner of the oxide film, whereas the graphene electrodes are intact.

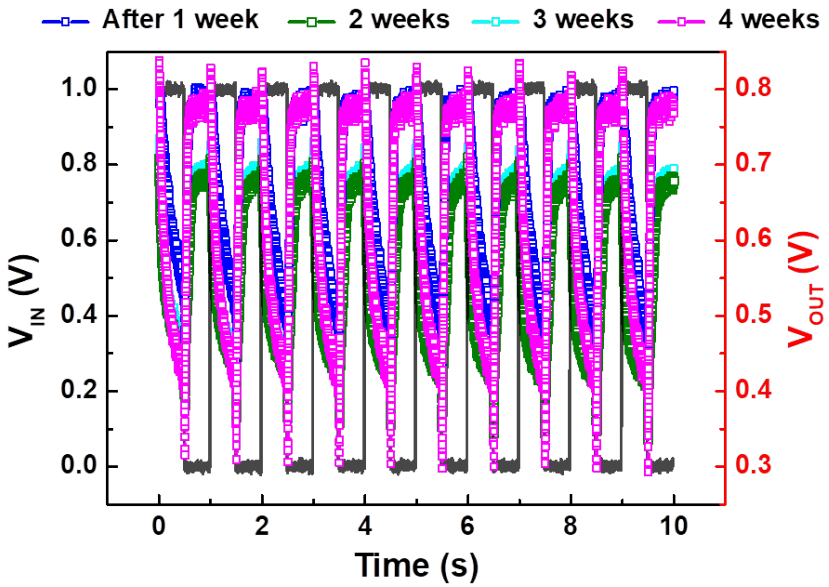
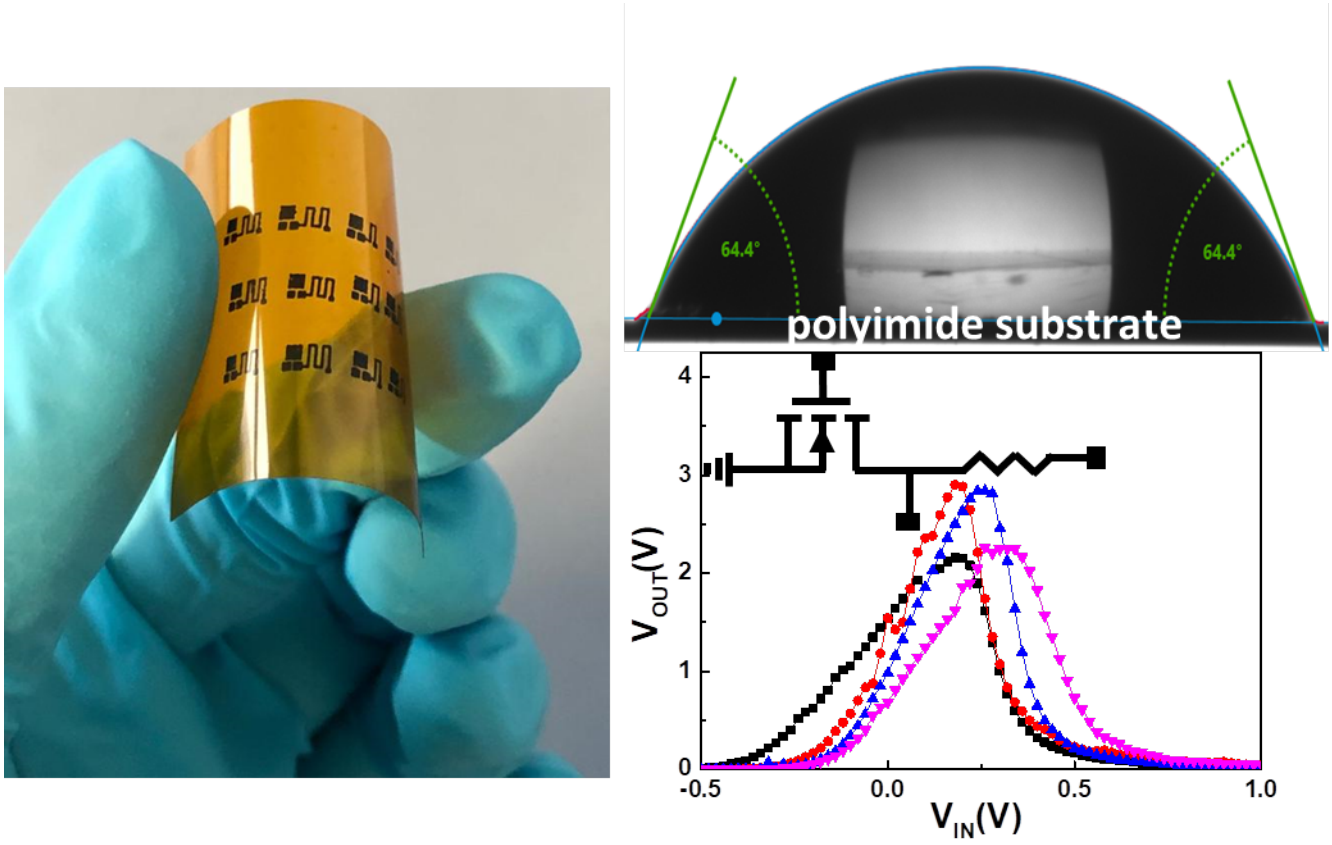


Figure 6: Temporal analysis of the transient characteristics of the fully printed inverter. The propagation delay remains constant at 30 ms.

Table of Contents



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