Boosting the speed of printed and direct-written polymer transistors

***M. Caironi*[1]**
[1]Center for Nano Science and Technology @PoliMi, Istituto Italiano di Tecnologia, Via Pascoli 70/3, 20133 Milano, Italy
Tel.:+39-02-2399-9875, E-mail: mario.caironi@iit.it

Printed organic field-effect transitors (OFETs) have been considered for many novel applications towards large area and flexible electronics [1], since they may enabkle pervasive integration of electronic functionalities in all sorts of appliances, their portability and wearability. Applications are countless: from personal devices (e.g. wearable health monitoring devices) to large-area sensors (e.g. electronic skin, bio-medical devices), smart tagging of products with radio-frequency identification tags. It is no doubt that a huge driving force comes from the display industry, with the goal to develop flexible and/or rollable displays deployable on demand, to be integrated with portable devices (e.g. smartphones). However, printed OFETs fabricated with scalable tools fail to achieve the minimum speed required for example to drive high-resolution displays, where a transition frequency (f_T), i.e. the highest device operative frequency, above 10 MHz is required. In this work we present effective strategies to increase f_T in polymer based devices by combining only printing and laser-based direct-writing techniques. In particular, we demonstrate the possibility to achieve MHz operation in all-organic transistors on plastic foils (Fig. 1), where short channels are ablated by a fs-laser. Moreover, we show that fs-laser sintering is another very promising approach for fast direct-written devices, with the possibility of achieving 10 MHz regime already with an OFET mobility in the range of 0.1 – 1 cm^2/Vs thanks to the drastically reduced capacitive parasitism.

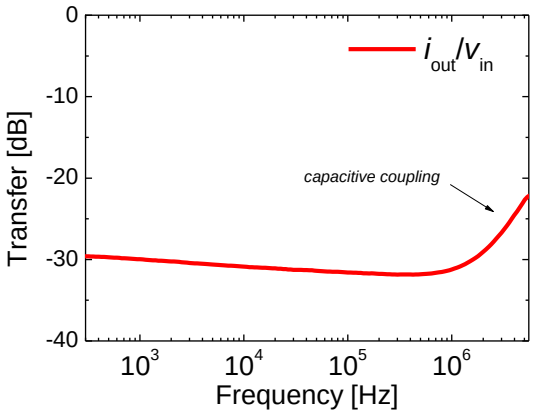

Fig. 1. Small signal ac voltage in / current out characterization of an all-organic, fully direct-written polymer based transistor with f_T close to 1 MHz.

Acknowledgment

This work has been in part financially supported by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme "HEROIC", grant agreement 638059.

References

1. M. Caironi and Y.-Y. Noh (eds.), Flexible and Large Area Electronics, Wiley, 2015, ISBN: 978-3-527-33639-5