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Printed organic smart devices characterized by nonlinear optical microscopy

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In this study, we demonstrate that nonlinear optical microscopy is a promising technique to characterize organic printed electronics. Using ultrashort laser pulses we stimulate two-photon absorption in a roll coated polymer semiconductor and map the resulting two-photon induced photoluminescence (TPPL) and second harmonic response. First, we show that the different nonlinear optical signals can be used to discriminate between the polymer semiconductor material and embedded metal nanoparticles which constitute the electrode in a real device. Next we demonstrate that the TPPL quenches when applying a current between source and drain; this decrease can be used to determine the electrical characteristic of the device [1]. Finally, we show that the TPPL increases with higher temperature in the 20 - 120 °C range, closely following the supported current characteristics of the semiconductor. With this technique, we can recognize different nanomaterials and we propose that the TPPL is a good indicator to map and monitor the charge carrier density and the molecular packing of the printed polymer material. Importantly, simple calculations based on the signal levels, suggest that this technique can be extended to the real time mapping of the polymer semiconductor film, even during the printing process, in which the high printing speed poses the need for equally high acquisition rates.

References

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