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Probing electric fields within organic transistors by nonlinear optics[1] PAULO B. MIRANDA, SILVIA G. MOTTI, DOUGLAS J. C. GOMES, Instituto de Fisica de Sao Carlos, Universidade de Sao Paulo, Brazil — Organic field-effect transistors (OFETs) are important building blocks in many organic devices, but further improvements in their performance will require a detailed knowledge of their operation mechanism. Thus mapping the electric fields in OFETs, both in the active organic layer and inside the gate dielectric, will allow a direct comparison with theoretical OFET models and guide advances in device engineering. The nonlinear optical processes of sum-frequency generation (SFG) and second-harmonic generation (SHG) may be used to probe electric fields in OFETs. With a proper choice of pump wavelength, SHG can selectively probe the field component along the OFET channel, inside the organic semiconductor. In contrast, SFG may probe the field within any organic material by selecting a specific molecular vibration and monitoring the field-enhanced SFG signal. Here we investigate OFETs fabricated with a polythiophene derivative (P3HT) on silicon substrates and with the insulating polymer PMMA for the dielectric layer. Both the strength and sign of the electric field in PMMA can be determined, yielding a direct probe of charge accumulation along the OFET channel. An extension of this technique to map the spatial distribution of accumulated charge along the channel will also be discussed.

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