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Micro-processing of Hybrid Field-Effect Transistor Arrays using Picosecond Lasers ROBERT IRELAND, YU LIU, Johns Hopkins University, JOSEF SPALENKA, University of Wisconsin, Madison, SUPRIYA JAISWAL, SHINGO OISHI, KENSHI FUKUMITSU, MOCHIZUKI RYOSUKE, Hamamatsu Photonics, Japan, PADMA GOPALAN, PAUL EVANS, University of Wisconsin, Madison, HOWARD KATZ, Johns Hopkins University — We use a solid-state picosecond laser to pattern thin-film semiconductors that completely cover a substrate and utilize an array of top-contact electrodes, particularly for materials with high chemical sensitivity or resistance. Picosecond laser processing is fully data-driven, both thermally and mechanically non-invasive, and exploits highly localized nonlinear optical effects. We investigate FETs comprised of p-channel tellurium and organic semiconductor molecules sequentially vapor-deposited onto Si/SiO_2 substrates. Secondly, zinc oxide and zinc-tin oxide are used for high mobility n-channel FETs, cast onto Si/SiO_2 by sol-gel method. Finally, zinc oxide FETs are prepared as photomodulatable devices using rhenium bipyridine as a light-sensitive electron-donating molecule. The laser effectively isolates FETs while charge carrier mobility is maintained, but leakage currents through the FET dielectric are drastically reduced, and other functions are enhanced. For instance, the ratio of measured gate current to photocurrent for photomodulatable FETs drops from a factor of five to zero after laser isolation, in both forward and reverse bias. We also observe a threshold voltage shift in organic semiconductors after laser isolation, possibly due to local charging effects.

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