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Customisable Ultrafast Laser Patterning of Organic Thin Film Transistor Backplanes for Flexible Electronics

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In the last few years ultrafast (picosecond and femtosecond) diode-pumped solid-state (DPSS) lasers have made great progress in terms of reliability, demonstrating to be a robust tool for industrial applications. Combined with the correct choice of wavelength, pulse duration and power these tools provide a versatile, selective and mask-less high precision micromachining technique.

In this work we show how ultrafast DPSS lasers can be used as an alternative technique to conventional photolithography for digital and customizable rapid prototyping of organic thin film transistors (OTFT) for flexible display backplanes. The processes under study are (a) transistor source/drain channel patterning and (b) single pulse high density via drilling for layer interconnection.

Totally debris free, high quality source/drain channel patterning is performed with a green picosecond laser achieving 5 µm spatial resolution. Electrical performance of such test OTFTs is presented. The use of laser beam shaping in combination with galvanometric scanner optics is also reported. Single and multiple pulse via drilling is investigated in the picosecond and femtosecond regime. Infrared, visible and UV wavelengths are employed and a comparative analysis is performed. The use of different substrate thickness is also considered. The influence of a thermal stress assisted mechanism will be discussed.

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