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Direct-Print Organic Photonics for Biodetection Chips

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The development of commercial portable Biochip applications based on optical detection is hindered by the lack of imaging systems that can be directly integrated into the chip itself. Currently, fluorescence/luminescence signals are read out with power-hungry, bulky and expensive off-chip imaging systems, like CCD cameras or photomultiplier tubes. Here we present an enabling technology that for the first time allows cheap and easy integration of imaging systems directly into disposable Biochip systems. Our technology is based on organic semiconductor materials that can be processed in liquid form by inkjet and screen printing, in a process much faster and cheaper than the complicated fabrication of silicon-based imaging sensors. Organic photosensors can be printed on various substrate materials like plastic foil or glass or directly onto Biochip systems. The ultrathin photodiodes with an overall thickness of only 300 to 500 nm show quantum efficiencies better than 0.5 and linear light-response over 6 orders of magnitude. The pixel size can range from 50 to over 1000 μm and inkjet fabrication allows tailoring the sensor layout to the needs of the specific application. Single photodiodes, photodiode line-arrays or 2D arrays of photodiodes can be printed onto diverse materials. Besides the dramatically reduced production costs for printed photodiodes, the presented readout architecture allows detection of e.g. chemiluminescence signals with highest sensitivities and minimum crosstalk due to the close proximity of sample and printed photodiode.