# Pocket scanner using organic transistors and detectors

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**A pocket scanner has been manufactured by integrating high-quality organic transistors with organic photodetectors. Because the pocket scanner requires no mechanical components, it is mechanically flexible, light to transport, shock-resistant and potentially inexpensive to manufacture.**

Organic field-effect transistors (FETs) have attracted much attention due to their excellent properties such as mechanical flexibility, lightweight, and low cost features. Those are complementary to silicon-based conventional electronics, which is high-performance, but expensive. Recent studies on organic transistors are motivated by two major applications, namely, flexible displays such as paper-like displays or e-paper and printable wireless tags.

As one of the new promising applications of organic transistors, we have recently successfully demonstrated the large-area, flexible, and lightweight sheet image scanner based on organic semiconductors. In this paper, we report recent progress and future prospect of sheet image scanners with organic transistors.

The device is manufactured on transparent poly(ethylene naphthalate) (PEN) films with integrating organic field-effect transistors and organic photodiodes. As shown in Fig. 1, the integrated device is mechanically flexible, very thin, and lightweight. The device structure is schematically illustrated in Fig. 2 along with chemical structure of each layer. Organic FET matrix and photodiode matrix have been manufactured separately on different plastic films and then laminated with each other with silver paste patterned by a microdispenser or anisotropic conductive films.

The transistor film has a 72x72 (~5,184) matrix of pentacene FETs with top contact geometry, which is manufactured with shadow mask technique [1-6]. The photodiode array consisting of a 30-nm-thick p-type semiconductor of copper phthalocyanine (CuPc) and a 50-nm-thick n-type semiconductor of 3,4,9,10-perylene-tetracarboxylic-diimide (PTCDI) is separately manufactured on the different PEN film coated with ITO.

The effective sensing area of the prototype is 5x5 $cm^2$; the resolution is 36 dots per inch (dpi), and the total number of sensor cells is 5,184. The pentacene FETs with top contact geometry have channel length of 18 μm, and mobility of 0.7 $cm^2$/Vs. The total thickness and the weight of the whole device are 0.4 mm and 1 g, respectively.

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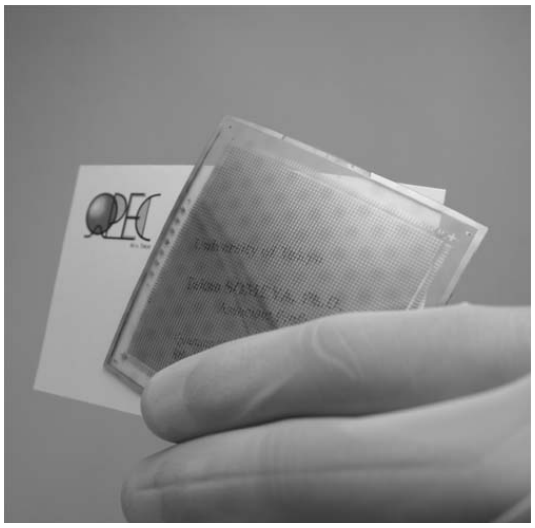

Fig. 1: An image of the manufactured large-area, flexible, and lightweight *sheet image scanner* consisting of organic transistors and organic photodiodes, which is placed on a business card under ambient light for capturing image.

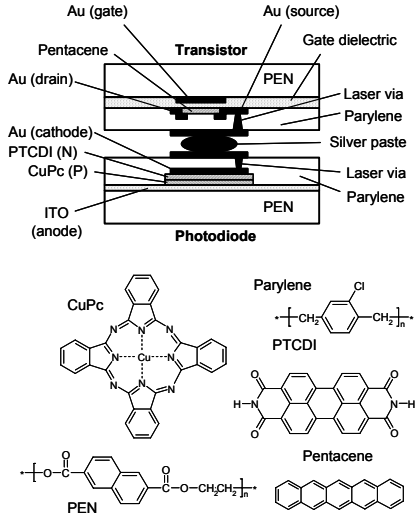


Fig. 2: The cross-sectional view of the device structure is schematically shown. The chemical structure of each layer is also shown.

The present scanning method does not require any mechanical or optical component. In conventional scanners, a linear array sensor is moved from the top to the bottom of a page to capture images. In the new design, a two-dimensional array of organic photodiodes coupled with organic transistors is used. Instead of a mechanical scanning procedure, the signal of the photodiodes is read out electrically by the organic transistors, avoiding the need to use any movable part. As a result, the device is thin, lightweight, and mechanically flexible.

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