Recent Advances in Applications of Organic Integrated Circuits for Large-Area Electronics

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Organic transistor integrated circuits are attracting much attention since they are expected to be complementary to the high-performance yet expensive silicon VLSI's. There are many attributes of organic transistors, which can't be easily achieved by silicon-based conventional electronics. Organic transistor integrated circuits are mechanically flexible, shock-resistant, thin, and lightweight. Furthermore it is expected that organic transistor integrated circuits woul be ultra-low in cost even for large area. Mobility of organic transistors is about two or three orders of magnitude lower than silicon and the resultant circuit is slow in speed. The slow speed may not fit for video and RF applications, but it is acceptable for most of area sensor applications (1-6).

In this paper, we present recent advances of organic transistors and their applications to two kinds of large-area sensors, namely electronic artificial skins and sheet image scanners.

It is believed that skin sensitivity will be important for future robots used by humans in daily life for home-care and entertainment purposes. However, relatively little progress has been made in the field of pressure recognition compared to the areas of sight and voice recognition, mainly because good artificial "electronic skin" with a large area and mechanical flexibility is not yet available. The fabrication of a sensitive skin consisting of thousands of pressure sensors would require a flexible switching matrix that cannot be realized with present silicon-based

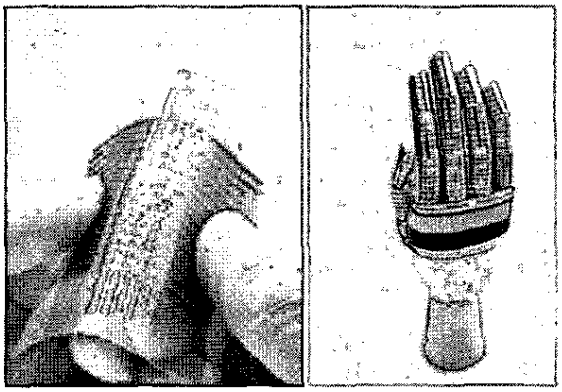

Figure 1: Images of flexible, large-area pressure sensors based on organic transistor active matrix. Those new devices are suitable for artificial skins for humanoid robots.

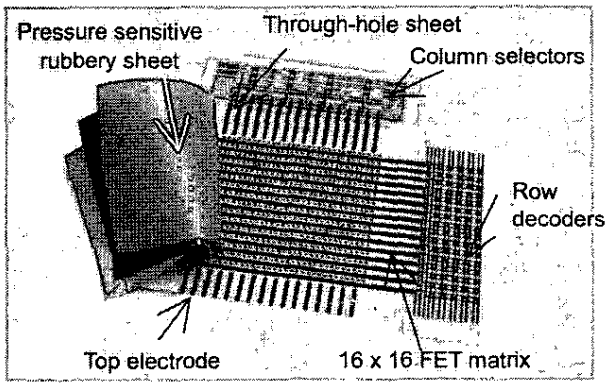

Figure 2: Images of organic transistor integrated circuits for artificial skin applications. Integrated circuits consist of 16x16 access transistor matrixes, row decoders, and column selectors.

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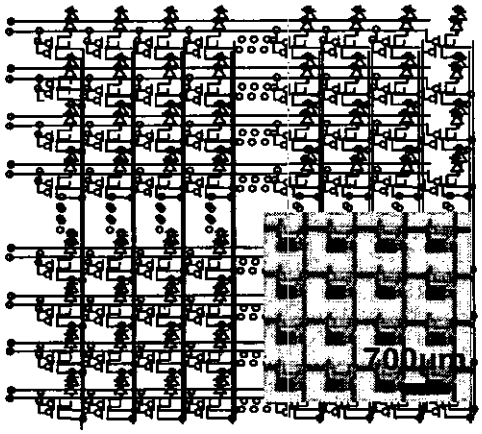

Figure 3: The circuit diagram of a sheet-image scanner. The microscopic image of sensor cells is also shown.

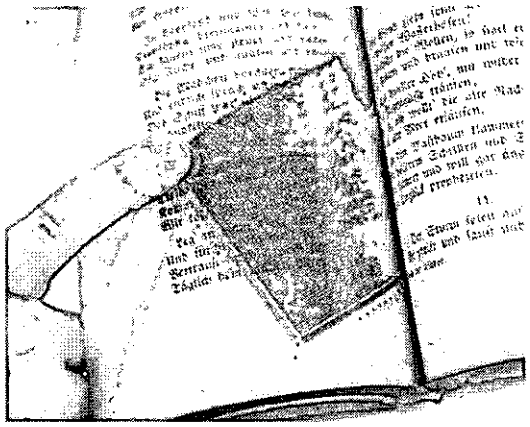

Figure 4: An image of a sheet image scanner, which is conformable to the bent page of a book.

electronics. Here we present that integration of organic transistors and rubber pressure sensors provides an ideal solution to realize a practical artificial skin. In particular, moving images of pressure have been taken by flexible active matrix drivers with organic transistors whose mobility reaches as high as 1.4 cm^2/Vs. The device is electrically functional even when it is wrapped around a cylindrical bar with a 2 mm radius.

Then, we also report on a large-area, flexible, and lightweight *sheet image scanner* on a plastic film integrating high-quality organic field-effect transistors (FETs) and organic photodiodes. Organic photodetectors distinguish between black and white from the difference of reflectivity between black and white parts on paper. The sheet has no optical or mechanical parts and therefore very thin and lightweight.

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