Rubber Stamped Plastic Electronics for Paper-like Displays

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Electronic systems that use rugged, lightweight plastics potentially offer attractive characteristics (low cost processing, mechanical flexibility, large area coverage, etc.) that are not easily achieved with established silicon technologies. This talk summarizes work that demonstrates many of these characteristics in a realistic system: organic active matrix backplane circuits (256 transistors) for large (~5”x5”), mechanically flexible sheets of electronic paper, an emerging type of display. The success of this effort relies on new or improved processing techniques and materials for plastic electronics, including methods for (i) rubber stamping (microcontact printing, μCP) high resolution (~1 μm) circuits with low levels of defects and good registration over large areas, (ii) achieving low leakage with thin dielectrics deposited onto surfaces with relief, (iii) constructing high performance organic transistors with bottom contact geometries, (iv) encapsulating these transistors, (v) depositing, in a repeatable way, organic semiconductors with uniform electrical characteristics over large areas, and (vi) low temperature (~100 °C) annealing to increase the on/off ratios of the transistors and to improve the uniformity of their characteristics. The sophistication and flexibility of the patterning procedures, the high level of integration on plastic substrates, the large area coverage and the good performance of the transistors are all important features of this work. We successfully integrate these circuits with microencapsulated electrophoretic ‘inks’ to form the sheets of electronic paper[1,2]. The figure below shows a typical display; mechanical flexing and bending does not affect its performance.

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References:

1. J.A. Rogers, *Science* **291**, 1502-1503 (2001).
2. J.A. Rogers, Z. Bao, K. Baldwin, A. Dodabalapur, B. Crone, V.R. Raju, V. Kuck, H. Katz, K. Amundson, J. Ewing and P. Drzaic, *Proc. Natl. Acad. of Sci.*, in press.