Wallpaper electronics

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The famous CMOS-driven Semiconductor Industry Technology Roadmap is geared towards smaller sizes, smaller dimensions, and higher speed of tiny crystalline silicon chips. However, a much less noticeable but equally important emerging trend is to scale up the size of integrated electronic circuits. This trend has first manifested itself in a rapidly increasing size and sophistication of flat panel displays driven by giant area VLSI. Future developments hold promise of much more exciting applications that will range from so-called *sensitive skin* that should allow robots to operate in unstructured locales like a school or a hospital ward [1, 2], to electro-textiles that will harvest energy from the environment and that will incorporate sensing, communication, and computing capabilities into the cloth.

Weaving cloth from wild plant fibers was invented approximately 5,000 BC. Merging this ancient technology with microelectronics is the next frontier of modern technology. Possible and promising approaches range from short-term solutions, such as embedding microelectronics chips into cloth, to developing electronics on large-area flexible substrates and on fibers with semiconducting properties. Some fairly established technologies that might be used for this purpose would rely on amorphous silicon, polysilicon, and organic semiconductors, which have proven themselves to different degrees in flat panel display applications. Yet a new and more adventurous approach to producing large area and stretchable semiconductor devices and circuits on cloth and flexible substrates is to deposit semiconducting films from water solutions. This latter approach has already led to the development of photodetectors fabricated on fibers [3] and view foils [4, 5] and holds promise of developing transistors on fibers in the near future.

[1] V. Lumelsky, M. S. Shur, and S. Wagner, eds., *Sensitive Skin*, Singapore: World Scientific, 2000. Also published as a special issue of *Int. J. High-Speed Electron. Sys*. **10**, No 2, 2000.

[2] V. Lumelsky, M. S. Shur, and S. Wagner, "Sensitive skin", accepted for publication in *IEEE Sensors J.* (2001).

[3] M. S. Shur, J. Sinius, R. Gaska, and S. Rumyantsev, "Photovoltaic effect in CdS on flexible substrate", unpublished.

[4] J. Sinius, R. Gaska, and M. S. Shur, "Flexible semiconductor films for sensitive skin", in *Proc. 2000 IEEE/RSJ Int. Conf. on Intelligent Robotics and Systems*, IEEE (2000), pp. 1511-1515.

[5] M. S. Shur, J. Sinius, R. Gaskiene, R. Rimeika, and S. Rumyantsev, "CuS photoconductor on fiber", unpublished.