

PRINTED POLY-Si TFTs ON PAPER VIA LIQUID-Si

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Solution process has received many attentions in recent years because of low-cost manufacturability of flexible electronic devices owing to the additive process. Organic and metal-oxide semiconductors can be printed at low-temperature however carrier mobility and reliability of TFTs using those materials are still much inferior than those for silicon. Silicon as the base material, on the other hand, has advantages in terms of high-mobilities for the both of electron and holes, chemical and electrical stability, and low-power consumption by CMOS circuit configuration.

Silicon can be printed using liquid silicon ink, which is a mixture of polymerized cyclopentasilane (CPS) and a solvent [1]. Thermal annealing higher than 350oC of this material, however, was necessary, to convert it to solid silicon, which prevented its usage on inexpensive substrates with a limited thermal budget.

In this paper, we review a novel method that forms polycrystalline silicon (poly-Si) patterns directly on paper using the same liquid silicon with doctor-blade coating and local irradiation of excimer-laser with room temperature process [2]. We review also the process and electrical properties of poly-Si TFTs fabricated on the paper. This technique will break-through the printed electronics by enabling applications such as fast printed electronics that are inexpensive, fully-recyclable, biodegradable and even edible.

[1] T. Shimoda, et al., "Solution-processed silicon films and transistors" Nature 440, 783-786 (2006).

[2] M. Trifunovic, T. Shimoda and R. Ishihara, "Solution-processed polycrystalline silicon on paper", Appl. Phys. Lett. 106, 163502 (2015)