ELECTRICAL PERFORMANCE OF AMORPHOUS IGZO THIN-FILM TRANSISTOR ON CELLULOSE NANOPAPER SUBSTRATE

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Key Words: Indium–gallium–zinc oxide (IGZO), thin-film transistor (TFT), cellulose nanopaper

Plastics are commonly used as substrates for flexible electronics today, but they cause significant impact to the environment. Paper has been considered as an alternative owing to their low cost, flexibility, biodegradability and recyclability. However, paper substrates are vulnerable to high temperature and/or wet processes. Therefore, most reported on-paper electronics were fabricated by using printing processes, transfer processes, and/or shadow-masking deposition techniques. In this work, amorphous indium-gallium-zinc oxide (a-IGZO) thin-film transistors (TFTs) were demonstrated on cellulose nanopaper substrates via a photolithography-compatible direct-fabrication method. The paper substrate was formed by drop-casting suspension containing cellulose nanofibers and cellulose nanocrystals on a rigid carrier substrate. A buffer layer consisting of parylene, SiN_x, SiO_2 and Al_2O_3 was then deposited to protect the paper substrate against processing gases and chemicals. To avoid deterioration of the cellulose nanopaper substrate, a low-temperature process of ≤ 150°C was developed. Fig. 1(a) shows the micrograph of a-IGZO TFTs made on a cellulose nanopaper substrate. The channel width and length are 60 µm and 30 µm, respectively. Figs. 1(b), (c), and (d) illustrate the transfer characteristics, output characteristics and linear field-effect mobility as a function gate voltage of an a-IGZO TFT fabricated on a cellulose nanopaper substrate. The on-paper TFT exhibits a field-effect mobility mobility of 4.23 $cm^2V^{-1}s^{-1}$, on/off current ratio of 2.17×10^7, threshold voltage of 4.35 V and subthreshold swing of 0.695 V/dec. The result paves a way toward large-area-compatible and scalable flexible green electronics productions.

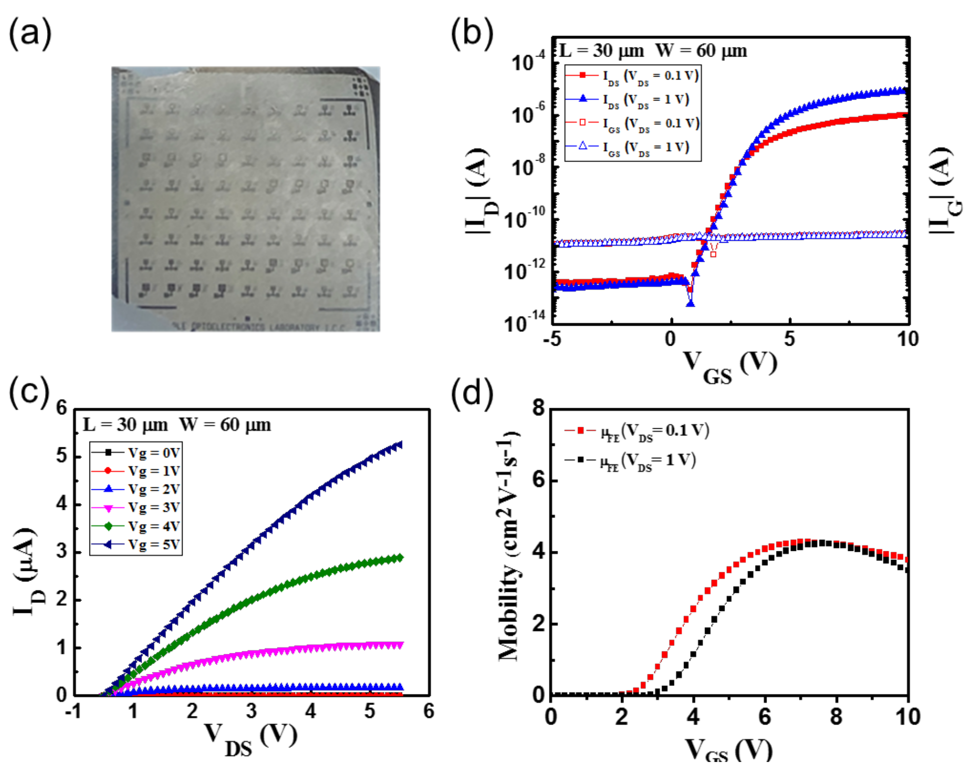

Figure 1 – (a) Optical micrograph, (b) transfer characteristics, (c) output characteristics, and (d) linear field-effect mobility as a function of gate voltage of a-IGZO TFT fabricated on a cellulose nanopaper using a photolithography-compatible approach.