P-TYPE TIN MONOXIDE THIN-FILM TRANSISTORS ON CELLULOSE NANOPAPER SUBSTRATES

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Oxide-based thin-film transistors (TFTs) possess advantages such as relatively high mobility, low process temperature and good uniformity, which make them attractive for flexible electronics applications. Most flexible oxide-based TFTs reported today were made on plastic substrates. In this work, flexible inverted-staggered bottom-gate p-type tin monoxide (SnO) thin-film transistors (TFTs) were demonstrated on cellulose nanopaper substrates using a photolithography-compatible direct-fabrication approach. 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 and SiO_2 was then deposited to protect the paper substrate from processing gases and chemicals. The processing temperatures of the TFT were kept ≤ 200°C to ensure the paper substrate remained intact during the process. The channel, gate, source, and drain patterns were defined by using conventional photolithography techniques. Fig. 1(a) shows the micrograph of p-type SnO 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 a p-type SnO TFT fabricated on a cellulose nanopaper substrate. The on-paper SnO TFT exhibits a field-effect mobility of 1.21 $cm^2V^{-1}s^{-1}$, threshold voltage of 3.56 V, subthreshold swing of 2.36 V/dec and on/off current ratio of 2.06×10^3.

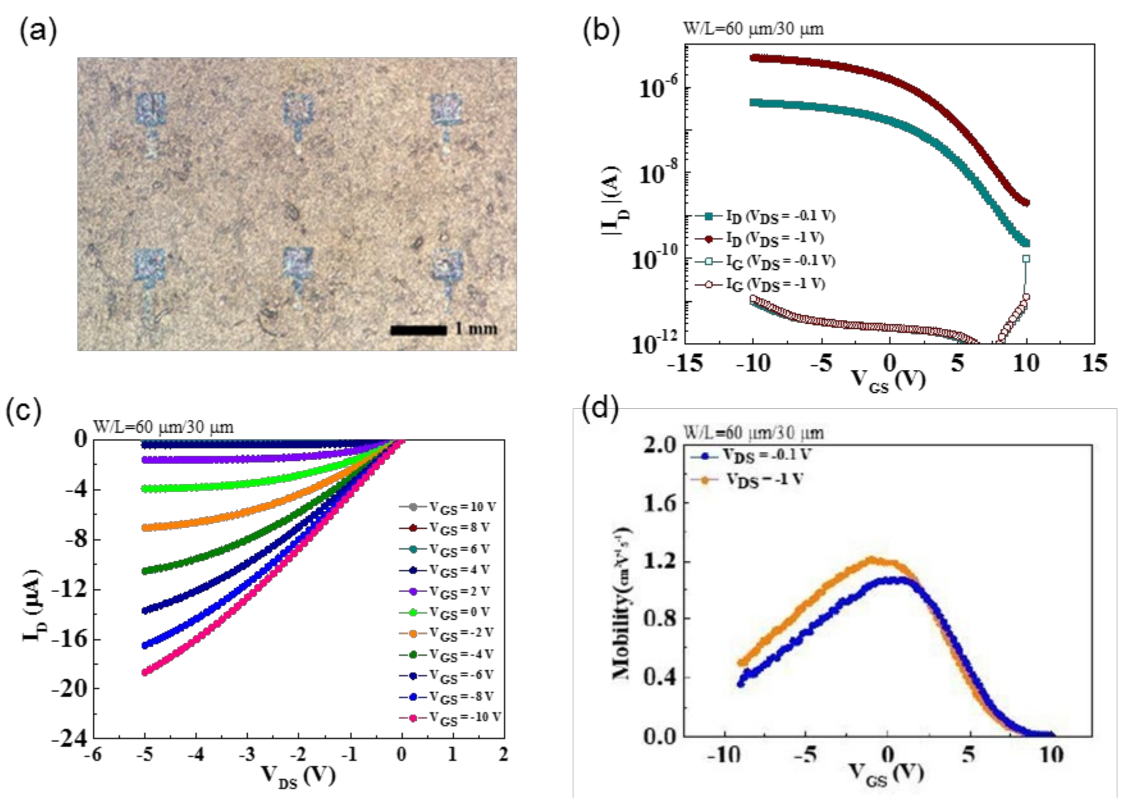

Figure 1 – (a) Optical micrograph, (b) transfer characteristics, (c) output characteristics, and (d) linear field-effect mobility as a function of gate voltage of p-type SnO TFT fabricated on a cellulose nanopaper using a photolithography-compatible approach.