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Green electronics for the future: paper-e

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In this paper we report the use of a sheet of cellulose fiber-based paper as the dielectric layer used in oxide based semiconductor thin film field effect transistors (FETs). In this new approach we are using the cellulose fiber-based paper in an “interstrate” structure since the device is build on both sides of the cellulose sheet. Such hybrid FETs present excellent operating characteristics such as high channel saturation mobility (>30 cm2/Vs), drain-source current on/off modulation ratio of approximately 104, near-zero threshold voltage, enhancement n-type operation and sub-threshold gate voltage swing of 0.8 V/ decade. The cellulose fiber-based paper FETs characteristics have been measured in air ambient conditions and present good stability. The obtained results outpace those of amorphous Si TFTs and rival with the same oxide based TFTs produced on either glass or crystalline silicon substrates. The compatibility of these devices with large-scale/large-area deposition techniques and low cost substrates as well as their very low operating bias delineates this as a promising approach to attain high-performance disposable electronics like paper displays, smart labels, smart packaging, RFID and point-of-care systems for self analysis in bio-applications, among others.