High-performance 1-D Fiber-based Thin-Film-Transistors using Solution-processed Metal-Oxide Semiconductors and Dielectrics

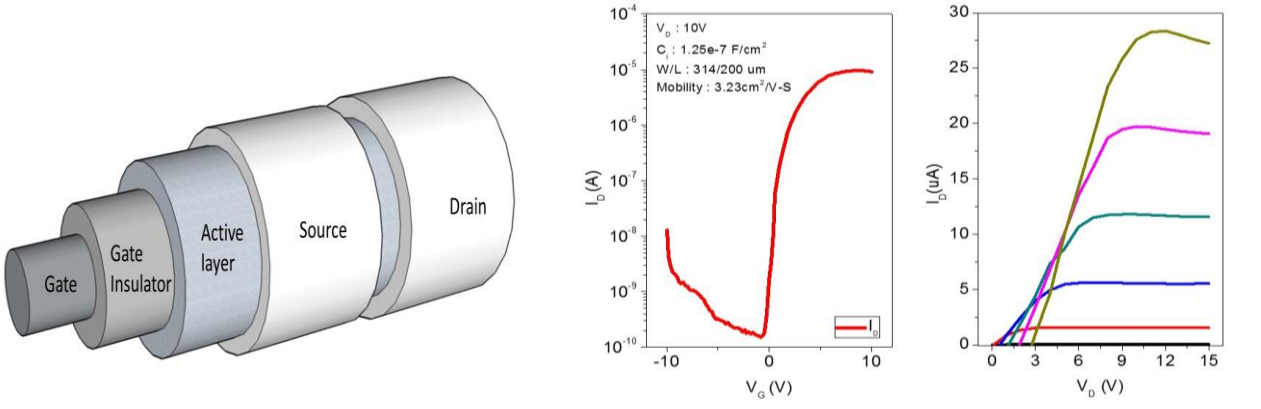
Chang jun Park, Gyeong min Yi, Jae sang Heo and Sung kyu Park
School of Electrical and Electronics Engineering, Chung-Ang University, Seoul, Korea
Tel.:82-2-820-8547, E-mail: skpark@cau.ac.kr

Recently, fiber has attracted lots of attention in flexible electronics and displays field due to flexibility, elasticity and availability of large scale. Because of these advantages, fiber-based thin film transistors (FTFTs) can be applied to various applications such as wearable electronics, flexible circuit, skin-like pressure sensors and other application with human body. To demonstrate FTFTs, metal oxide semiconductors (MOS) as channel layer were used because MOS thin-films have high electric performances, good uniformity and availability in solution process. However, most of MOS required high temperature (>350 ℃) process which cannot be applied to flexible substrate to obtain reasonable electrical performances. So, photochemical activation process which has used deep-ultraviolet irradiation (DUV) with 253.7 and 184.9 nm wavelength was used to obtain high electrical performance at low temperature.

In this study, we demonstrated that solution-processed MOS FTFTs were fabricated by using facile dip-coating and DUV irradiation method on optical fiber substrates with 200 μm diameter. Optical fiber was cleaned by sonic equipment at 15min for a smooth surface. Cr gate was deposited by sputter on the optical fiber. On the gate electrode, Al_2O_3 gate dielectric layer was formed by facile dip-coating method DUV irradiation in N_2 atmosphere for 2h using a mercury lamp. Indium gallium zinc oxide (IGZO) active layer was deposited by identical method to above described gate dielectric formation process. After forming the IGZO thin film, Aluminum (Al) was deposited by thermal evaporating as source/drain electrode and patterned by using shadow mask. The channel width and length of the TFTs were 314 μm and 200 or 50 μm, respectively.

Figure (b) and (c) show transfer and output current characteristics of solution-processed Al_2O_3 & IGZO TFTs, The saturation mobility and on-off current ratio of fiber-based IGZO TFTs were 2.50~3.97 cm^2/V-s and $3.85x10^2$~$6.66x10^4$ respectively.

For the first time, we have demonstrated 1-dimensional MOS FTFTs. The FTFTs show good electrical characteristics that high carrier mobility and on-off current ratio. In addition, we are researching integrated circuits that inverter by using two MOS FTFTs.



(a) **(b)** **(c)**

Fig. (a) Schematic illustrations structure of 1-Dimensional Fiber-based IGZO TFTs (b) Transfer curve with gate voltage (I_{DS}-V_G) of fiber-based TFTs (c) Output characteristic with drain voltage of fiber-based TFTs

References

1. Y.H.Kim, J.S.Heo, T,H.Kim, S.J.Park, M.H.Yoon, J.W.Kim, M.S.Oh, G.R.Yi, Y.Y.Noh and S.K.Park, *Nature*, **489,** 128-132 (2012)