Investigation of the Electrical Properties of Double-Gate Dual-Active-Layer (DG-DAL) Thin-Film Transistor (TFT) with $HfO_2/La_2O_3/HfO_2$ (HLH) Sandwich Gate Dielectrics

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In this paper, the electrical properties of a double-gate dual-active-layer (DG-DAL) thin-film transistor (TFT) is investigated. To increase the ON-current and pixel intensity, and control the voltage stress bias, the conventional gate oxide material (silicon dioxide SiO_2) is replaced with a tri-high-k gate dielectric layer, hafnium dioxide HfO_2/lanthanum oxide La_2O_3/hafnium dioxide HfO_2 (HLH). Further, the performance of the proposed DG-DAL structure is compared with the single-active-layer (SAL) and dual-active-layer (DAL) TFTs. The amorphous indium-gallium zinc-oxide (*a*-IGZO) is considered as active layer for SAL channel region, and on the other hand, *a*-IGZO and indium-tin-oxide (ITO) are considered as active layers for DAL TFT and DG-DAL TFT channel regions. The parameters such as OFF-current, ON-current, I_{ON}/I_{OFF} ratio, threshold voltage, mobility, average subthreshold swing, etc. are evaluated for the considered structures. It is observed that the DG-DAL TFT with HLH dielectric offers high ON-current of $3.85 \cdot 10^{-3}$ A/μm, very low OFF-current of $2.53 \cdot 10^{-17}$ A/μm, very high I_{ON}/I_{OFF} ratio of $1.51 \cdot 10^{14}$, the threshold voltage of 0.642 V, high mobility of $35\,cm^2 \cdot v^{-1} \cdot s^{-1}$ and average subthreshold swing of 127.84 mV/dec. A commercial TCAD simulation tool ATLAS from Silvaco^{TM} is used to investigate all the parameters for considered structures.

Keywords: single active layer (SAL), dual active layer (DAL), double-gate dual active layer (DG-DAL), InGaZnO (IGZO), InSnO (ITO), thin-film transistor (TFT), $HfO_2/La_2O_3/HfO_2$ (HLH).

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