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# Influence of oxygen-content on the characteristics in amorphous InGaZnO TFT-based Temperature Sensors

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Amorphous indium-gallium-zinc-oxide (a-IGZO) thin-film transistor (TFT) is promising device in wearable/IoT applications due to adequate advantages such as low temperature process, fair mobility, large-area uniformity, compatibility with the integration on flexible/stretchable substrates [1]. Although a-IGZO TFT-based temperature sensors using a temperature (T)-dependent threshold voltage ($V_T$) have been proposed [2], the influence of oxygen-content on the T-dependency of device characteristics has been seldom quantitatively analyzed. In this work, the effect of oxygen-content on the characteristics of a-IGZO TFT-based temperature sensors is quantitatively investigated. The oxygen-content in a-IGZO active thin-film is varied by modulating the oxygen flow rate (OFR) during the sputter-deposition, such as Ar:$O_2$=35:21 and 35:63 sccm. Initial $V_T$ in case of OFR=21 is lower than that of OFR=63 due to higher density of oxygen vacancies [Fig. 1(a)]. It is also found that in case of OFR=21, the current at the same overdrive voltage is more sensitive to T and shows a better linearity with T than that of OFR=63 [Fig. 1(b)]. The linear relationship between the resistance (R) of a-IGZO TFT and T is very important in terms of temperature sensor applications. In order to breakdown the effect of oxygen-content on the linearity between R and T, the T-dependencies of $V_T$ [Fig. 1(c)] and field-effect mobility $\mu_{FE}$ [Fig. 1(d)] are investigated. The $V_T$ is more sensitive to T in case of OFR=21 rather than 63. It is worthwhile to note that the linearity of $\mu_{FE}$ to T is broken in high temperature only in the case of OFR=63 [Fig. 1(d)]. It is due to the trap-limited conduction associated with the localized tail states, whose density is higher in case of OFR=63 resulting from more acceptor-like tail states near conduction band minimum [3]. Our result is potentially useful in the design and optimization of a-IGZO TFT-based temperature sensors.

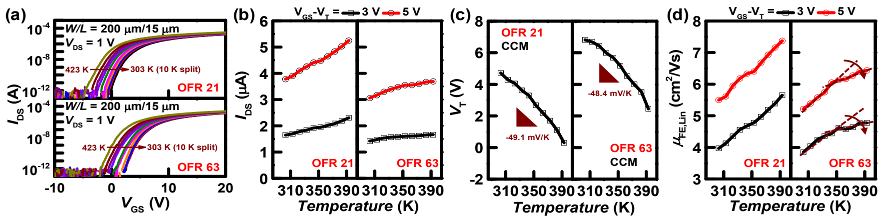


**Fig. 1.** The temperature-dependences of (a) transfer characteristics, (b) drain current, (c) $V_T$ and (d) mobility.

**Reference**

[1] K. Nomura, et. al., *Nature*, vol. 432, p. 488, (2004), [2] H. Jeong, et. al., *IEEE Electron Device Letters*, vol. 34, no. 12, pp. 1569-1571, (2013), [3] S. Lee, et. al., *Scientific Reports*, vol. 5, no. 13467, (2015).

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