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Ionic liquid gated IGZO thin film field effect transistors PUSHPA RAJ PUDASAINI, JOO HYON NOH, ANTONY WONG, AMANDA VICTO HAGLUND, Department of Materials Science & Engineering, University of Tennessee, Knoxville, SHENG DAI, Chemical Sciences Division, ORNL, THOMAS ZAC WARD, Materials Science and Technology Division, ORNL, DAVID MANDRUS[1], PHILIP D. RACK[2], Department of Materials Science & Engineering, University of Tennessee, Knoxville — Ionic liquid gated field effect transistors have been extensively studied due to their low operation voltage, ease of processing and the realization of high electric fields at low bias voltages. Here, we report ionic liquid (IL) gated field effect transistor based on amorphous Indium Gallium Zinc Oxide (IGZO) thin film active layers. Conveniently, our device structure includes a conventional bottom gate SiO_2 insulator so the transfer characteristics of the IL could be directly compared to an equivalent 100 nm thick SiO_2 gate insulator. The transport measurement of the IL revealed the intrinsic n-channel property of the IGZO thin film with high ON/OFF ratio $\sim 10^5$ and a large field effect electron mobility of 2.54 $cm^2V^{-1}S^{-1}$ at 300K and a threshold voltage of 0.1V. Comparable measurements on the bottom SiO_2 gate insulator revealed an ON/OFF ratio $\sim 10^9$ and field effect electron mobility of 5.24 $cm^2V^{-1}S^{-1}$ and a threshold voltage of 4.0V. Interestingly, temperature dependent measurements revealed that the ionic liquid electric double layer can be "frozen-in" when dropped below the glass transition temperature which could lead to new switching and possibly non-volatile memory applications.

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