Capacitance-Voltage Technique for Extraction of Intrinsic Subgap DOS in AOS TFTs with Bias-Dependent Channel Conduction Factor Model

Hyunjun Choi, Hagyoul Bae, Jaeyeop Ahn, Jun Seok Hwang, Jungmin Lee, Sung-Jin Choi,
Dae Hwan Kim, and Dong Myong Kim
School of Electrical Engineering, Kookmin University, Seoul 136-702, Korea
E-mail : dmkim@kookmin.ac.kr

For consistent characterization and modeling of amorphous oxide semiconductor TFTs, extraction of the subgap density-of-states (DOS) over the bandgap (E_V<E<E_C) is very important for electrical properties and long-term instability [1]. When extracting the subgap DOS per unit volume through the capacitance-voltage (C-V) measurement, it is necessary to normalize the result by the effective volume considering the metallurgical channel length (L_m), the width (W), and the active layer thickness (T_{IGZO}) regardless of the gate voltage [2]. However, the minimum total capacitance under V_G(<<V_{OFF} (V_{OFF} as the cut-off voltage)) strongly depends on the configuration and the active region is partially conductive or fully depleted by the gate bias. On the other hand, the maximum total capacitance is independent of the configurations for the C-V measurement. Therefore, the normalization should be performed by the V_G-dependent effective volume (υ_{eff}) considering the conductivity of the active region. Consequently, these approaches improves the accuracy of the extracted subgap DOS and robust characterization and modeling of TFTs.

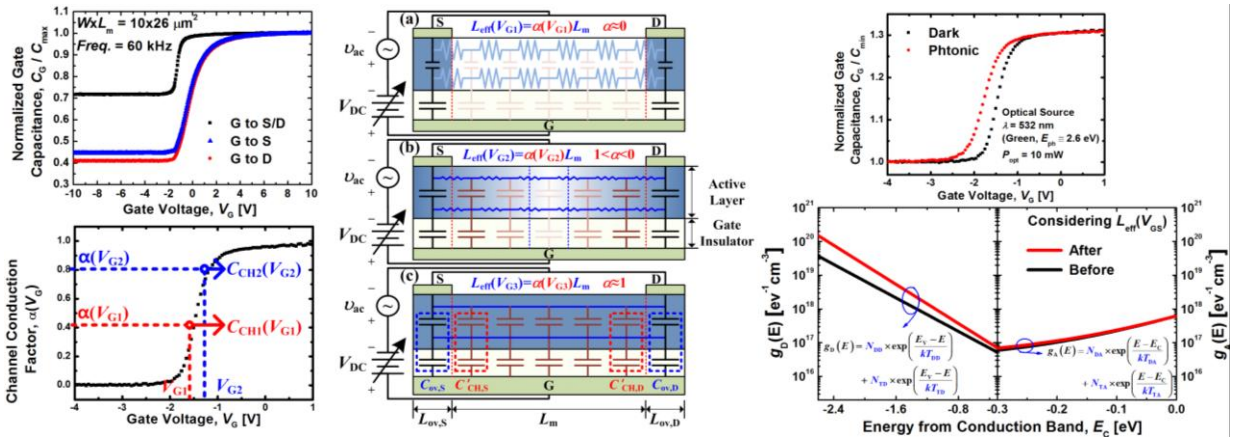

Fig 1. C-V characteristics, proposed model, distributed model and its electrical data

[1] H.-H. Hsieh, T. Kamiya, K. Nomura, H. Hosono, and C.-C. Wu, Appl. Phys. Lett., vol. 92, no. 13, p. 1335 (2008).
[2] H. Bae, S. Jun, H. Choi, C. Jo, Y. H. Kim, J. S. Hwang, J. Ahn, D. H. Kim, and D. M. Kim, SID Symp. Digest of Tech. Papers, vol. 44, no. 1, pp. 1033-1036 (2013).