UNIVERSITY OF CAMBRIDGE

HETERO–GENESYS LABORATORY

Carrier Transport in Amorphous Oxide Semiconductor Thin Film Transistors

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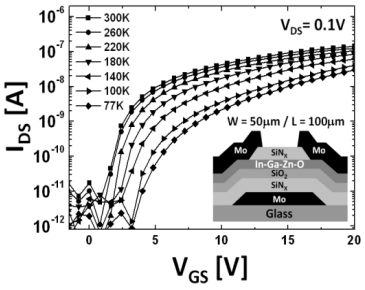
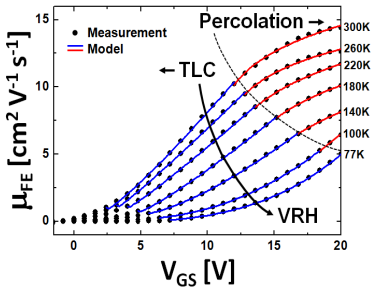
Introduction

- TLC and Percolation dominant at high temperatures, depending on gate bias.
- VRH prevalent at low temperatures, showing a linear signature in $T^{-1/4}$.

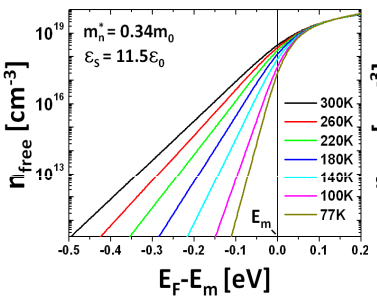
Results and Discussions

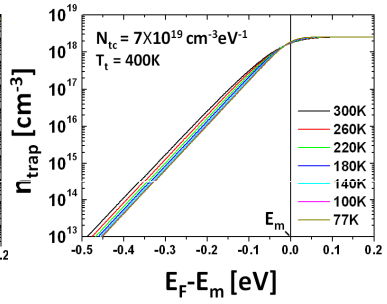
- I-V and field effect mobility:

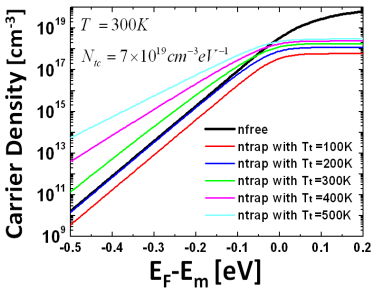


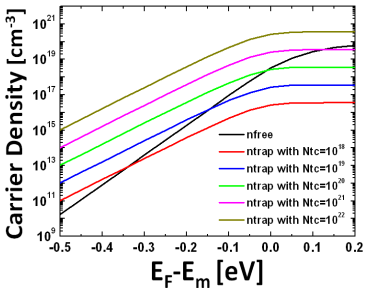


- Carrier densities in different temperatures:

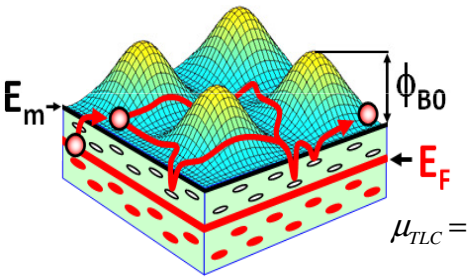






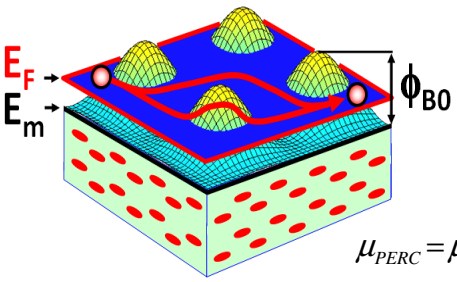


- Illustration of TLC, Percolation, and VRH:



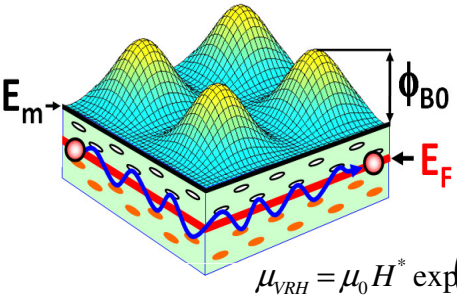
for a low V_{GS} at high temperatures

$$\mu_{TLC} = \mu_b^* A^* (V_{GS} - V_T)^{2(T_t/T-1)}$$



for a high V_{GS} at high temperatures

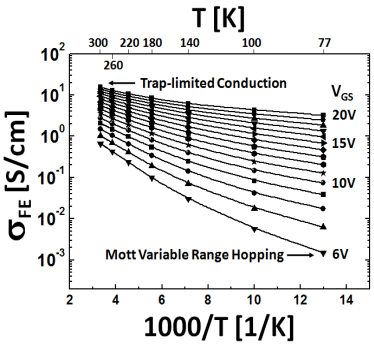
$$\mu_{PERC} = \mu_b^* B^* (V_{GS} - V_P)^{4[(D-W)/D]}$$

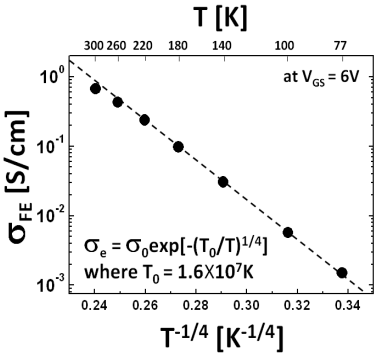


for a low V_{GS} at low temperatures

$$\mu_{VRH} = \mu_0 H^* \exp\left(-(T_0/T)^{1/4}\right)(V_{GS} - V_{FB})^{\gamma}$$

- Conductivity and VRH signature:





Conclusion

- Results provide a key analytical insight into electron transport and mobility in AOS TFTs, capturing the relative dominance of trap limited conduction, percolation, and variable range hopping.

Related Publications:

- Sungsik Lee *et al.*, ***Applied Physics Letters*** 98(20), 203508 (2011).
- Sungsik Lee *et al.*, ***IEEE IEDM*** (2011).