Modeling electrical characteristics of thin-film field-effect transistors

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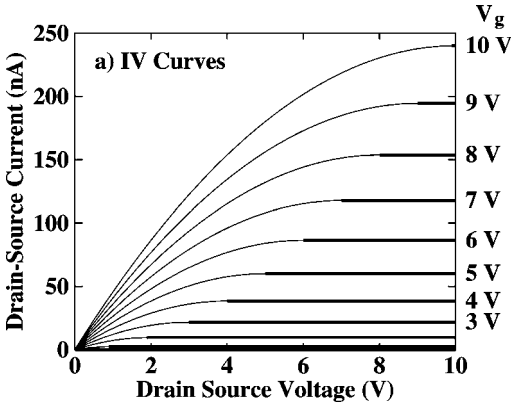
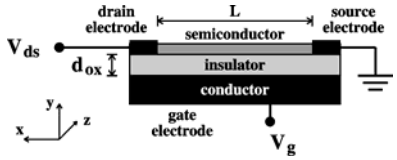
A new model for thin-film field effect transistors working in accumulation is presented. The basic assumption of the model is that the active layer of semiconducting material is treated as purely two-dimensional. In fact, as long as the devices are working in accumulation, the model is also applicable to thick (MOS-FET) transistors.
In the first step, the model is described and it is shown how it results in the same basic equations as the MOS-FET model [1], conventionally used for TFTs [2]. The difference is in the parameter extraction. As an example, the model does not need acceptors or donors; hence, the subthreshold current does not represent the doping concentration. The effects of resistive areas or Schottky diodes at the contacts are analyzed. It is shown how these can distort the electrical characteristics.
The threshold voltage is discussed, as well as the sub-threshold current.
Finally, ambipolar devices are presented and it is shown how the curves are substantially different from unipolar devices.





Above: Cross-section of a TFT used for the model. The semiconductor layer is two-dimensional.
Left: Simulation of typical Ids-Vds curves.

[1] S. M. Sze, "Physics of semiconductor devices", 2nd edition, Wiley Interscience, (1981).
[2] G. Horowitz, Adv. Mat. **10**, 365 (1998).