UAlg:FCT – INESC:MN

“Metal-active-layer TFT”

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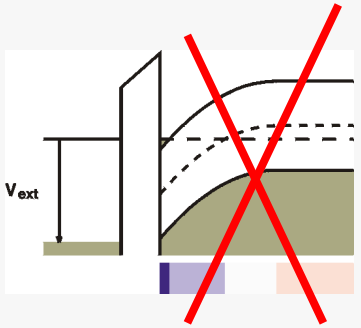
Why a TFT is not a MOS-FET

A TFT is made of a **thin** film and cannot accommodate band bendings.

A TFT normally works in **accumulation** and thus cannot store the immobile charge needed for band bendings (there are no electronic states, N_D^+).



There **are** no band bendings!

Not even in thick film transistors! Not even at contacts!

All bias-induced charge is free charge, adjacent to the interface

The Algarve Model

One single simple axiom:

Any charge induced by the gate is at the interface

The device is purely **two-dimensional**

The device is a like a metal-plates capacitor

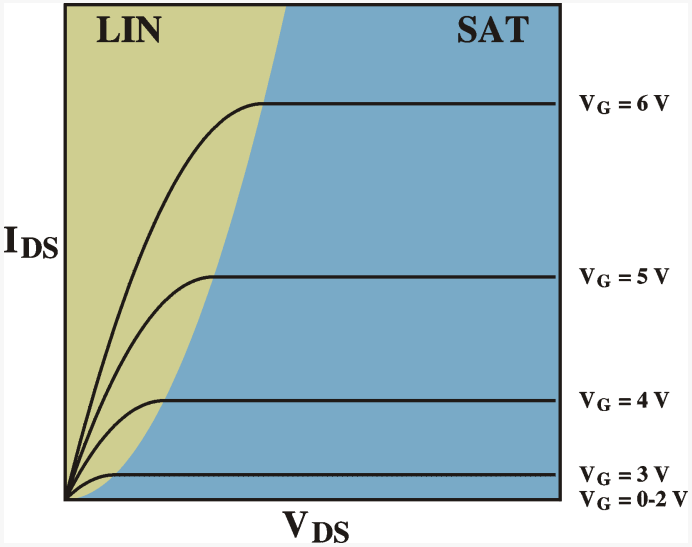
$$Q = C\,V$$

$$Q(x) = q\,p(x) = C_{ox}[V(x)\text{-}V_g]$$

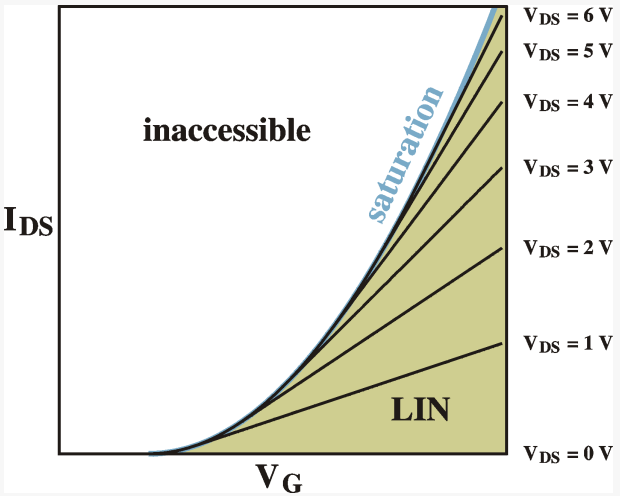
$$I(x) = W\,q\,p(x)\,\mu\,[-\mathrm{d}V(x)/\mathrm{d}x]$$

The Algarve Model TFT curves

IV curves



transfer curves



LIN: $I_{DS} = \mu\,(W/L)\,C_{ox}\,V_G \square V_{DS}$

SAT: $I_{DS} = \frac{1}{2}\,\mu\,(W/L)\,C_{ox}\,V_G^{\,2}$

Organic TFTs behave like MOS-FETs

IV: Metal TFT

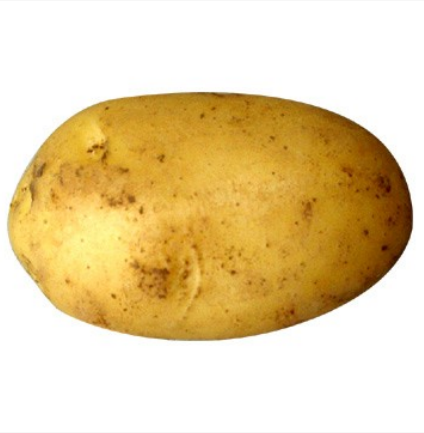
“If what you are saying is correct, we can use other materials as well for TFTs”

Yes! Since doping is not essential.

As long as the mobility of the charges is high enough

As long as the charges have a barrier going (leaking) to the gate

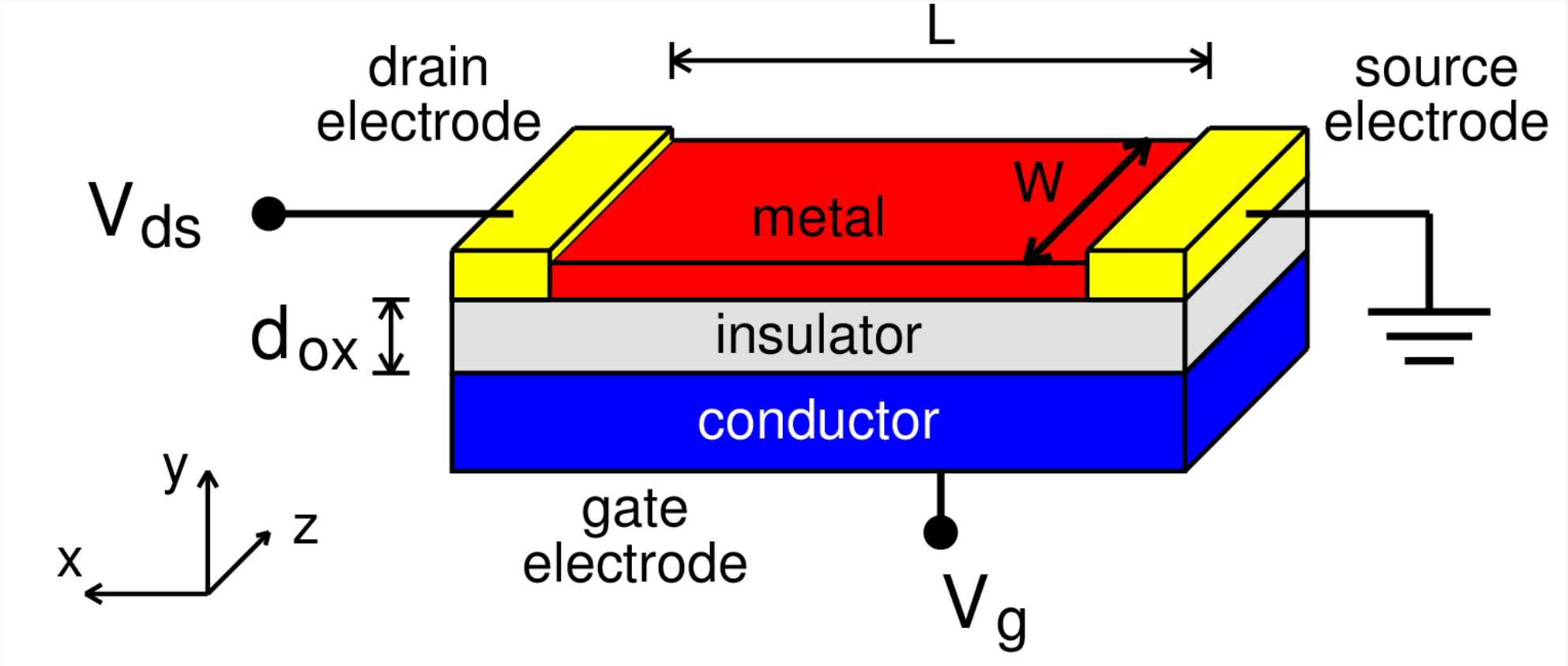
Any semiconductor will do. Wait, any material will do. Even a potato!



Even a metal will do!

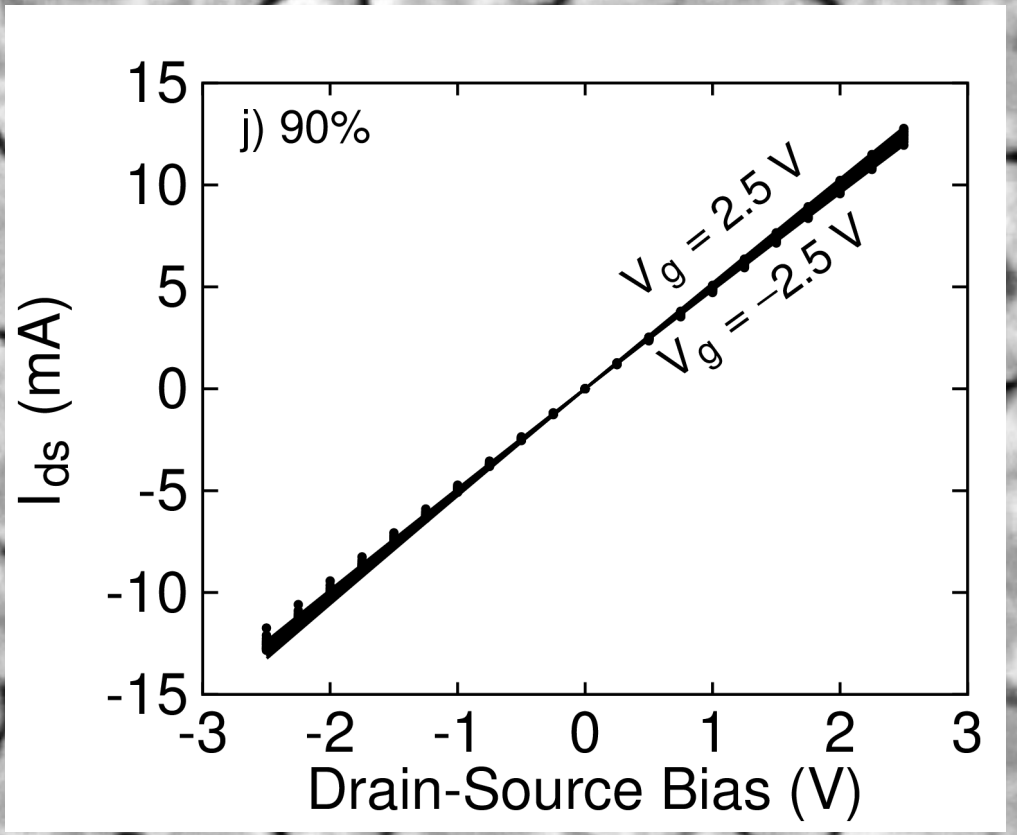
I'll show you!

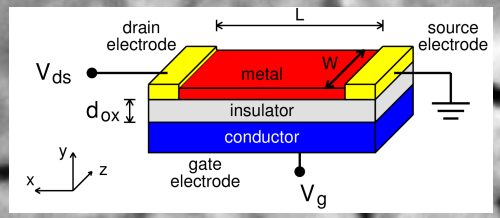
IV: Metal TFT

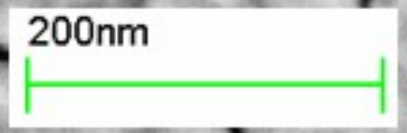

L
drain
electrode
source
electrode
V ds
metal
W
d ox
insulator
conductor
y
z
x
gate
electrode
V g

IV: Metal TFT

i) 90%

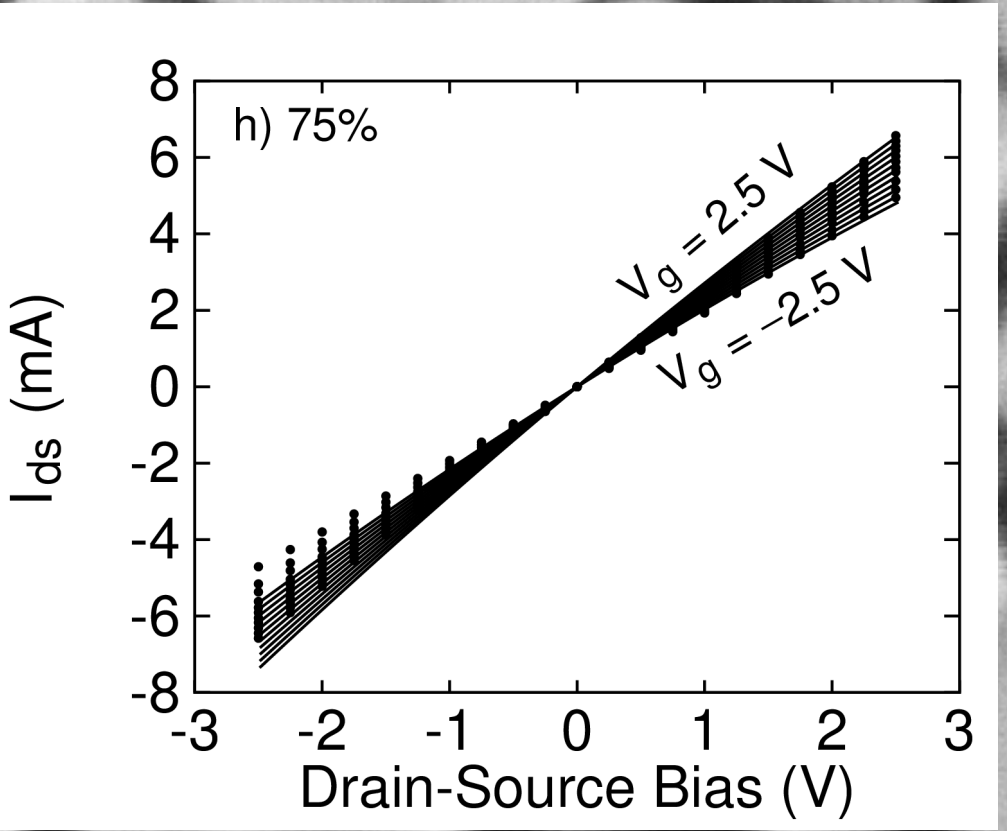


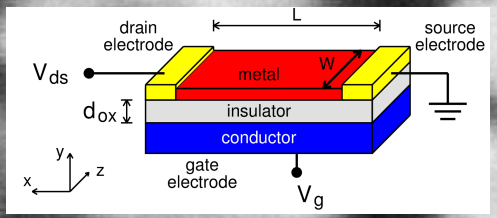




IV: Metal TFT

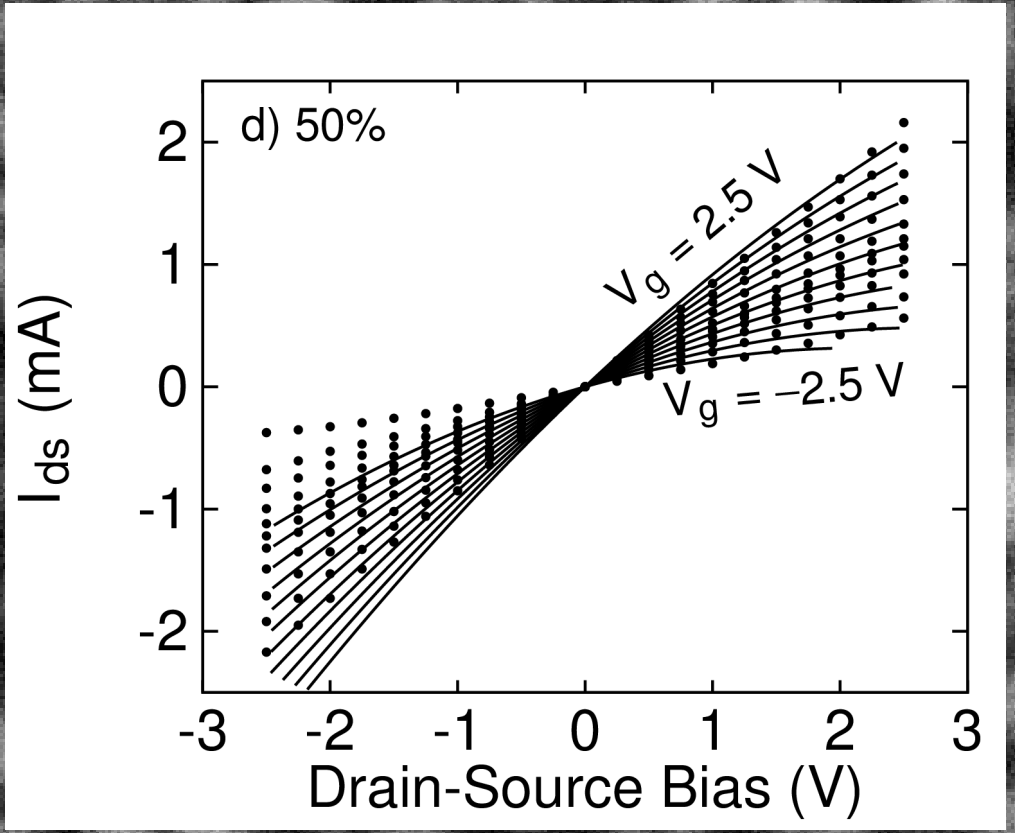
g) 75%

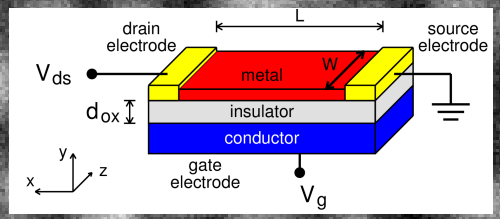


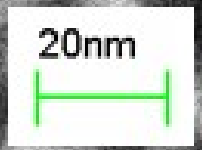


IV: Metal TFT

c) 50%

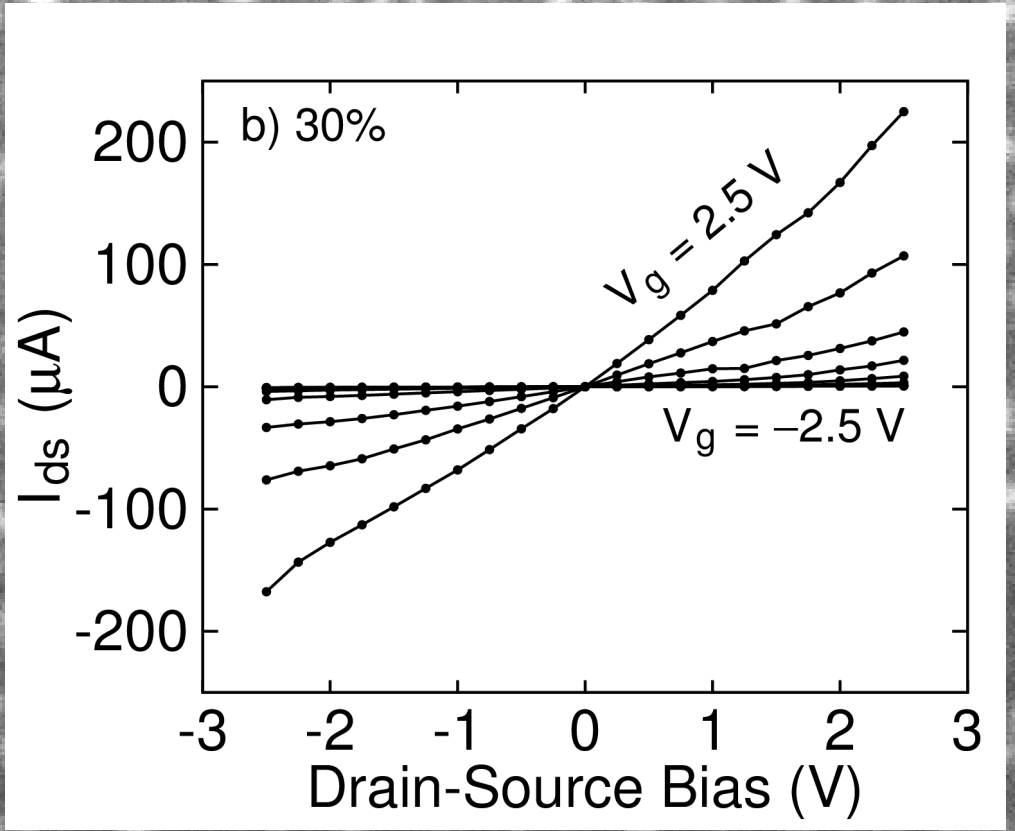


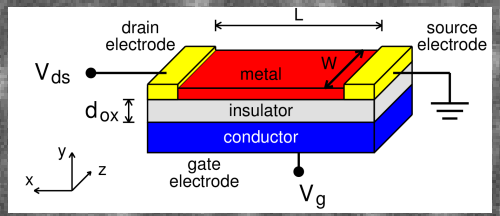


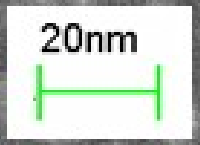


IV: Metal TFT

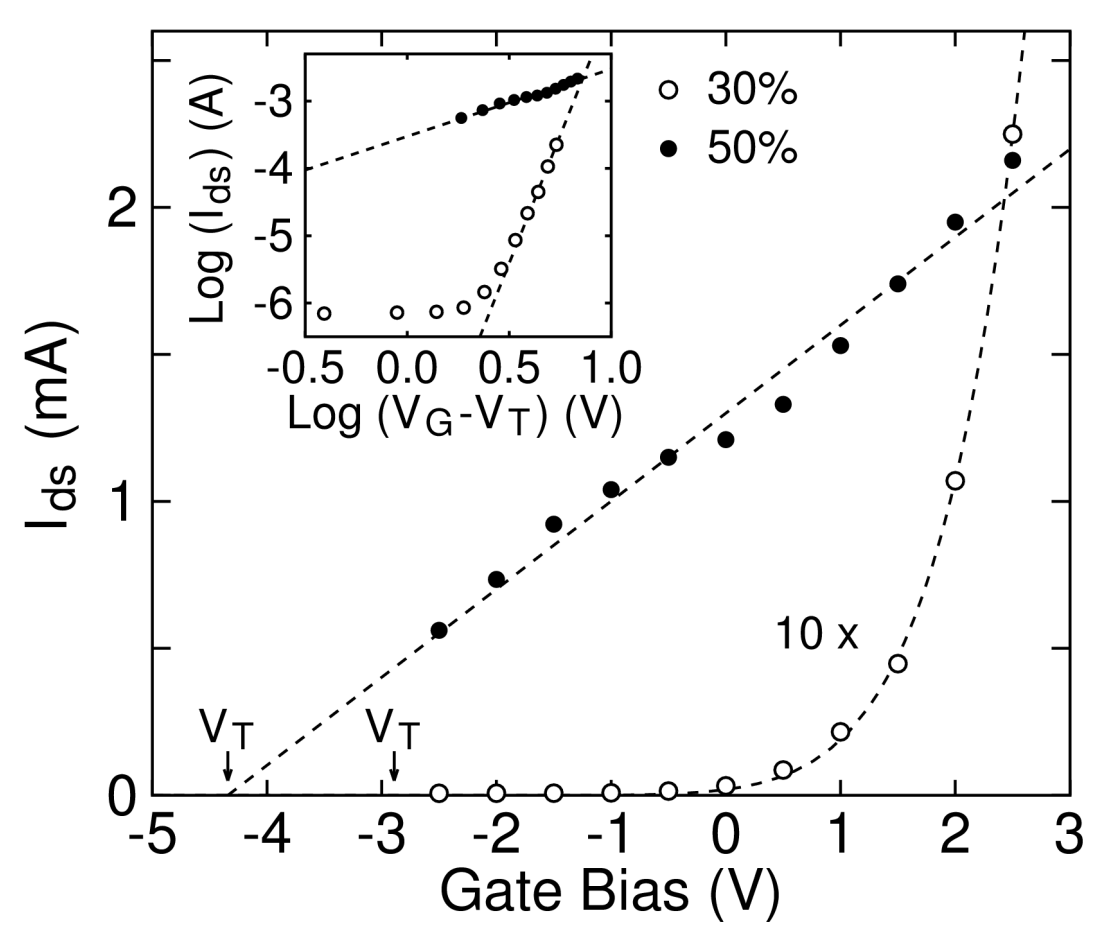
a) 30%





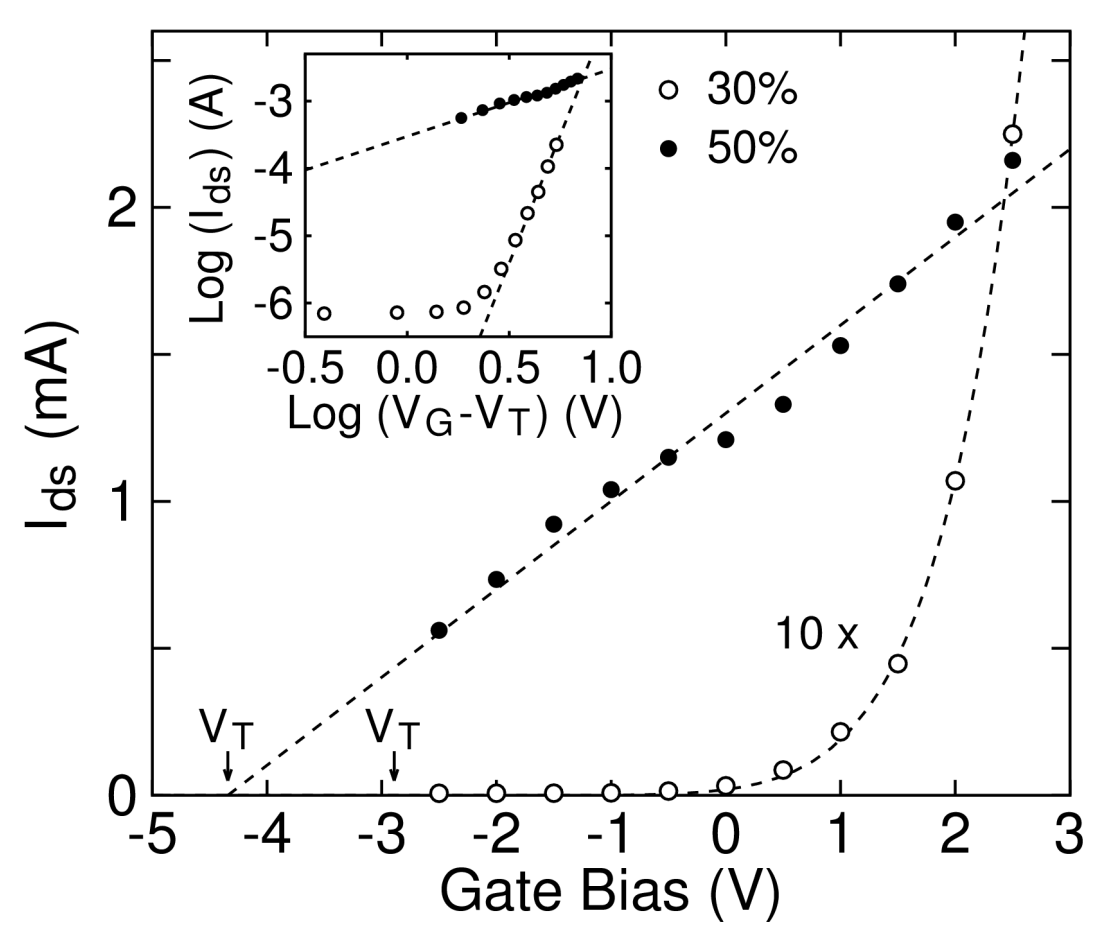


IV: Metal TFT
Transfer Curves



$$I_{ds} = \mu C_{ox} (W/L) V_{DS} (V_{GS} - V_T)^{\alpha}$$

IV: Metal-layer TFT
Fast electronics?



$$f_T = \frac{g_m}{2\pi C_{gs}} = \frac{\partial I_{ds}/\partial V_{gs}}{2\pi W L C_{ox}}$$

should be orders of magnitude faster than state-of-the-art silicon technology MOS-FET transistor

$(V_{gs}$-$V_T)$ [V]	f_T/f_{TMOS}
1	0.01
2	5
2.5	30
3	100

Bastos, submitted Electr. Lett. 2010