EDA/CAD FOR NANOELCTRONICS 2020/21

M. Helena Fino

Eda/CAD for Nanoelectronics

- We will start preparing the second evaluation project
- The project will focus on TFTs – Thin Film Transistors
  - Modeling
    - Model 1
    - Model 2
  - Parameter extraction
- We will develop our work using measurements on devices implemented at the Materials Department

- **Model 1**

$$I_D = \begin{cases} 0 & \leftarrow & V_{gs} < V_t \\ \mu_{ef} C_i \dfrac{W}{L}\left(V_{gs} - V_t - \dfrac{V_{ds}}{2\alpha}\right) V_{ds} & \leftarrow & V_{gs} > V_t \land V_{ds} < \alpha\left(V_{gs} - V_t\right) \\ \mu_{ef} C_i \dfrac{W}{L}\left(V_{gs} - V_t\right)^2 \left(\dfrac{\alpha}{2}\right) & \leftarrow & V_{gs} > V_t \land V_{ds} \geq \alpha\left(V_{gs} - V_t\right) \end{cases}$$

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- **Model 1** [1]

$$I_D = \begin{cases} 0 & \leftarrow & V_{gs} < V_t \\ \mu_{ef} C_i \dfrac{W}{L}\left(V_{gs} - V_t - \dfrac{V_{ds}}{2\alpha}\right) V_{ds} & \leftarrow & V_{gs} > V_t \wedge V_{ds} < \alpha\left(V_{gs} - V_t\right) \\ \mu_{ef} C_i \dfrac{W}{L}\left(V_{gs} - V_t\right)^2 \left(\dfrac{\alpha}{2}\right) & \leftarrow & V_{gs} > V_t \wedge V_{ds} \geq \alpha\left(V_{gs} - V_t\right) \end{cases}$$

$$\mu_{ef} = \mu_0 \left(\frac{V_{gs} - V_t}{V_{AA}}\right)^{\gamma}$$

[1]P. Servati, D. Striakhilev and A. Nathan, "Above-threshold parameter extraction and modeling for amorphous silicon thin-film transistors," in IEEE Transactions on Electron Devices, vol. 50, no. 11, pp. 2227-2235, Nov. 2003, doi: 10.1109/TED.2003.818156.

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- **Model 1**

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$$\mu_{ef} = \mu_0 \left(\frac{V_{gs} - V_t}{V_{AA}}\right)^{\gamma}$$

$$I_{D\_sat} = \mu_0 \frac{C_i}{V_{AA}^{\gamma}} \frac{W}{L}\left(V_{gs} - V_t\right)^{2+\gamma} \left(\frac{\alpha}{2}\right)$$

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- **Model 1**
  a) **Read Measurements files:**
     1. **Id(Vgs) in transfer in saturation**
     2. **Plot Id(Vgs)**
     3. **Id(Vds) output characteristics for severa**
     4. **Plot Id(Vds) for several Vgs**

  b) **Obtain model parameters K_{sat}, V_t, m, γ, λ ($Id=I_{D\_sat}(1+\lambda.vd)$**

$$I_{D_{sat}} = K_{gsat}\frac{W}{L}\left(V_{gs}-V_t\right)^m$$

$$I_{D\_sat} = \mu_0\frac{C_i}{V_{AA}^{\gamma}}\frac{W}{L}\left(V_{gs}-V_t\right)^{2+\gamma}\left(\frac{\alpha}{2}\right)$$

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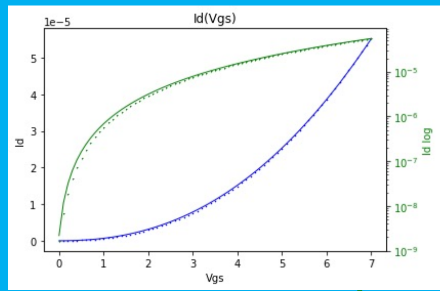
- **Model 1**
  - a) **Read Measurements files:**
    1. Id(Vgs) in transfer in satu
    2. Plot Id(Vgs)
    3. Id(Vds) output characteristi
    4. Plot Id(Vds) for several Vgs
  - b) Obtain model parameters K_{sat}, V_t, m, γ (Id=I_{D_sat}(
  - c) Plot Id(Vgs) from the model, again Id from measurements
  - d) Repeat c) in logaritmic scale
  - e) Repeat all for W/L= 50/05; 50/10; 50/20
  - f) Derive conclusions on the scalability of the model



$$gs - V_t)^m$$

$$I_{D\_sat} = \mu_0 \frac{C_i}{V_{AA}^{\gamma}} \frac{W}{L} \left(V_{gs} - V_t\right)^{2+\gamma} \left(\frac{\alpha}{2}\right)$$