

Simulation Report 2

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Codes for data processing:

https://github.com/yifuhhh/EE396V_TFT/blob/master/DataProcess/Project_2.py

Script for one of the bulk trap sweeps:

https://github.com/yifuhhh/EE396V_TFT/blob/master/Prj_2/prg_2_bulkshallow/TFT_bulkshallow.in

Script for channel length sweep:

https://github.com/yifuhhh/EE396V_TFT/blob/master/Prj_2/prg_4_channel/TFT_channel.in

Section I

1. Interface trap peak density

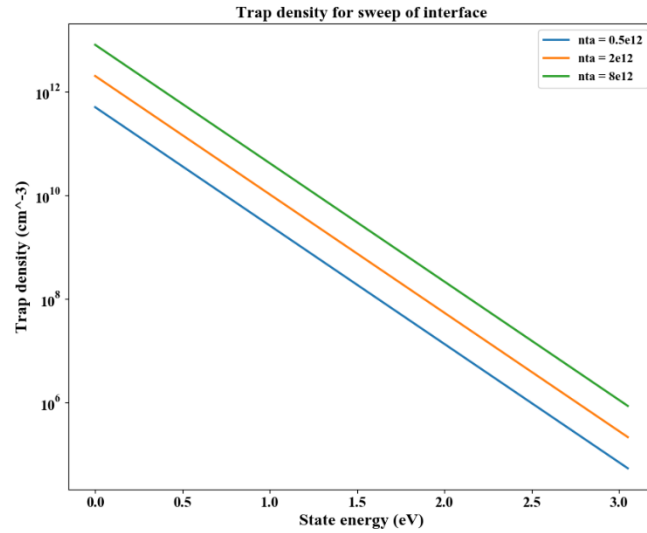


Figure 1.1 Trap density of states for sweep of interface trap

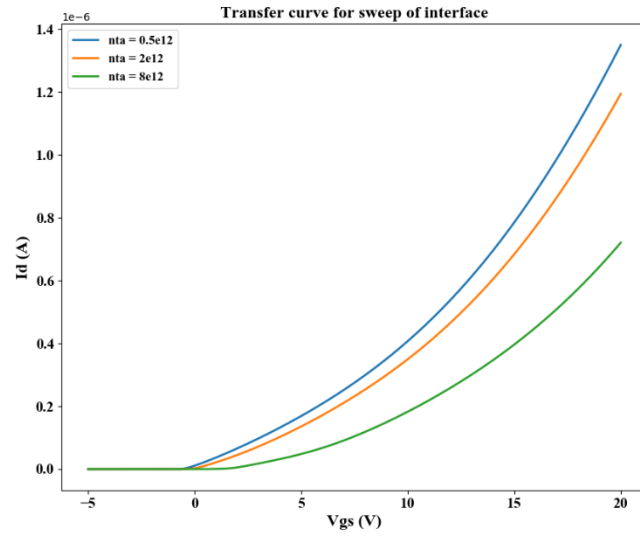


Figure 1.2 Transfer curve for sweep of interface trap, linear scale

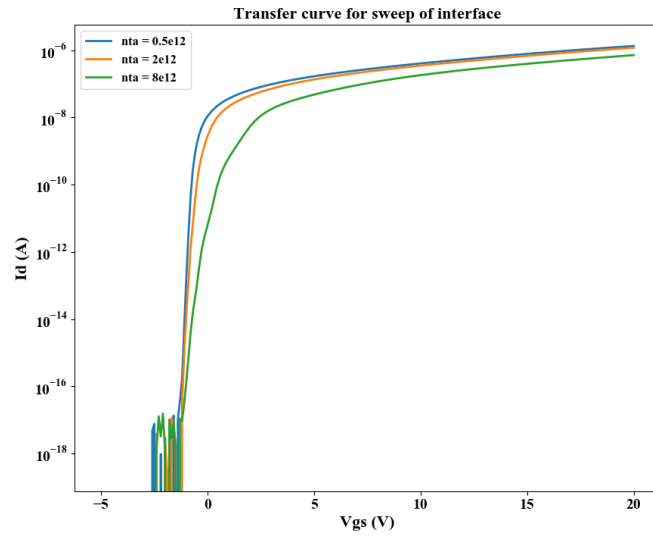


Figure 1.3 Transfer curve for sweep of interface trap, log scale

From Fig 1.2 and 1.3, it is observed that when the density of acceptor-like states in the tail distribution at the conduction band edge in interface increases, I_d would decrease at the same V_{gs} .

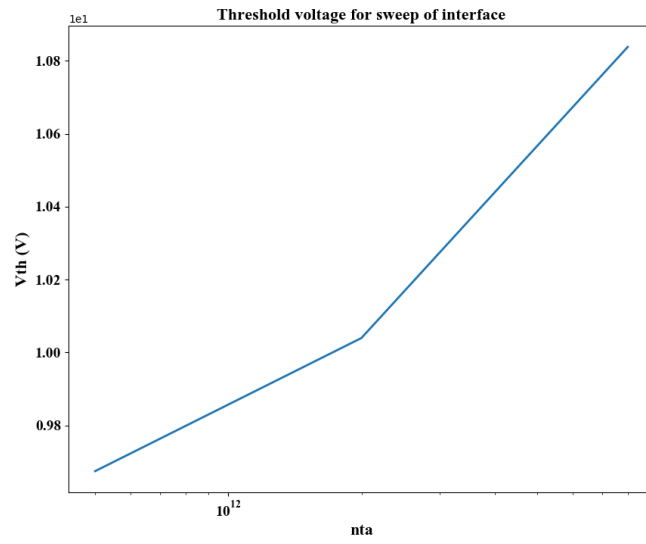


Figure 1.4 Threshold voltage for sweep of interface trap

From Figure 1.4, it is observed that V_{th} increases as the density of acceptor-like states in the tail distribution at the conduction band edge in interface increases.

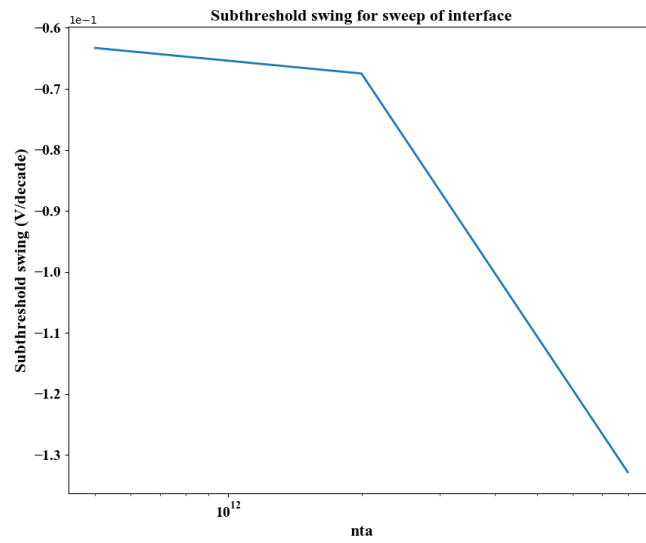


Figure 1.5 Subthreshold swing for sweep of interface trap

From Figure 1.5, it is observed that subthreshold swing decreases as the density of acceptor-like states in the tail distribution at the conduction band edge in interface increases.

2. Bulk shallow trap peak density

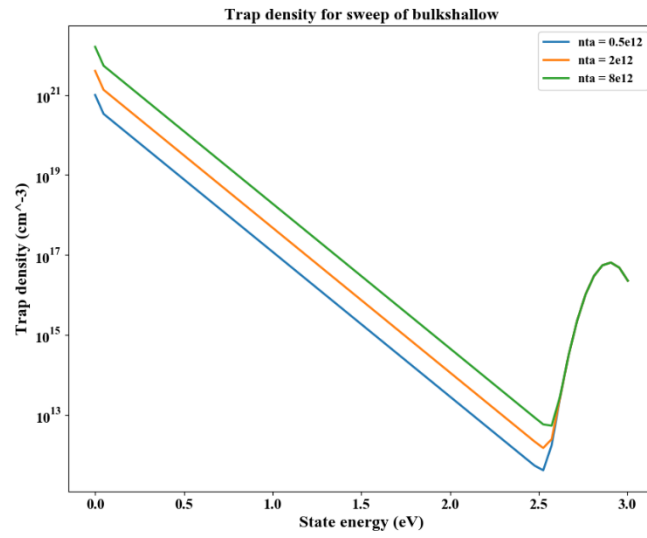


Figure 2.1 Trap density of states for sweep of bulk shallow trap

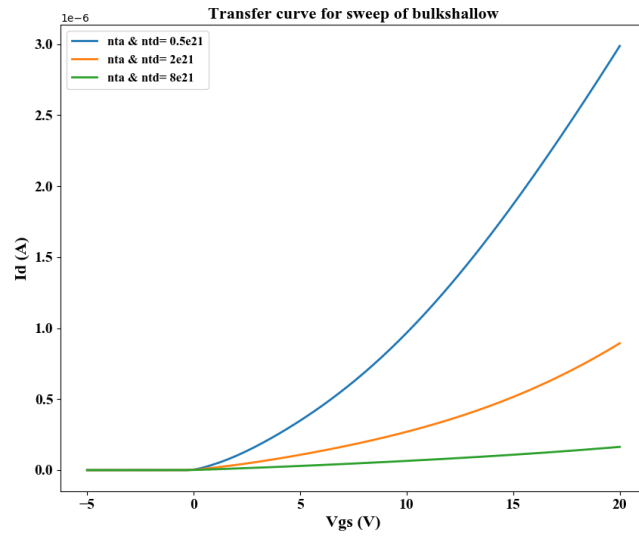


Figure 2.2 Transfer curve for sweep of bulk shallow trap, linear scale

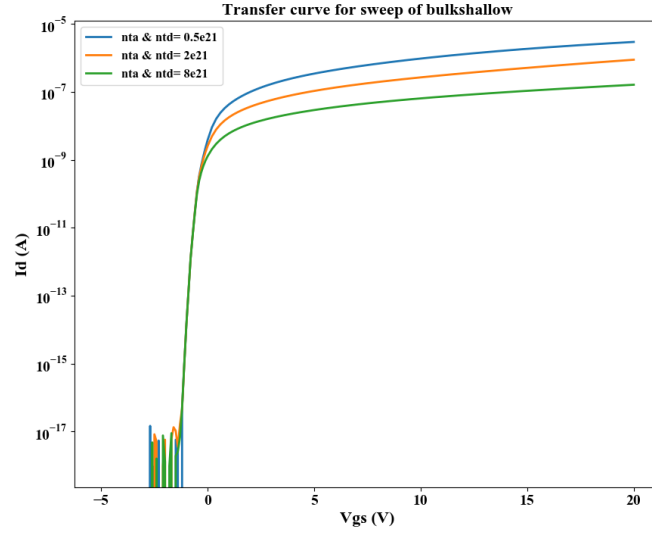


Figure 2.3 Transfer curve for sweep of bulk shallow trap, log scale

From Fig 2.2 and 2.3, it is observed that when the density of acceptor-like and donor-like states in the tail distribution at the conduction band edge in shallow bulk increases, I_d would decrease at the same V_{gs} when $V_{gs} > 0$.

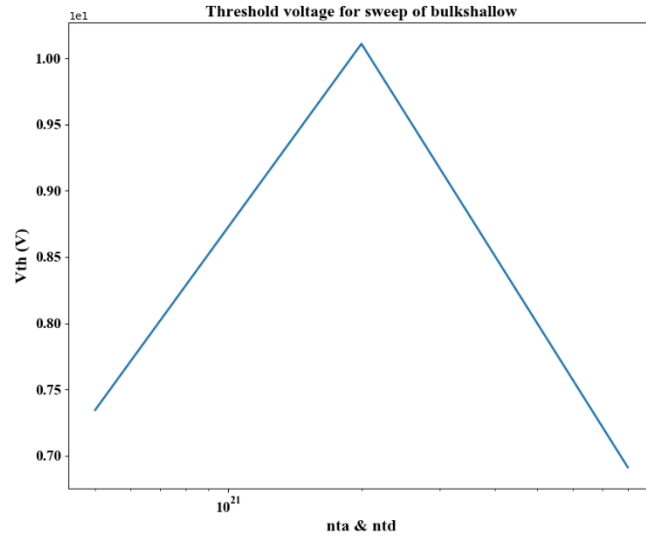


Figure 2.4 Threshold voltage for sweep of bulk shallow trap

From Figure 2.4, it is observed that V_{th} gets maximum at $NTA \& NTD = 2e21 \text{ cm}^{-3}/\text{eV}$. However, it is not consistent with the trend in Figure 2.2. The main reason for this phenomenon is that in our simulation, V_{gs} goes up to 20 V. To fully describe the transfer performance especially when $NTA \&$

NTD = $8 \times 10^{21} \text{ cm}^{-3}/\text{eV}$, V_{gs} has to increase more.

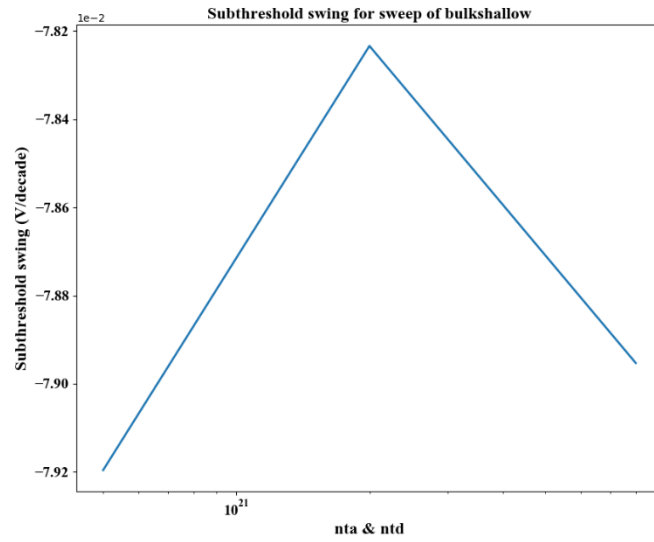


Figure 2.5 Subthreshold swing for sweep of bulk shallow trap

From Figure 2.5, it is observed that subthreshold swing (absolute value) gets minimum at NTA & NTD = $2 \times 10^{21} \text{ cm}^{-3}/\text{eV}$.

3. Bulk deep trap peak density

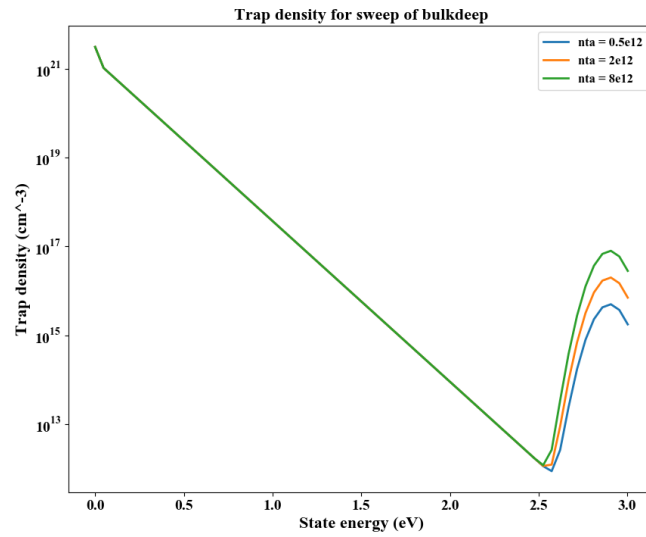


Figure 3.1 Trap density of states for sweep of bulk deep trap

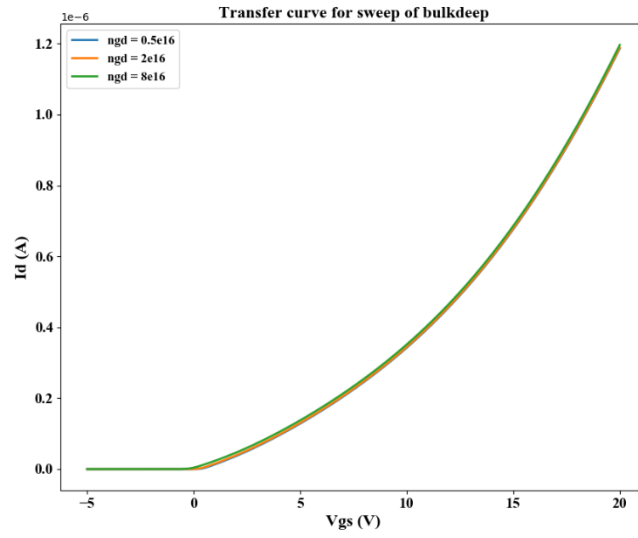


Figure 3.2 Transfer curve for sweep of bulk deep trap, linear scale

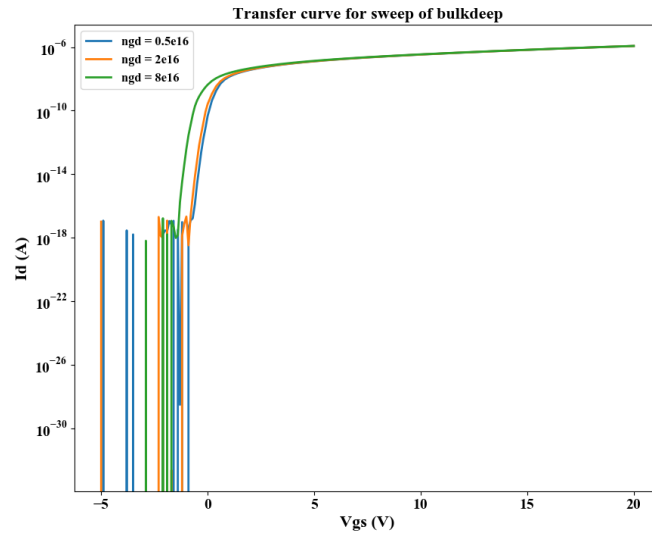


Figure 3.3 Transfer curve for sweep of bulk deep trap, log scale

From Fig 3.2 and 3.3, it is observed that when total density of donor-like states in a Gaussian distribution in the deep bulk increases, I_d would not be affected a lot when $V_{gs} > 0$ and I_d would decrease as NGD increases when $V_{gs} < 0$.

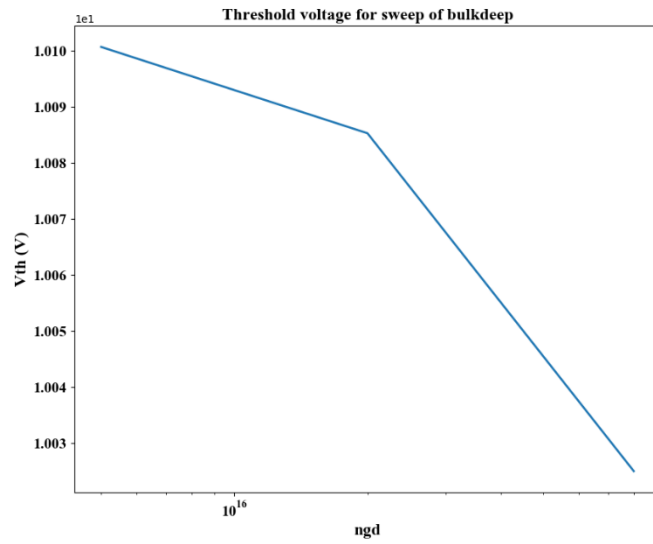


Figure 3.4 Threshold voltage for sweep of bulk deep trap

From Figure 3.4, it is observed that V_{th} decreases as NGD increases.

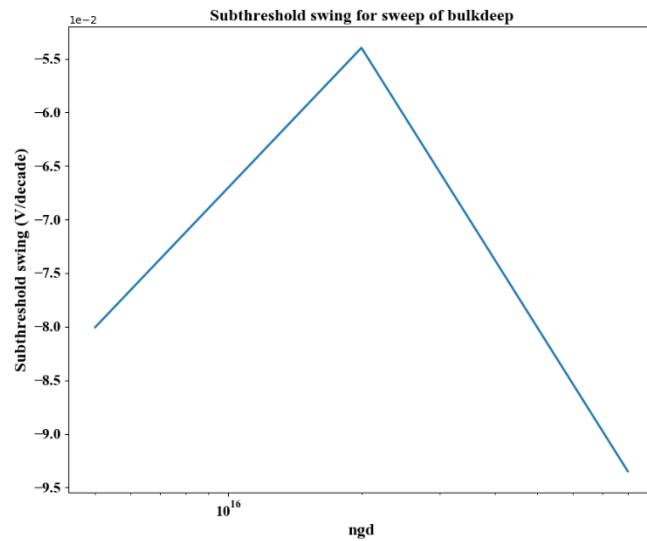


Figure 3.5 Subthreshold swing for sweep of bulk deep trap

From Figure 3.5, it is observed that subthreshold swing (absolute value) gets minimum at $NGD = 2e16 \text{ cm}^{-3}/\text{eV}$.

Section II

4. Channel length

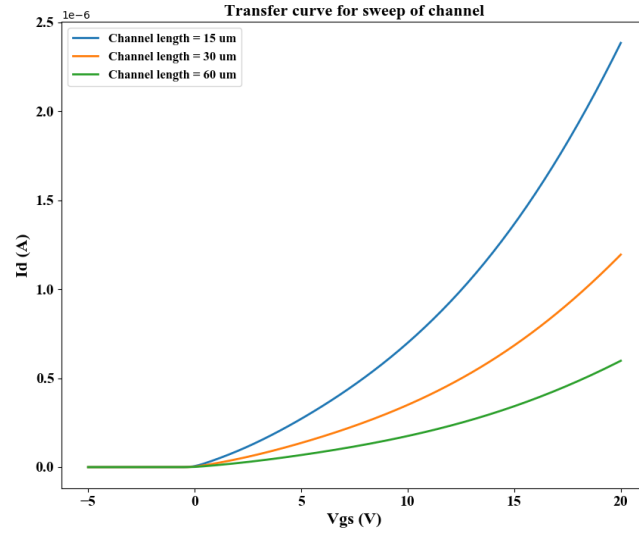


Figure 4.1 Transfer curve for sweep of channel length, linear scale

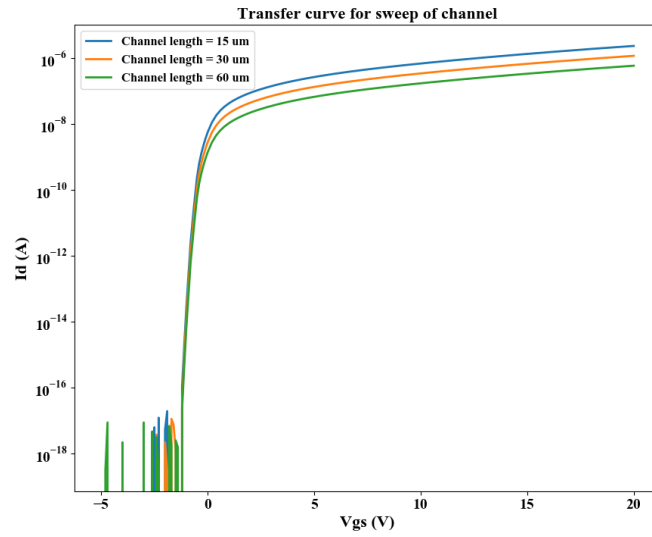


Figure 4.2 Transfer curve for sweep of channel length, log scale

From Fig 4.1 and 4.2, it is observed that when channel length increases, I_d would decrease at the same $V_{gs} > 0$.

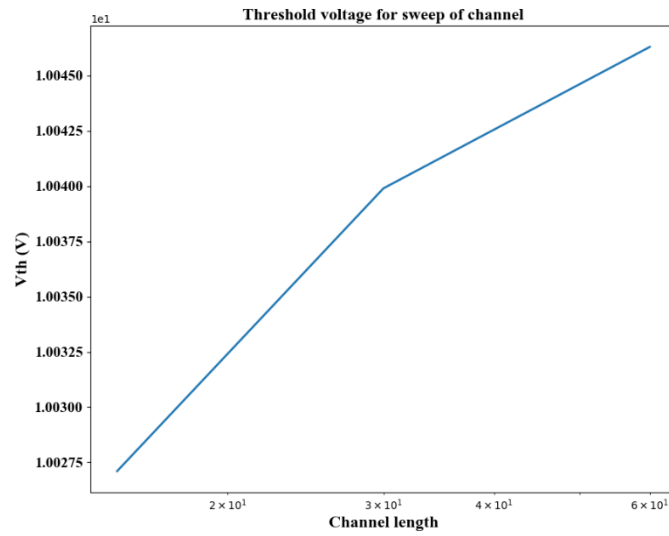


Figure 4.3 Threshold voltage for sweep of channel length

From Figure 4.3, it is observed that V_{th} increases as channel length increases.

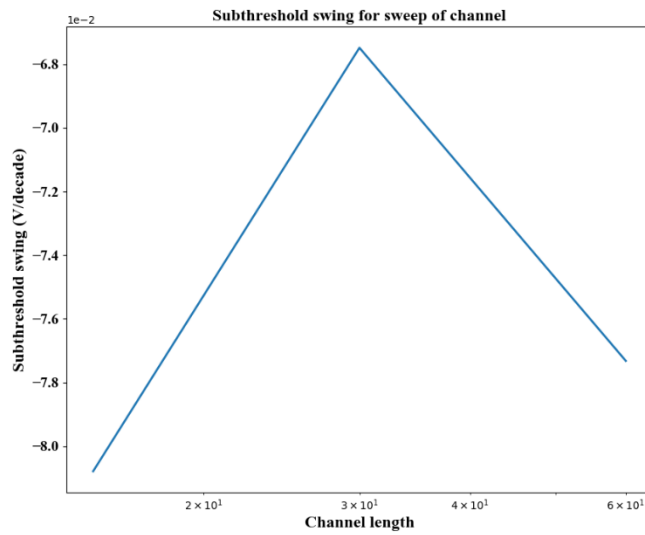


Figure 4.4 Subthreshold swing for sweep of channel length

From Figure 4.4, it is observed that subthreshold swing (absolute value) gets minimum at channel length = 30 μm .