Influence of structure parameter on Mg$_2$Si-Si Hetero-junction Tunneling FET

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**Introduction:** Tunnel FET (TFET) has more steep response on transistor transfer subthreshold region, the carrier injection mechanism is due to occupancy tunneling probability and breakthrough the ideal Subthreshold slope of thermal injection[1]. However, the drive current is lower than convensional type owning to tunneling injection at source-channel junction. To this issue, 3D structure[2] and hetero-junction by III-V material[3] has produced. The silicide semiconductor material has lower band gap and hetero-junction can decrease the Tunneling resistance owing to band gap and potential width and improve the drive current[4]. In this work, the influence of device structure and applied volatage for the TFET with Mg2Si/Si hetero-junction use simulation.

**Model description:** An n-type silicon MOS structure in an SOI with a thickness of 10 nm was used in the present simulation. The gate oxide thickness and the buried-oxide thickness (BOX) were set to be 0.3 and 40 nm, respectively, and the work function of the metal gate was set to be 4.3 eV.

**Results and discussion:** Figure 1 shows the $I_d$–$V_g$ characteristics of the TFET with Mg$_2$Si hetero-junction with $L_g$ of 100nm (a) and 20nm (b) with $N_d$ of 1 x10$^{17}$cm$^{-3}$. The drain voltage is taken as a parameter ranging from 0.1V to 1.0V. Although there is not much change in the characteristics in 100nm and 20nm, the reduction in the off leakage current by the lowering of the drain voltage is clearly observed in 20nm case. This is considered to be due to the reduction of the drain-induced tunneling width modulation observed especially in short $L_g$ devices. The tunneling width was increased by the lowering of drain voltage from 1.0 to 0.3V. Fig.2 shows the minimum SS as a function of the drain voltage. It should be noted that the on-state drain current is not changed much even when the drain voltage is reduced to as low as 0.3V.

**Reference:** 
[4] Y. Wu et al., IWDTF 2013 P-18