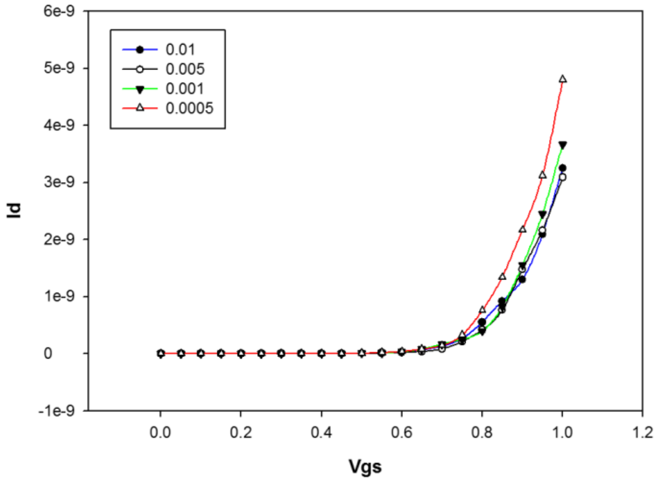

Figure 7: Transfer characteristics with SiO2 as dielectric

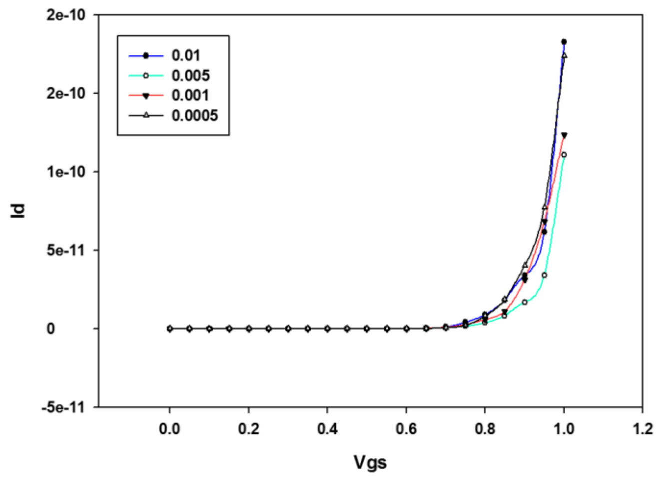

Figure 9: Transfer characteristics with HfO2 as dielectric

6. STBFET Simulation

Basic Sandwich tunnel barrier FET (STBFET) structure is shown in Fig. 10.

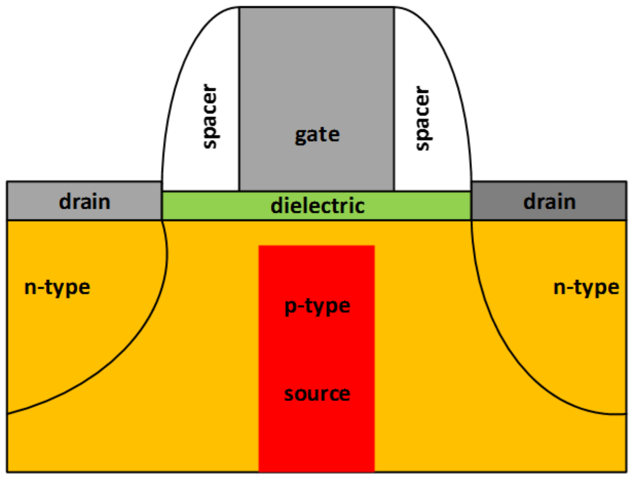

Figure 10: Basic STBFET structure

The modified structure of TFET, sandwich tunnel barrier FET (STBFET) [8] was designed as a scaled down version of TFET. The overall size of STBFET is low when compared to that of TFET. STBFET consists of a source region sandwiched in between two drain regions. The device parameters are given below. TCAD simulated structure of STBFET is shown in Fig. 11.

- Total device length: 0.23 μm
- Total device height: 0.119 μm
- Source doping: 2×10^{20} *per* cm^3
- Drain doping: 5×10^{19} *per* cm^3
- Substrate doping: 1×10^{13} *per* cm^3
- Gaussian doping depth: 0.01
- Gaussian doping factor: 0.8
- Dielectric: SiO_2

Transfer characteristics of STBFET is shown in Fig. 10. Fig. 11 gives the log plot for SS calculation of STBEFT. There was no variation in transfer characteristics when Gaussian doping depth of STBFET was varied. A very high ON current (1.4 μA) was obtained for STBFET when compared to that of planar TFET. Simulated values of electrical characteristics of STBFET are shown below.

- ON current (I_{ON}): 1.4 μA
- OFF current (I_{OFF}): 7.0 pA
- Threshold voltage (V_{th}): 0.76 V
- Subthreshold swing (SS): 36 mv/dec

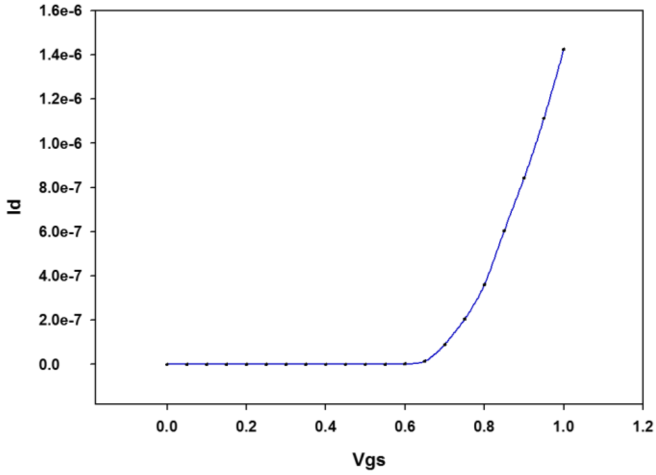

Figure 10: Transfer characteristics of STBFET

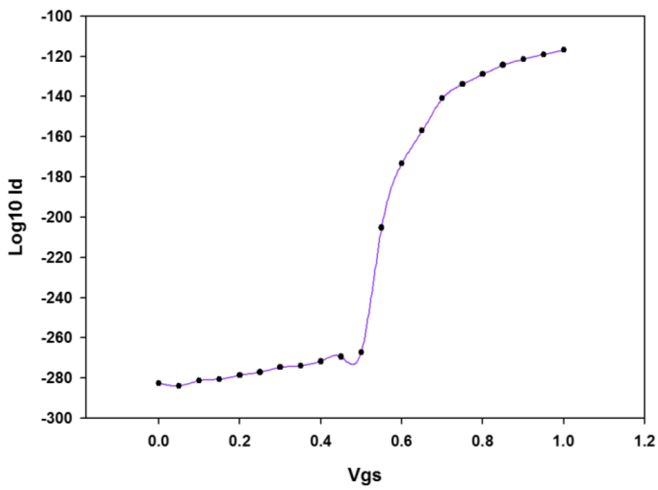

Figure 11: Log plot for SS calculation of STBFET

STBFET offered a very much low SS of 36 mv/dec compared to 42 mv/dec SS of TFET. This implies that, turn ON time of STBFET is less than that of TFET. A very high ON current obtained for STBFET shows that it is a promising candidate in the FET arena.

7. Conclusion

With the dimensions of dielectric layer remaining the same, the silicon dioxide seems to be a better dielectric than hafnium dioxide. At an increased capacitance level, the simulated results of HfO_2 shows fluctuations, although the device is expected to deliver better ON current as per the drain current equation. A smooth transition was observed in the case of TFET structures with SiO_2 as dielectric. The optimized Gaussian doping depth for TFET with SiO_2 as dielectric is 0.0005 and for TFET with HfO_2 dielectric layer, the optimized value is 0.01. Compared to the peak ON current value of 0.18 nA obtained by using HfO_2 as dielectric, a greater value of 4.8 nA was obtained when using SiO_2 as dielectric. An increase in capacitance thus resulted in degradation of ON current of the device. The STBFET, have much higher I_{ON} –to–I_{OFF} ratio com- pared with the MOSFETs and traditional TFETs. Due to the specific device topology employed in STBFET, the device shows several distinct advantages. The tunneling current in this device scales with the gate area, instead of gate width leading to high I_{ON}. I_{OFF}, is essentially dependent on spacer thickness and is very low. STBFET have an excellent output current saturation

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