Hybrid Ge-Si Based MOSFET Devices

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Abstract

A numerical study on MOSFET with two substrate materials has been investigated in this paper. The objective of this study is to reduce the drain current value by using two equal amounts of different substrate materials. In this study the transfer characteristics of basic and hybrid MOSFET are analyzed. The outcome of this study is to analyze the performance of the hybrid MOSFET.

Keywords: Hybrids MOSFET, output characteristics, transfer characteristics.

I. INTRODUCTION

Scaling of complementary metal-oxide-semiconductor (CMOS) technology for the past forty years has led to current device technology with channel length well below 30 nm [1].The International Roadmap for Semiconductors (ITRS) predicts the MOSFET channel length to be less than 8nm in ten years [2].Instead of reducing the channel size drain current can be reduced by using different material set [3].By using two different substrate material the performance of MOSFET can be improved.

The performance of this hybrid MOSFET can be studied by simulation.

II .OVERVIEW OF DEVICE DESIGN

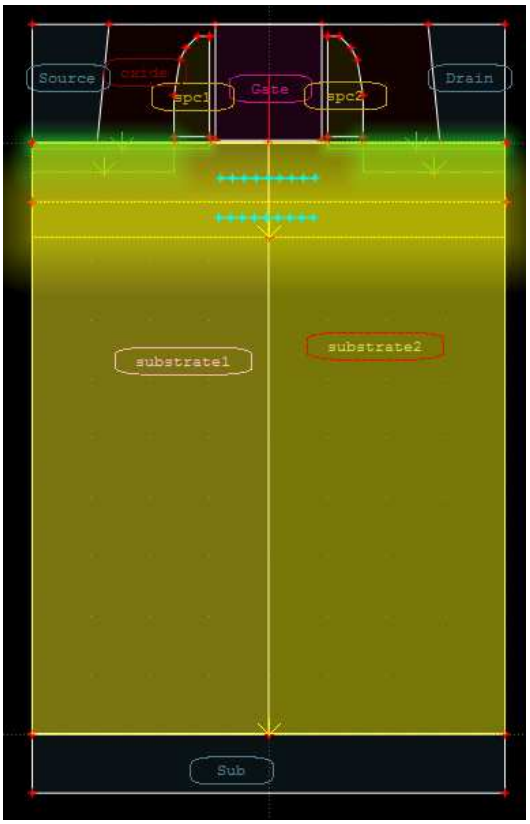

Figure1: structure of hybrid MOSFET

Specifications:

Gate material: NPolysilicon

Source material: Aluminium

Drain material: Aluminum

Channel doping: 1e+18 cm^-3

Substrate 1: silicon

Substrate 2: germanium

Figure 1 gives the structure of hybrid MOSFET.It has a single gate with two substrate materials silicon and germanium.

III.SIMULATION RESULTS

In this section, the output and transfer characteristics of hybrid MOSFET are obtained and compared with the basic MOSFET by simulating using Visual TCAD software.

TABLE 1: COMPARISON OF DRAIN CURRENT FOR HYBRID MOSFET AND BASIC MOSFET

VDS	DRAIN CURRENT FOR HYBRID MOSFET	DRAIN CURRENT FOR BASIC MOSFET
0	-1.37022e-06	-9.43271e-17
0.2	4.06354e-07	0.000313125
0.4	4.78721e-07	0.000549286
0.6	5.32796e-07	0.000686028
0.8	5.71367e-07	0.000738348
1.0	5.96546e-07	0.000754079
1.2	6.11857e-07	0.0007626
1.4	6.22387e-07	0.000769337
1.6	6.31304e-07	0.000775202
1.8	6.3971e-07	0.000780502
2.0	6.47935e-07	0.000785343

Hybrid MOSFET and basic MOSFET are simulated with gate voltage (VGS) equal to 2V.Drain voltage is varied from 0V to 2V and the corresponding drain current values are tabulated in table 1.

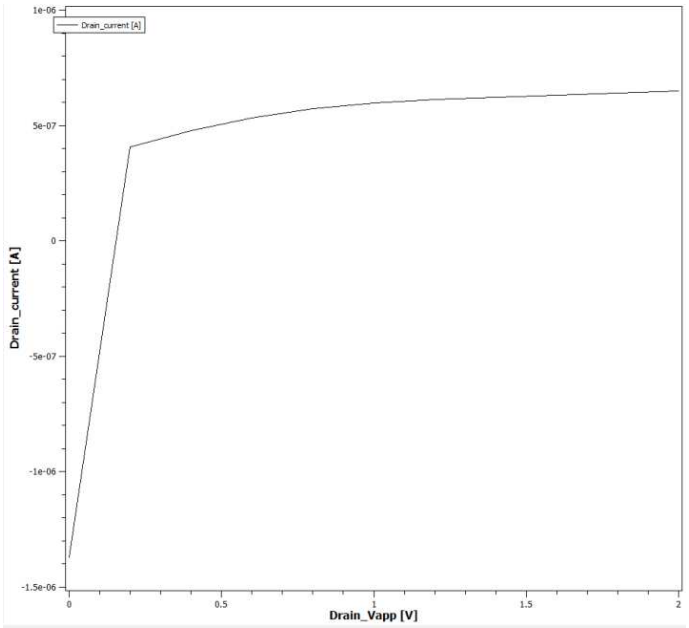

Figure 2: Transfer characteristics of hybrid MOSFET

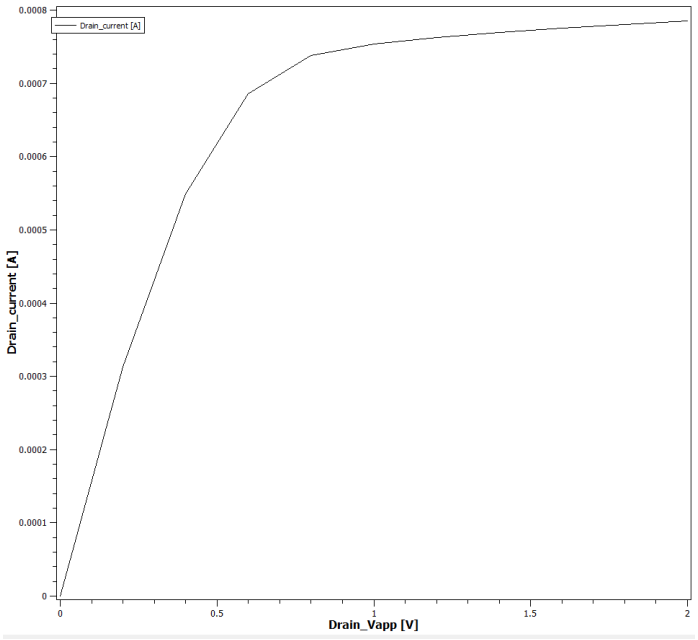

Figure 3: transfer characteristics of basic MOSFET

Figure 1 and Figure 2 explains the transfer characteristics of hybrid and basic MOSFET.From the figure it can be observed that drain current starts saturating at much earlier time for hybrid MOSFET than basic MOSFET.Earlier saturation reduces the ON time of MOSFET.Further the drain current value is also reduced in hybrid MOSFET.Hence power dissipation can also be controlled.

IV.CONCLUSION

This paper has explained about the performance of hybrid MOSFET by comparing with the basic MOSFET.The transfer characteristics of both the MOSFETs are studied. By comparing both it can be seen that hybrid MOSFET has improved performance than basic MOSFET.

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