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Review on Performance Parameter of MOSFET and FinFET Transistor

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Abstract- In modern world technologies are grooming very fast day by day along with the world semiconductor industry the world of IC is also grooming and enhancing the technologies day by day as we know according to Moore's law the number of transistors will be double on a chip in every eighteen months that means the size of components will be reducing day by day in the same way types of transistors were introduced like MOSFET and FinFET. FinFET replaced MOSFET, FinFET resolved all the challenges of MOSFET and helped in compact designing of electronic devices, FinFET is widely used in various modern electronic devices because of its structure, fast switching speed, low power consumption and less leakage current.

Index Terms- Transistor, FinFet, MOSFET, low power and voltage

I. INTRODUCTION

As we know that day by day technologies are changing and enhancing very fast and semiconductor industry also changing by reducing the size of semiconductor devices, as we all know it is following Moore's law.

In this changing and enhancing world device's structure and size plays a very important role, In this semiconductor world Transistor is main building block of the IC. There are two types of transistors.

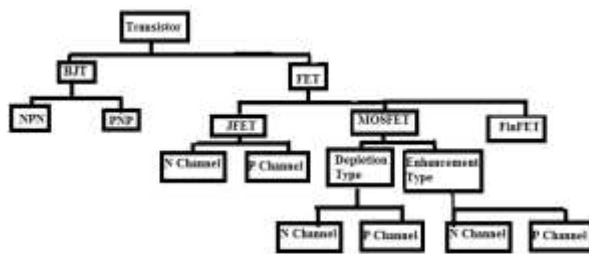

Fig.1.Transistor classification

II. MOSFET

Metal Oxide Semiconductor Field Effect Transistor is it main building block of semiconductor design. It is four terminal device Gate, Drain, Source and Substrate it is also known as body but in most of MOSFET's the Substrate is internally connected to source, this result in three terminal device.

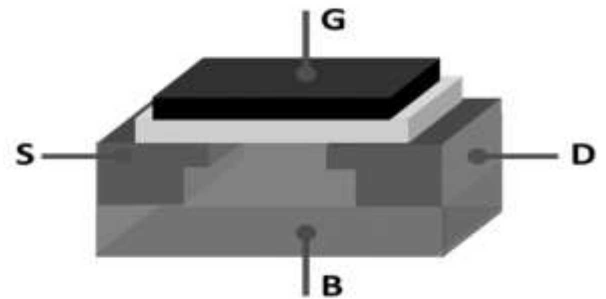

Fig.2. General Structure of MOSFET

The working of MOSFET depends on the variation in channel width with the flow of charge carries the charge carries inter in the structure from source side and exit from the Drain side. The width of the channel can be controlled through Gate voltage. The Gate terminal is between the source and Drain terminal and Gate is insulated from channel by a thin layer of silicon dioxide deposited near the channel.

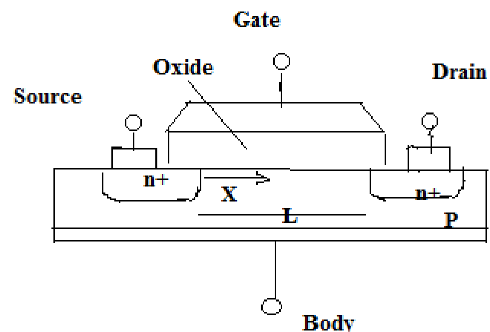

Fig. 3. Basic Structure of MOSFET

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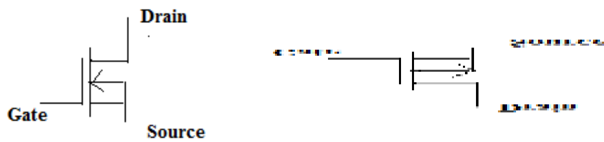
MOSFET operates in two different modes:

- Depletion Mode
- Enhancement Mode

Depletion Mode: In this mode we apply negative gate to source voltage in the result of this positive charges are induced in the channel, because of the positive charges the free electrons available in channel will repel away from the channel as a result of this the free electrons will reduce in channel, as we increase negative gate voltage at particular voltage the channel will depleted from free electrons, this voltage is known as VGS (off) and the drain current reduce to zero.

Enhancement Mode: In this mode we apply positive gate to source voltage, due to this positive gate to source voltage the number of free electrons passing through the channel increases, as positive gate to source voltage increase the number of free electrons passing through the channel also increase.

This increases the channel conductivity, due to this fact this mode of operation known as enhancement mode. If gate to source voltage is zero the depletion type MOSFET can conduct, that is why this is also known as ON MOSFET.



N Channel Depletion type MOSFET
P Channel Depletion type MOSFET

N Channel Enhancement type MOSFET
P Channel Enhancement type MOSFET

Fig.4. Symbol of MOSFET

FinFET: Fin Field Effect Transistor is a three terminal device,It belongs to the FET family, it based on the same principle of MOSFET but it is different in the performance, it is known as multi gate MOSFET,

The structure of FinFET is three dimensional,FinFET is developed on silicon body and the Gate terminal is between the Drain and source. The name FinFET is originate from Fin of Fish the top view of drain and source is look like Fin that is why this is known as FinFET. The channel between drain and source is also interpreted as Fin.

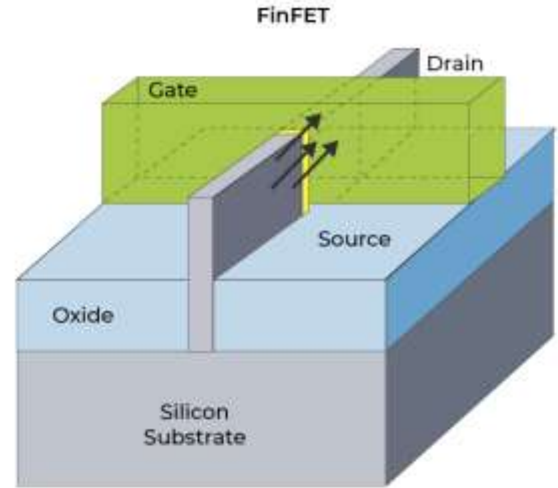
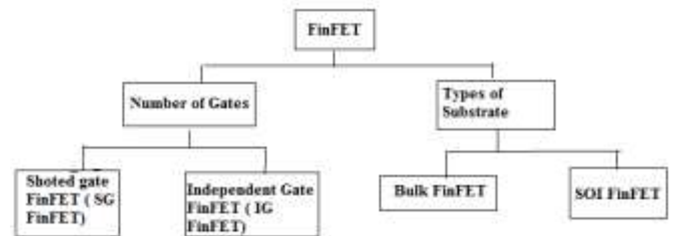


Fig. 5. Structure of FinFET

FinFET Classification



Shorted Gate FinFET: In this front gate and back gate is shorted and they are connected to each other, the channel is exist betweenfront gate and back gate, it has three terminals, it's threshold voltage cannot controlled externally, this device required less area.

Independent Gate FinFET: It is also known as IG FinFET, in this front gate and back gate is not shorted and they are free to each other, the channel does not exist betweenfront gate and back gate, it has four terminals, it's threshold voltage can be controlled externally, this device required large area.

Bulk FinFET: The silicon wafer is base of Bulk FinFET, it is easy to fabricate this type of FinFET, it cosume more power and the cost of this device is low. It's leakage current is also high.

SOI FinFET: in this device base is made of silicon on insulator waferit is difficult to fabricate this type of FinFET, it cosume less power and the cost of this device is high. It's leakage current is also less.

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III. RESULT

Table 1

S.No.	Parameters	MOSFET	FinFET
1	DIBL	47 mV	0.00005 mV
2	Leakage Current	High	Less (8.62x10^-8 nA)
3	Short Channel Effect	High	Low
4	Subthreshold Slop	0.72 V/dec	0.982 V/dec
5	Speed	low switching speed as compared to FinFET	High switching speed
6	Power	High power consumption as compared to FinFET	Low power consumption

IV. CONCLUSION

In this overall study and observing all the parameters, FinFET gives better performance as compared to MOSFET. Drain induced barrier lowering parameter of FinFET is very small, DIBL occur due to short channel effect. Leakage current of FinFET is very small as compared to MOSFET, short channel effect is low, high switching speed and low power consumption, so the performance of FinFET is better than MOSFET.

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