International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-1, Issue-6, January 2013

Simulation of Carbon Nano Tube Field Effect Transistor (CNTFET) for Reconfigurable Logic Gate Design

Harish Kumar Pal, Anand Kumar Singh, Prerna Sharma

Abstract- ***With the help of scaling down of CMOS, we have achieved higher integration density, the higher performance of devices, low power consumption and more complex functions. But with the increasing the complexity at nanometer scale in conventional Si CMOS technology, it is very difficult to maintain the pace of scale downing and it will limits in few years. The main objective of this project is to detail study of carbon nanotube Field Effect Transistor, types of CNTFETs and it is very important to show that the Carbon Nanotube Field Effect Transistor work properly with respect to conventional transistor and is more efficient than the conventional MOSFETs at nano scale regime which is shown in this project with the help of simulation studies of Top Gate CNTFET and Coaxial CNTFETs with the help of tools provided by online tools of Nano Hub. In the project at last a reconfigurable logic gate is also designed with the help of CNTFETs***

***Keywords*: CNTFET, GRAPHENE, NANOTUBES, RECONFIGURABLE LOGIC**

I. INTRODUCTION

In the present scenario of electronic industries, the further down scaling of CMOS transistor has become more difficult and also become difficult to meet the Moor's law. At new technology node as CMOS physical gate length has reached the nano geometry scale (1-100nm) therefore nano scale CMOS device starts to be influenced by quantum mechanical property effect Quantum phenomena and dimensional transport may lead to new functional devices with very different power/performance tradeoffs. The new devices for the future VLSI applications are Nanotubes, Nanowires, molecular devices and novel device concepts for nano electronics .Overview of CNTFET Carbon nano tubes are allotropes of carbon with a cylindrical nano structure and its length to diameter ratio is about 1000:1, therefore carbon nano tubes can be considered as nearly one-dimensional structures.

It is supposed that the Carbon nano tubes are made by rolling up of Graphene sheet in a specific orientation. Nanotubes are members of the fullerene structural family, which also includes the spherical bucky balls. The ends of a nanotube might be capped with a hemisphere of the buck ball structure.

Revised Manuscript Received on 30 January 2013.
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II.PROPSED METHOD

A) Design of Reconfigurable Logic Circuit with CNTFETs –

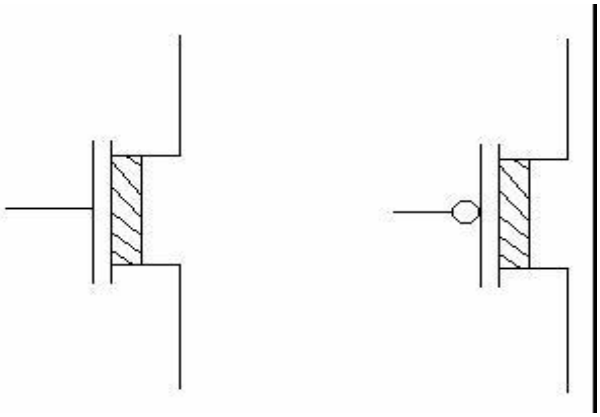

Fig.1: Representation of n-type and p-type CNTFETs

With the help of these CNTFETs it is possible to make inverter with these n and p-type of CNTFETs which is also shown in paper. The inverter, NAND and NOR logic is shown in the figure 4.23, the representation is same but the building block is different as CNTFET; These are the basic building blocks to make any digital system. The block contains two input pins, three select mode pin and one output pin. On the input pins we can give desired input and with the help of select pins we can select the mode in which the circuit will work in one of seven modes as AND gate, OR gate, NOT gate, NAND gate, NOR gate, XOR gate and XNOR gate.

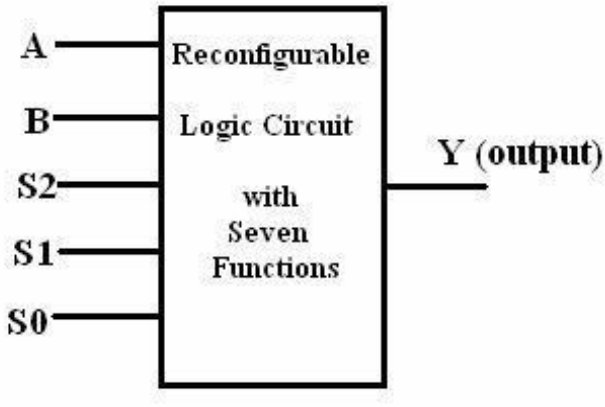

Fig.-2: Reconfigurable logic circuit

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The select input pins functions is given in the table .1 which clearly describe the modes of operation of the circuit which is obtained by giving the proper signal on the select pins and by selecting we can see the output by applying the proper input signal on A and B pins.

Table-1: modes of operation of the circuit

Select Mode			Gate Function
S2	S1	S0	
0	0	0	OR
0	0	1	AND
0	1	0	NOT
0	1	1	NAND
1	0	0	NOR
1	0	1	XOR
1	1	0	XNOR
1	1	1	X(Don't Care)

B- ***Design of Reconfigurable Logic Gate circuit made of CNTFETs based on CMOS logic.***

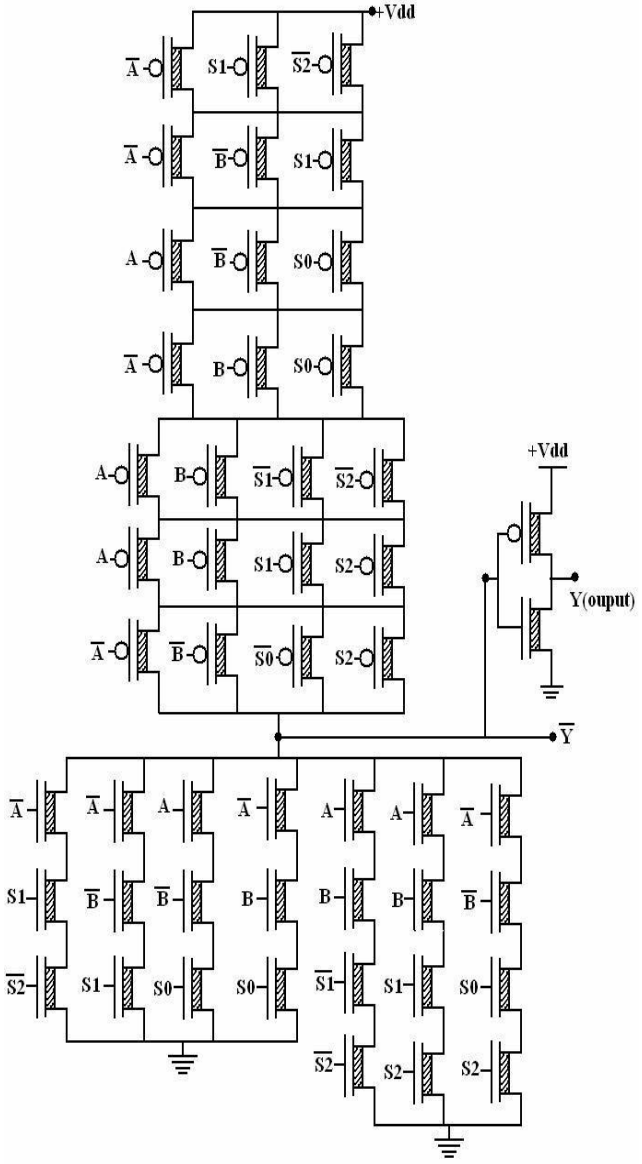

Fig.-3: CNTFETs based on CMOS logic.

II. SIMULATION RESULT

The output wave form of this VHDL program is shown in the figure 3. From the wave form it is clear that the Reconfigurable circuit works properly and gives the desired output when we give specific signals on the select input pins.

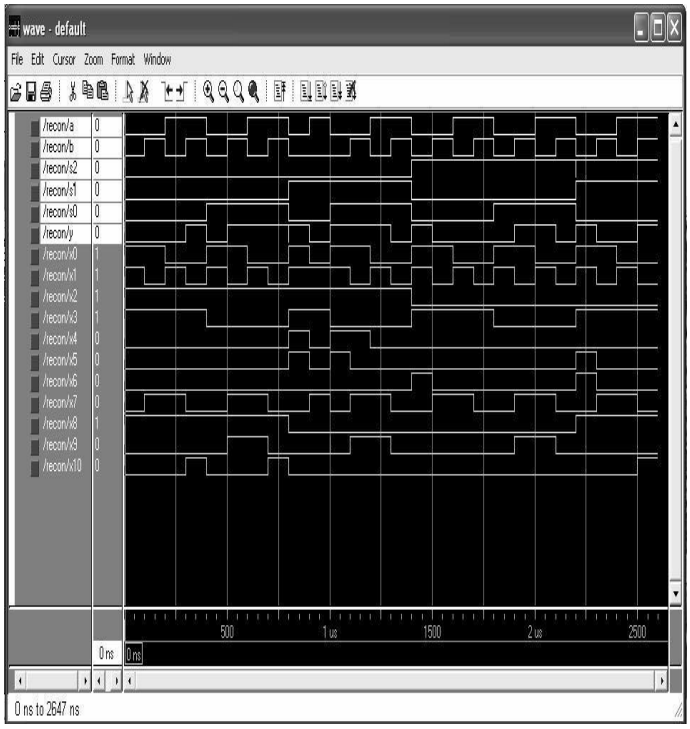

Fig.-4: The output wave form of the VHDL program

III. CONCLUSION

The main purpose of this project is to study about the carbon nano tubes, how many types of carbon nanotube are, what are the interesting electrical properties they have which make them useful for future electronic industries and also discuss about the physical properties of the carbon nanotube. In this project detail study of Carbon Nanotubes FETs (CNTFETs) is done. The very important topic of this project is to proof that the CNTFETs are better than the conventional Si MOSFETs at nano scale for which simulation of Top Gate Planner CNTFET and Coaxial CNTFET have done and from the simulation results we have proof that the CNTFETs are very strong player against the conventional Si MOSFETs for the future VLSI industries. The simulation results in this project contains the output characteristics (Id ~ Vg) of the Top gate CNTFET from which it is clear that the CNTFETs have high current carrying capability as in conventional MOSFETs. The simulation results for Coaxial CNTFETs contains output characteristics, transfer characteristics, average velocity verses drain voltage etc. from where it become clear that the Ion/Ioff ratio for CNTFETs are greater than the conventional MOSFETs and mobility of charge carriers in the carbon Simulation of Carbon Nanotube Field Effect Transistor (CNTFET) for Reconfigurable Logic Gate Design nanotube is also high as compared to the conventional MOSFETs etc. in this project a reconfigurable circuit of having seven functions is also proposed.

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Mr. Harish Kumar Pal- Currently working as an Assistant Professor in the department of Electronics and Tele Communication Engineering, Mr. Harish Pal is a hard working, responsible and research author of this research paper. He has graduated in Electronic & Communication Engineering from B.I.T Meerut affiliated to U.P.T.U, Lucknow. And pursing M.Tech. in Electronics and Communication Engineering from M.T.U. Noida. He has participated in various national and international seminar and conferences.

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