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| Reading Assignment |
| Advanced VLSI Design |
| Assigned by Dr. V. Agrawal |

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Objective: A one page report on the paper “Molecular, Chemical And Organic Computing” by Robert Stadler.

**a**. Due to the inevitable roadblocks ensuing through traditional downsizing of silicon devices alternative technologies has been considered. Among them molecular [1] electronics has become very active field of research. Molecular electronics involves the replacement of a wire, transistor or other solid-sate electronic element with one or a few molecules. The author gives a brief description of the progress in three different fields, chemical computation (CC), single organic molecular computing (SOMC) and organic electronics (OE), while discussing the application of organic molecules or materials for information processing or storage. But the author thinks that, though CC is interesting on a basic research level but unlikely to result in competitive electronic devices. On the other hand, SOMC is nano scale computing, which is also at the stage of basic research but is envisioned to have a significant practical impact when it is fully developed. He also talks about OE which is already commercialized for light-emitting diodes and display technology.

**b**. The fundamental scientific barriers in traditional downsizing of silicon devices includes oxide layers at the three atom thick level which is not adequately insulating and result in charge leakage. On the contrary, molecular electronics involves the use of single or small packets of molecules as the fundamental units for computing. Each molecule is approximately one million times smaller in area than their present day microelectronic counterparts. Different approaches have been adopted in the three fields in discussion.

In CC, the photo absorption or emission in spectra in (bio) chemical reactions are interpreted as logic gates. Both input and output can be defined to be either optical , electrical or chemical. Specially fluorescence phenomena have been found to be suitable for being interpreted as rather complex algebraic operation when the input output pattern is translated in the truth table of a logic gate.

In SOMC, there have been several proposals for wires, diodes, transistors, memory cells or logic cells based on the conductance properties of single organic molecules. Also several approximations have been developed regarding the characterization of electron transport through single molecules.

In OE, which is based on bulk materials such as polymers, efforts have been made to make polymer based transistor.

**c**. In CC, the experimental implementations have been carried out on a macroscopic scale and it is still needed to be figure out whether these systems can be scaled down to the level of single molecules rather than ensemble of molecules in a liquid. In SOMC, the experimental measurements of the theoretically developed quantum mechanical equations for the characterization of electron transport through single molecules difficult as it is difficult to create a controlled and reproducible fabrication of nano junctions. Moreover, in such a down scaling of electrical circuits, classical concepts of circuit design collapse and quantum effects introduce additional terms in Kirchhoff’s laws.

Reference: [1] James. M. Tour ;’Molecular Electronics, Synthesis and testing of Components ‘Acc. Chem. Res 2000,33,791-804