© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

A Comprehensive Review of Nanotechnology and Research Trends in Science and Technology

Deepika Nain[1*] | Vikas Sindhu[2]
[1,2] Department of Electronics and Comm. Engineering, U.I.E.T, Maharishi Dayanand University, Rohtak, Haryana, India
[*]Corresponding Author: deepika.rs.uiet@mdurohtak.ac.in

Abstract
Nanotechnology is a branch of science and technology concerned with the manipulation and control of the scale of molecules and individual atoms at nanoscale. It entails creating materials and technologies with structures and properties that develop at the nanoscale scale. In this paper, various applications of nanotechnology in different field like medicine, IT system, customer goods are discussed. Also, different type of technology such as Scanning probe microscopy (SPM), X-Ray diffraction (XRD) and Air force microscopy are discussed. Various challenges which are faced by scientist during formation of nano-devices are discussed.

Introduction
Numerous technological and industrial fields are being improved through nanotechnology. It supports energy and information technology. Additionally, it is important to environmental science. It consists of transportation, food safety, and national security [1, 2]. The national nanotechnology project moved on to define nanotechnology as the manipulation of matter with at least one dimension scaled up to 100nm, a broader definition of the subject [3].

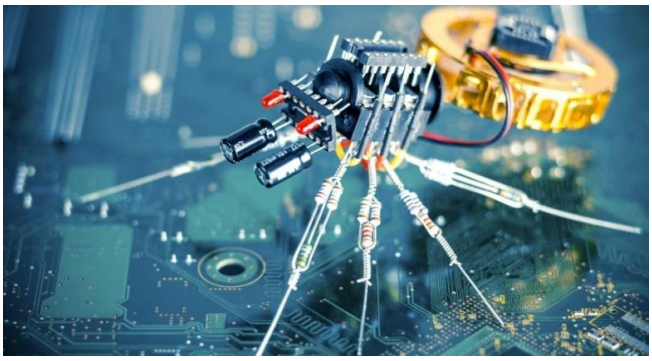

Fig 1.1 Nano Technology (source: [1])

In the figure 1.1 the Nano Technology has been described**.** Nanotechnology has the potential to build projects from the ground up. It is carried out with the use of methods and equipment. These are being developed right now to produce high-performance products.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

2. Literature Review

In [4,52], author discovered that the quality factor is maximized by shorter lengths and thicker beams. The structures have been made with large capacitive air gaps to reduce squeeze film damping. They report a considerable impact of the gap width on the quality factor (QF) despite the high gap to thickness ratio. It is discovered that while this impact lasts till high pressure range for nano-beams, it is limited for micro-beams at low pressure.

In [5], author discuss the use of new MEMS CMOS infrared (IR) sensors to create small occupancy detections without filters. The viability of this application will be evaluated using such sensors in terms of sensitivity, response time, and selectivity with and without the plasmonic structure. They will contrast the detection range, field of view, and object size that these sensors can detect with and without optical lenses as well.

In [2], author discussed the investments are which are made in nanotechnology right now, both in the USA and internationally. The National Nanotechnology Initiative (NNI), a vast and ambitious programme, has been launched by the US federal government. It's crucial to understand that practically all of the different US government entities involved in funding basic research and development are represented by the NNI.

In [6], author discuss the fundamentals of nano technology in computer science. The terms "cloud computing," "big data management," and "current opportunities" are defined in reference to nanotechnology. The document was created with difficulties and obstacles taken into account.

In [7], author discuss the utilizing customizable flow charts as the mechanism for the adjustments, instructors can choose the direction of the task and the level of content to be covered. Focus groups and surveys will evaluate this strategy's value and efficacy and offer suggestions for improvement.

In [8], author discus the 2 phases of Alliance. c

In [36], the author discusses the significance of nanotechnology-enabled materials linked with additive manufacturing processes for the realization of radio frequency components and modules for Internet of Things and millimetre wave applications.

TABLE 2.1 LITERATURE REVIEW IN TABULAR FORM

SNO.	TITLE	NAME OF AUTHORS	Methodology\ tool	ADVANTAGE	LIMITATION
1	Resonant electron tunneling Through Azurin in air and liquid by STM (2005)	Frascerra, F. Calabi, G. Maruccio, R. Cingolani, R. Rinaldi et. al [12]	Tunneling Microscopy	Induce tunneling through azurin in air	Limited work has been made

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

2	Investing in nanotechnology (2001)	C. R. K. Marrian et. al [3]	Survey	Represent a redirection of existing budget lines	Lack of technical work
3	Current Status of Nano-technology in Arab Gulf (2012) [9]	Alfeeli, T. Mohiudin, and K. Saoud et. al	Arab Gulf States	scientific capacity and worldwide developments in nanotechnology	Requirement of more work
4	Nanotechnology Computing having a special reference to cloud computing and big data management.	P. K. Paul et. al [6]	Study	Discuss the Nanotechnology Computing considering special reference to Cloud Computing and Big Data Management	Requirement of technical work
5	Laboratory Course in Nanotechnology(2015)	J. E. Morris et. al [10]	CNT percolation experiments	Wrote on laboratory course in nanotechnology	Limited scope of work
6	Engineering a Changes in cancer diagnosis and therapy through Nano-technology (2011)	G. W. Hinkal, D. Farrell, S. S. Hook, N. J. Panaro, K. Ptak, and P. Grodzinski et. al [8]	Nano technology	proposed on drastic change in cancer diagnosis and therapy.	Not sufficient according to the requirement
7	Nanotechnology progress and future opportunities (2010)	Mihail C. Roco et. al [11]	N\A	Discussed on nanotechnology progress and future opportunities	Consider limited factor for research
8	Nanotechnology and Its Advent In Electronics and Communication Networks (2001)	Mrs. TondareS.P et. al [13]	N\A	Wrote on nanotechnologyand its advent in electronics and communication networks	Lack of technical work
9	Fresh advance in Nano technology (2012)	Kuldeep purohit et. al [22]	nanotechnology	Fresh advances in Nano technology	Limited work has been made.

3. Nanotechnology and its type

Nanotechnology has been regarded as important system engineering [9]. Molecular engineering is used in this process. It adheres to both the concepts and the current work. It is therefore extremely advanced. Nanotechnology has the potential to build projects from the ground up. It is carried out with the use of methods and equipment. These are being created today in order to provide high-performance products [1].

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

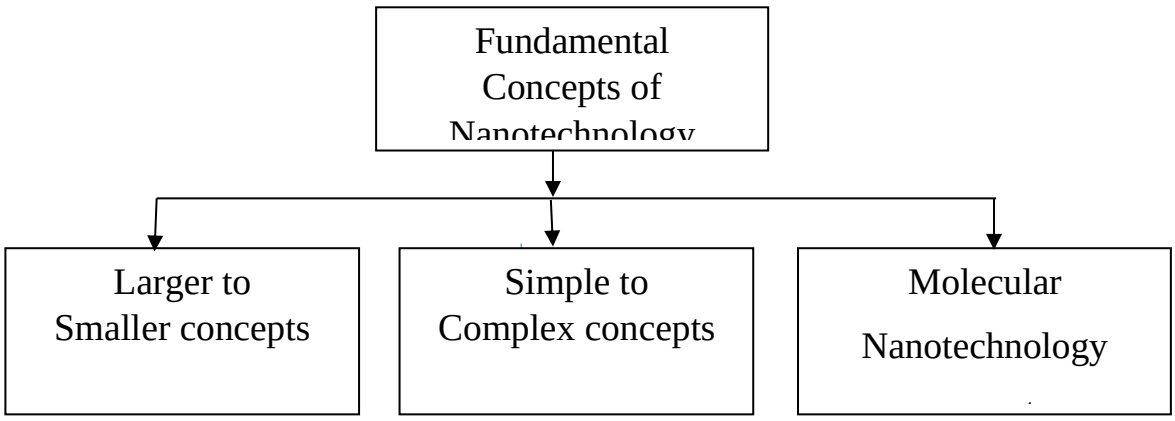

Fig 2. Fundamental concepts of Nanotechnology (source: [1])

In the figure 2. Fundamental concepts of Nanotechnology has been described. The first concept is larger to smaller. Many phenomena are becoming pronounced because size of system gets reduced. The second is simple to complex. Modern synthetic chemistry is approaching where it has been found feasible to develop mini molecules to almost all structure The third and last is molecular nanotechnology Molecular nanotechnology is known as molecular manufacturing. It usually explains engineered nano systems. These systems are operating on molecular scale.

a) Larger to smaller concept of technology

Many phenomena are becoming pronounced because size of system gets reduced. Se consists of statistical mechanical effects. It also consists of quantum mechanical effects [14].

b) Simple to complex concept of technology

Modern synthetic chemistry is approaching where it has been found feasible to develop mini molecules to almost all structure. Such methods are traditional in present time to fabricate a wide diversity of significant chemicals. These chemicals may be pharmaceuticals as well as saleable polymers [11].

c) Molecular based Nanotechnology concept of technology

Molecular nanotechnology is known as molecular manufacturing. It usually explains engineered nano systems. These systems function at the molecular level. Molecular assemblers are typically the focus of molecular nanotechnology. A desired structure can be produced by a machine.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

Additionally, it might be utilised to create devices atom by atom. This is accomplished using mechanising thesis concepts [15].

3.1 Future scope of nanotechnology

Future industrial applications for nanotechnology are incredibly diverse. The following are some prospective fields where major improvements in nanotechnology are anticipated:

- Medicine and healthcare: The diagnosis, therapy, and drug administration in the medical field could all be improved by nanotechnology. Targeted medicine delivery, imaging, and sensing can all be accomplished with nanoscale technology. Personalized medicine, regenerative medicine, and implantable biosensors for ongoing health monitoring can all be made possible by them [16].
- Due to frequent advent in medical technology there is need of rapid data processing devices that's why medical technology also gets support from nano technology [17].
- Nanotechnology is a subfield of technology that makes use of the characteristics of materials with dimensions down to the nanoscale range. Materials change their characteristics and behave differently in this state. Usually, economic factors are taken into account as well. However, a reduction in losses indicates that this nanotechnology has successfully entered the field of power engineering [18].
- Broadband CMOS class-E power amplifier for LTE applications [19].
- Cost Infra-Red Emitter in CMOS Technology [20].
- A Sub-1G CMOS-MEMS Accelerometer [21].
- Fresh Advances in Nano technology [22].

4. Current trends of nanotechnology

Nano electronics have been known as disruptive technology [23]. As present candidates varies from traditional transistors. This technology featured amazing qualities that were not found in any other technology. Phenomena that were not previously possible are now simply realised thanks to Nanotechnology. Some of research trends are shown in figure 3 [24].

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

Fig 3. Research Trend of nanotechnology (source: [24]

In the figure 4. evaluation and physiochemical properties of nanomaterial has been described [13]

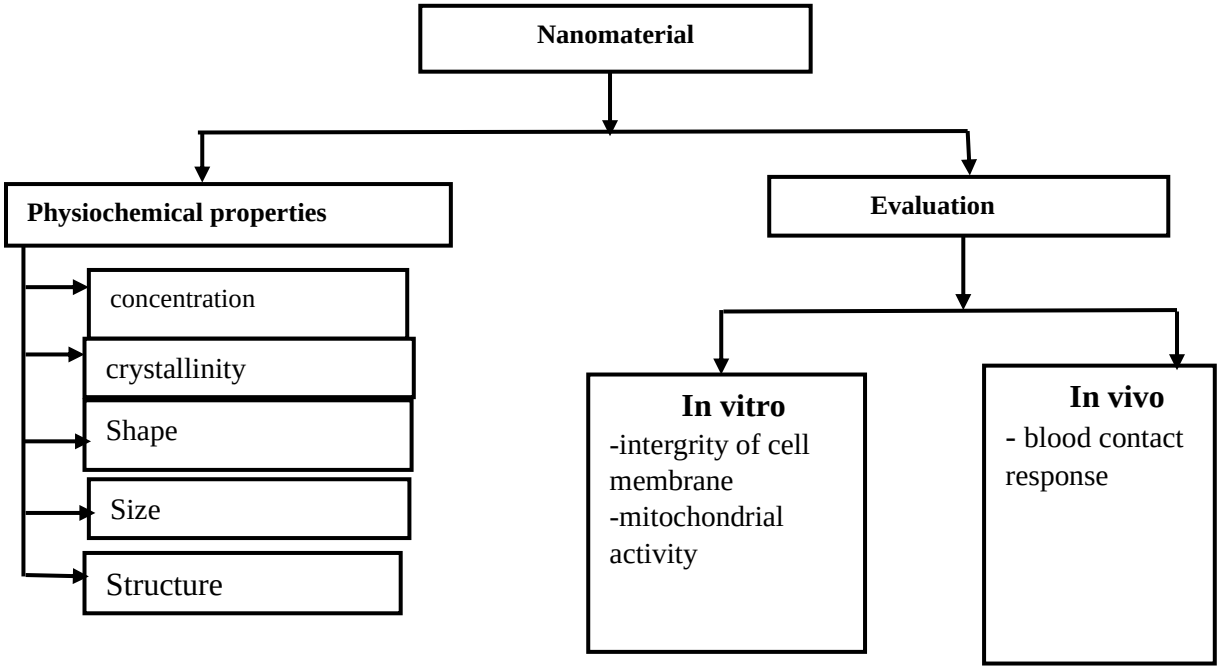

Figure 4: Evaluation and Physiochemical properties of nanomaterial (source: [13])

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

Molecular electronics

One more option is single molecule devices. Molecular self-assembly would be heavily utilized in these plans. With the help of these ideas, a larger structure can be built. These also create an entire system on their own. In terms of reconfigurable computing, this is really helpful. These have the capacity to entirely replace current FPGA technology [25].

A model system with a carbon structure that offers a molecular diode roughly half a nanometer wide has been discovered. Poly-thiophene molecular wires could be used to connect it. Theoretical simulations revealed that the design was sound in principle, and there is still optimism that such a system may be built [26].

Molecular Materials used in Electronics

The main advantage of conductive polymers is their process ability. There process ability consists of dispersion. Conductive polymers are not plastics. Usually they are not thermo formable. But they are organic polymers such as polymers. Thus, they are capable offer high electrical conductivity. But it has been observed that they have different mechanical properties as compare to other commercially utilized polymers. Electrical properties might be fine-tuned. It is performed with the help of methods of organic synthesis [15].

4.1 Application of Nanotechnology

In figure 5, different application of nanotechnology are shown:

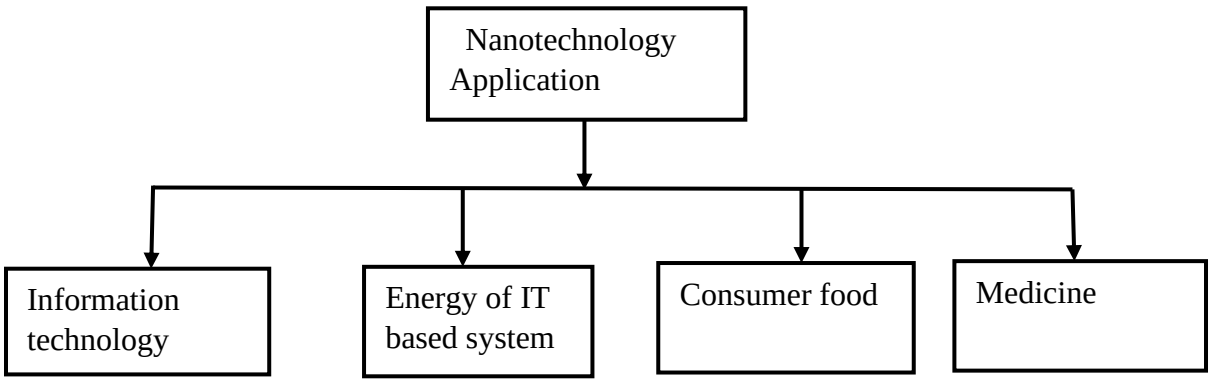

Figure 5: Application of Nanotechnology

a) Information technology

Nanotechnology has made significant contributions to the field of information technology (IT), enabling the development of smaller, faster, and more efficient devices. Quantum computing, nano-electronics are the application in IT sector [22].

b) Energy of IT based system

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

Renewable energy resources are used [27] [28]. Such as Solar cell, Bio fuels, fossil fuel [6] [29] [30].

c) **Medicine [16]**
d) **Consumer food**

Through active and innovative studies in food packaging, innovative packages such as smart, intelligent, and active food packaging are being developed for more effective and efficient packaging with accompanying balanced environmental problems [31,51].

According to [32] [33] [34], nanotechnology have a several purpose in food packaging which are following:

- Improved packaging
- Active packaging
- Intelligent/smart packaging [35]

4.2 Challenges in nanotechnology

The biggest problem considered in research is heat production in nano devices, although there are several challenges that have been encountered throughout nanotechnology application. Several factors influence the performance of nanotechnology, including:

a) **Cost factor:** The first and most important factor is the cost factor. It comprises of expenses incurred while using technology. The cost factor comprises of the expenses incurred while using technology. The nanotechnology device utilizes less material, which reduces production costs [21, 37].
b) **Power consumption factor:** Nano devices require far less power than other electronics [25, 38].
c) **Mass production:** This component takes into consideration large-scale manufacturing with minimal effort [39].
d) **Pollution factor:** To ensure the quality of device configuration, there must be fewer particles during device operation [40, 43].
e) **Number of devices:** Because the number of devices has a substantial impact on how nanotechnology works [41].
f) **Quality factor**: the quality of device is represented by minimum input and maximum output [42].

4.3 Type of Technology which support nanotechnology

Here three main technology are discussed which are used in nanotechnology

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

Scanning Probe microscopy: Scanning probe microscopy (SPM) is a popular technique for imaging the nano-world. This broad idea includes any approach that generates images from the interaction of a probe and a sample. Many strategies have been developed depending on the nature of the engagement [44, 45, 48].

X-Ray Diffraction (XRD): The crystal structures and phases of nanomaterials can be determined using XRD. Researchers can learn about the atomic arrangement and lattice characteristics of nanoscale materials by studying X-ray scattering patterns [46].

Atomic Force Microscopy: AFM is best in its capacity to see insulating particles, it has enabled the visualization of nanometer-scale structures in liquids. Researchers in biological sciences were ecstatic about this unique potential because biomolecules only perform critical functions in aqueous solutions [47, 49,50].

5. Conclusion

The electronic age of nanotechnology had begun. It does not means that it replace the existing electrical and electronics technology, but it provides a lot of opportunity to design new applications and characteristics of electronic devices such as LED, transistor, detector. Based of review, it seems that there are a number of challenges during the formation nano devices. So, to overcome different type of technologies are used. We conclude that there are many field in which nanotechnology play important role.

References

[1] Mobasser, ShariatandFiroozi, Ali. (2016). Review of Nanotechnology Applications in Science and Engineering. 6. 84-93. C. R. K. Marrian, "Investing in nanotechnology" 1 p-4-1, p. 72.

[2] Bita Farhang, " Nanotechnology and Applications in Food Safety", 'Food Science and Technology', pp. 401-410 https://doi.org/10.1016/B978-0-12-374124-0.00022-3.

[3] C.R.K. Marrian , "Investing in nanotechnology", 2001.

[4] S. N. R. Kazmi, S. Ilyas, P. M. F. J. Costa, and M. I. Younis, "Mechanical Computing Using Multifrequency Excited NEMS Resonator," *2018 IEEE 13th Annu. Int. Conf. Nano/Micro Eng. Mol. Syst.*, pp. 229–233, 2018.

[5] G. Tao, "Inverse eigenvalue analysis techniques for coupled M / NEMS resonators," pp. 17–20, 2016.

[6] P. K. Paul, "Nanotechnology Computing having special references to Cloud Computing and Big Data Management: Techno Managerial Knowledge Study," pp. 1–5, 2017.

[7] D. M. Newberry, "A Modularized Approach to Nanotechnology Education : Opportunities , Challenges and Requirements," 2012.

[8] G. W. Hinkal, D. Farrell, S. S. Hook, N. J. Panaro, K. Ptak, and P. Grodzinski, "Engineering a Change in Cancer Diagnosis and Therapy through Nanotechnology," 2011.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

[9] B. Alfeeli, T. Mohiuddin, and K. Saoud, "Current Status of Nanotechnology in Arab Gulf," 2012.
[10] J. E. Morris, "Laboratory Course in Nanotechnology," pp. 267–270, 2015.
[11] Mihail C. Roco "Nanotechnology progress and future opportunities: 2000–2020", 2010.
[12] V. Frascerra, F. Calabi, G. Maruccio, P. P. Pompa, R. Cingolani, and R. Rinaldi, "Resonant Electron Tunneling Through Azurin in Air and Liquid by Scanning Tunneling Microscopy," vol. 4, no. 5, pp. 637–640, 2005.
[13] Mrs. Tondare S.P. (2001) "Nanotechnologyand Its Advent In Electronics and Communication Networks" International Journal of Computer Science and Engineering Technology, Volume 3 Issue, Value: 13.98 Issn: 2321-9653
[14] D. M. Newberry, Nanotechnology: A platform for education change. "I," 2012.
[15] V Aradhya, Sriharshaand Venkataraman, Latha. (2013). Single-molecule junctions beyond electronic transport. Nature nanotechnology. 8. 399-410. 10.1038/nnano.2013.91.
[16] Sudip Mukherjee, Susheel kumar , Chitta Ranjan Patra , "Green Synthesized Gold Nanoparticles for Future Biomedical Applications", 2017.
[17] Anna Pratima G. Nikalje (2015)Nanotechnology and its Applications in Medicine
[18] SumerederProspects (2007) "Nanotechnology in Electrical Power Engineering", 19th International Conference on Electricity Distribution Vienna, 21-24 might 2007
[19] D. Kalim, D. Erguvan, and R. Negra, "Broadband CMOS class-E power amplifier for LTE applications," pp. 2–5, 2009
[20] S. Z. Ali , "A Low-Power , Low-Cost Infra-Red Emitter in CMOS Technology," *IEEE Sens. J.*, vol. 15, no. 12, pp. 6775–6782, 2015
[21] D. Yamane, M. Takayasu, H. Ito, S. Dosho, N. Ishihara, and K. Masu, "A Sub-1G CMOS-MEMS Accelerometer," pp. 5–8, 2015
[22] Kuldeep purohit (2012) "Fresh Advances in Nano technology", International Journal of Scientific and Engineering Research, Volume 3, Issue 11, November-2012
[23] Ali Mohamed "Design of optimum Nano Scale CMOS inverter Integrated With RRAM", 2019 international conference on computer , Control, Electrical and Electronics Engineering (ICCCEEE),2019.
[24] Ratner, Mark. "Introducing molecular electronics" , pp.20–27, 2002. 10.1016/S1369-7021(02)05226-4.
[25] D.Bhattacharyya1 et.al., "Nanotechnology, Big things from a Tiny World: a Review", International Journal of u- and e- Service, Science and Technology, Vol. 2, No. 3, September, 2009.
[26] Neil C. Greenham, Richard H. Friend, "Semiconductor Device Physics of Conjugated Polymer", 'solid state physics', pp. 1-149, Vol.49, 1996.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

[27]Ahmed Kadhim Hussein, "Applications of nanotechnology in renewable energies-A comprehensive overview and understanding", Vol. 42,pp-460-476,2015.
[28]Lund, "Renewable energy strategies for sustainable development", Vol.3,Issue no.6, pp-912-919, 2007.https://doi.org/10.1016/j.energy.2006.10.017
[29] Afgan NH, Carvalho MG. "Multi-criteria assessment of new and renewable energy power plants", pp.739–55, 2002.
[30] Afgan NH, Carvalho MG. "Sustainability assessment of hydrogen energy systems" Int J Hydrogen Energy 2004;29(13): 1327–42.
[31] Mlalila,N.,Kadam,D.M., Swai, H.andHilonga,A.(2016),"Transformation of food packaging from passive to innovative evia nanotechnology: concepts and critiques", Journal of Food Science and Technology,Vol.53No.9,pp.3395-3407.
[32]Silvestre,C.,Duraccio,D.andCimmino,S.(2011),"Food packaging based on polymer nanomaterials", ProgressinPolymerScience,Vol.36,Isuue no.12,pp.1766-1782.
[33] Echegoyen, Y.(2015),"Nano developments for food packaging and labeling applications", Nanotechnologies in Food and Agriculture ,Springer International Publishing;NewYork,NY,pp.141-168.
[34] Sharma,R. and Ghoshal, G.(2018),"Emerging trends in food packaging", Nutrition and Food Science, Vol.48No.5,pp.764-779,availableat:https://doi.org/10.1108/NFS-02-2018-0051
[35] Pal,M.(2017),"Nanotechnology :a new approach in food packaging", Journal of Food: Microbiology, Safety and Hygiene,Vol.2No.121,doi:10.4172/2476-2059.1000121.
[36] A. Eid et al., "Nanotechnology-Empowered Flexible Printed Wireless Electronics," IEEE Nanotechnol. Mag., vol. PP, no. December 2018, p. 1, 2019
[37] T. Ghani, "Innovations to Extend CMOS Nano-transistors to the Limit," p. 60558, 2008.
[38] Maine E, Thomas V, Bliemel M, Murira A, Utterback J, "The emergence of the nanobiotechnology industry", Nature nanotechnology, pp.12-15,2014.
[39] Handbook on "Nanoscience, Engineeering and Technology", 2nd Ed., Taylor and Francis, 2007.
[40] William Illsey Atkinson "Nanocosm: Nanotechnology and the Big Changes Coming from the Inconceivably Small" ,2003.
[41] Atsushi Ogasawara (2004) "Applying Nanotechnology to Electronics", Recent Progress in Si-LSIs to Extend Nano-Scale MRS Bulletin, p. 838, Vol. 29, No. 11, Nov. 2004.
[42] Abbas, Mohammed & S, Duaa. (2015). "Quality Factor Improvement for Nano Cavity". International Journal of Computer Applications. 127. 22-25. 10.5120/ijca2015906372.
[43] Mehndiratta, Poorva & Jain, Arushi & Srivastava, Sudha & Gupta, Nidhi. (2013). "Environmental Pollution and Nanotechnology". Environment and Pollution. 2. 10.5539/ep.v2n2p49.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 02 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
DOI: 10.5281/zenodo.7994805

[44] G M Sacha and P Verona,“ Artificial Intelligence in nanotechnology”,2013,http://dx.doi.org/10.1088/0957-4484/24/45/452002.
[45] J R Matey, J. Blanc ,“ Scanning capacitance microscopy”, Vol. 57, issue no. 5,1985 https://doi.org/10.1063/1.334506.
[46] M Joshi, A Bhattacharya, S Wazed Ali , “Characterization techniques for nanotechnology applications in textiles”, Vol. 33, pp. 304-317, 2008.
[47] Toshio Ando, Takayuki Uchihashi ,Takeshi Fukuma, “High-speed atomic force microscopy for nano- visualization of dynamic biomolecular processes”, pp. 337-437,2008.
[48] G. Binnig, H. Rohrer, Ch. Gerber, E. Weibel, “Surface studies by scanning tunneling microscopy”, Phys. Rev. Lett. 49, pp.57–61, 1982.
[49] G. Binnig, C.F. Quate, Ch. Gerber, “Atomic force microscope”, ‘Phys. Rev. Lett. 56, pp.930–933,1986.
[50] G. Meyer, N.M. Amer, “Novel optical approach to atomic force microscopy”, Appl. Phys. Lett. 53 (1988) 1045–1047.
[51] Samuel Ayofemi Olalekan Adeyeye, “Food packaging and nanotechnology: safeguarding consumer health and safety”,Nutrition and Food Science,2019.
[52] Nouha Alcheikh, Lakshmoji Kosuru, Sayed N.R. Kazmi ,Mohammed I. Younis, “ In-Plane Air Damping of NEMS and MEMS Resonators”, ‘conference on Nano/ Micro Engineered and Molecular System (NEMS)’,2018.