World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(REVIEW ARTICLE)

Check for updates

India as a semiconductor manufacturing hub towards becoming ATMANIRBHAR and VIKSIT Bharat: A different perspective with respect to Nanotechnology

Shanti Swamy [1,*] and Pavan Patel [2]

[1] *SPIT, MUMBAI, Maharashtra, India.*
[2] *SSIM, Hyderabad, India.*

World Journal of Advanced Engineering Technology and Sciences, 2024, 12(02), 766–769

Publication history: Received on 05 July 2024; revised on 12 August 2024; accepted on 15 August 2024

Article DOI: https://doi.org/10.30574/wjaets.2024.12.2.0327

Abstract

With the remarkable incentives and enhanced budget allocation for the semiconductor industry, India is on the right direction for significant growth in the years to come. Semiconductors are the most important piece of electronics present in every electronic device ranging from smartphones to LCDs, vehicles, washing machines, refrigerators, or even defence equipments. With India's growing focus on digitalization and technological innovation, the semiconductor industry presents a great opportunity to contribute to the nation's progress and thereby VIKSIT BHARAT. In this paper, the focus is on the semiconductor requirements which incorporates the nanotechnology based semiconductor materials called as semiconductor nanoparticles. The need of semiconductor industry becomes more and more relevant for India towards becoming a developed nation.

Keywords: Semiconductor; Nanotechnology; Qubits; Nanoelectronics; Industry; R and D

1. Introduction

Though India has been a traditional semiconductors importer, the country is looking forward to lead in the semiconductors supply chain management and manufacturing as well. The current issues in India's semiconductor industry, how R&D's are playing a vital role, the loopholes in the policies, and various other imperative aspects of the industry are addressed in the paper. India’s consumption of semiconductors is expected to cross $80 billion by 2026 and $110 billion by 2030. The country is currently depending on imports for the supply of chips but is looking forward to sharing the stage with the top leaders in the sector. Semiconductors are materials that have electrical conductivity like a conductor such as copper wire and an insulator like plastic. This unique property makes them different and animportant part of electronic devices. Ref(1)

2. Mission Semiconductor

The potential for development and innovation in the semiconductor has been addressed with respect to India as a semiconductor production centre at 2030. The world semiconductor sector is studied for a decade of expansion and is forecasted to reach a trillion-dollar industry by the year 2030 driven by automobile, data storage, and wireless industries. There must be enhanced focus and investment in R&D to meet indigenous Semiconductor application capabilities. Ref(2)

As a result, India is predominantly going to emerge as a crucial player in the global semiconductor market, focussing on both

* Corresponding author: Shanti Swamy

domestic and international fronts. India can hundred percent compete the semiconductor manufacturing is an important entity of today's technology-driven world, supporting from smartphones and computers to nanoelectronics and IoT nanodevices.Fig.1

Figure 1 Sample Semiconductor Industry

First and foremost, so as to focus on creating strategic alliance with global semiconductor companies, prioritizing talent and skill enhancement initiatives to nurture a skilled workforce capable of meeting the demands of the semiconductor industry is quintessential thing to be done. This requires collaborating with academic and research Institutions to float specialized training programs in semiconductor engineering, manufacturing, and marketing. Further, semiconductor industry encompasses a strategic move to leverage expertise and support to India's technological and economic growth. With association, discovery, and proper funding, India can create a thriving semiconductor industry that supports essentially to India's economic activities and technological roadmap. Ref(3)

3. Potential India and challenges

India has a very competent hold when it comes to production of Semiconductors. Currently, around 60000 potential persons are involved in the VLSI, Chips design industry for electronics, since there was no packaging facility in India. These packages were developed in India but assembled elsewhere in the world. Through the industry growing, there will be a change in this model. The Indian Semiconductor industry will affect the global semiconductor supply chain management system.

In order to understand the challenges in the Semiconductor domain, remedies are required at different levels. Firstly, there should be focussed investment in R&D to consider meticulous semiconductor design opportunities. This is done by establishing more design institutes, providing funding for research collaboration between academia and industry, and encouraging start-ups in the semiconductor domain. Additionally, endeavours should be required to create the skill development ecosystem via specialized training activities ,and association with educational Institutions.

Infrastructure facility is also important, comprising investment in chip designing facilities and advanced technology hub. This will shorten dependency on imports and provide internal manufacturing of semiconductor chips. Also, streamlining regulatory policies and supporting requisite support will enhance capital investment in the semiconductor domain at every level. Ref(4)

4. Semiconductor nanoparticles

Nanomaterials are showing applications in monitoring and understanding existing environmental contaminants and reducing new pollution. Nanoparticles like carbon,gold , and ,silver can be used in the treatment of various contaminated media by chemically transforming contaminants or acting as a “super adsorbent” for many compounds. They play a vital role in the development of efficient and precise environmental sensors which can be applied in the detection of pollutants at molecular levels and also for eliminating harmful bacteria.

Furthermore, fostering a conducive environment for novel sector and entrepreneurship will encourage the growth of start-ups and SMEs in semiconductor design and manufacturing. This can be attained with schemes and funding on incubation centres, support, and regulatory reforms to ease market entry. Overall, addressing these challenges requires

a coordinated effort from government, industry, and academia to nurture a robust semiconductor ecosystem in India and enable the country to compete globally in the semiconductor industry.

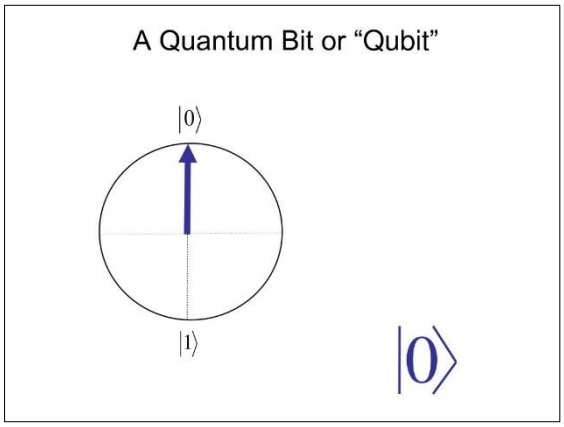

Figure 2 Semiconductor Nanoparticles (Qubits)

When the dimension of semiconductor materials like silicon, germanium are reduced to nanoscale, their physical and chemical properties change considerably, resulting in changed properties due to their large surface area or quantum size effect. Vehemently, semiconductor nanomaterials and devices are still in the infant stage, but they are showing good results in applications, such as solar cells, nanoscale electronic devices, light-emitting nano devices, laser technology, waveguide, chemicals and biosensors. Further, with the advent of nanotechnology ,significant breakthroughs in the semiconductor industry can be observed. This paper deals with some of the current initiatives and critical issues in the improvement of semiconductors based on nanostructures and nanodevices Ref(5)

Semiconductor nanocrystals (NCs) are made from a variety of different alloys. They are referred to as II-VI, III-V or IV-VI semiconductor nanocrystals, based on the periodic table groups into which these elements are formed. For example, silicon and germanium are group IV, GaN, GaP, GaAs, InP and InAs are III-V, while those of ZnO, ZnS, CdS, CdSe and CdTe are II-VI semiconductors.

Also, Silicon spin qubits have demonstrated some interesting properties at the individual level, but the technology is dominated by a late entry and visibility to the world. To overcome these challenges, the quantum computing and Electronics Engineering communities will work to discover interesting ways .

5. Creation of Quantum Superposition

The researchers with finely tuned laser pulses created a superposition between the hole ground state and the higher energy state. The hole thus existed in both states simultaneously. Such superpositions are the basis for quantum bits, which, unlike conventional bits, exist not only in the states “0” and “1,” but also in superpositions of both.

As per the quantum applications, semiconductor qubits are incredibly adaptable and cover an entire ecosystem. This is obviously correct when considering quantum simulation, sensing, computation, and communication. For practical applications in sustainable requirements, a photocatalyst's stability is important. The stability and repeatability of semiconductor-based catalysts are essentially understood by the application of iterative experiments, in which the photocatalysts are gathered and repeatedly employed for specific photocatalytic reactions. Industries based on the production of semiconductor integrated circuits adapt intricate procedures such as wire bonding, wafer back grinding, sawing, die attachment, trimming, encapsulation, electroplating, forming, and marking.For example, Samsung Electronics overtakes Intel as the leading manufacturer of semiconductor chips with sales of 75.85 billion US dollars whereas, Intel remained in 69.8 billion US dollar sales income. As of right now, semiconductor technology has integrated 100.8 million transistors at a node size of under 10 nm.

6. Conclusion

Size becomes the nanometre_then its surface area increases significantly, and the properties of the materials alter. Comparatively, bulk materials smaller than 1 mm, there are very less atoms at the surface in bulk materials. In many processes involved in producing semiconductors, nanoparticles are important. The rigorous changes in dimension of

nanoparticles in semiconductor applications holds great innovation for the future, and reshaping the electronic industry. Also, Nanotechnology with semiconductor industry, India would certainly compete with the developed nations as far as economy is concerned.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Anil Rego, "ETMarkets Smart Talk: Global semiconductor sector likely to reach a trillion-dollar industry by 2030". 2023

[2] Ashok Mehta, Suchi Semicon, "There Must Be Increased Focus and Investment in R&D to Foster Indigenous Semiconductor Design Capabilities". 2024

[3] Semiconductor Industry Association ,"New Report Suggests India Can Expand Role in Global Semiconductor Value Chains with the Right Policies", Washington and New Delhi—Feb. 14, 2024

[4] Bhavika Gupta," India's Rise as a Manufacturing Superpower: From 'Make in India' to Global Production Hub", Oct 12, 2023

[5] Sagadevan Suresh," Semiconductor Nanomaterials, Methods and Applications: A Review", 2013