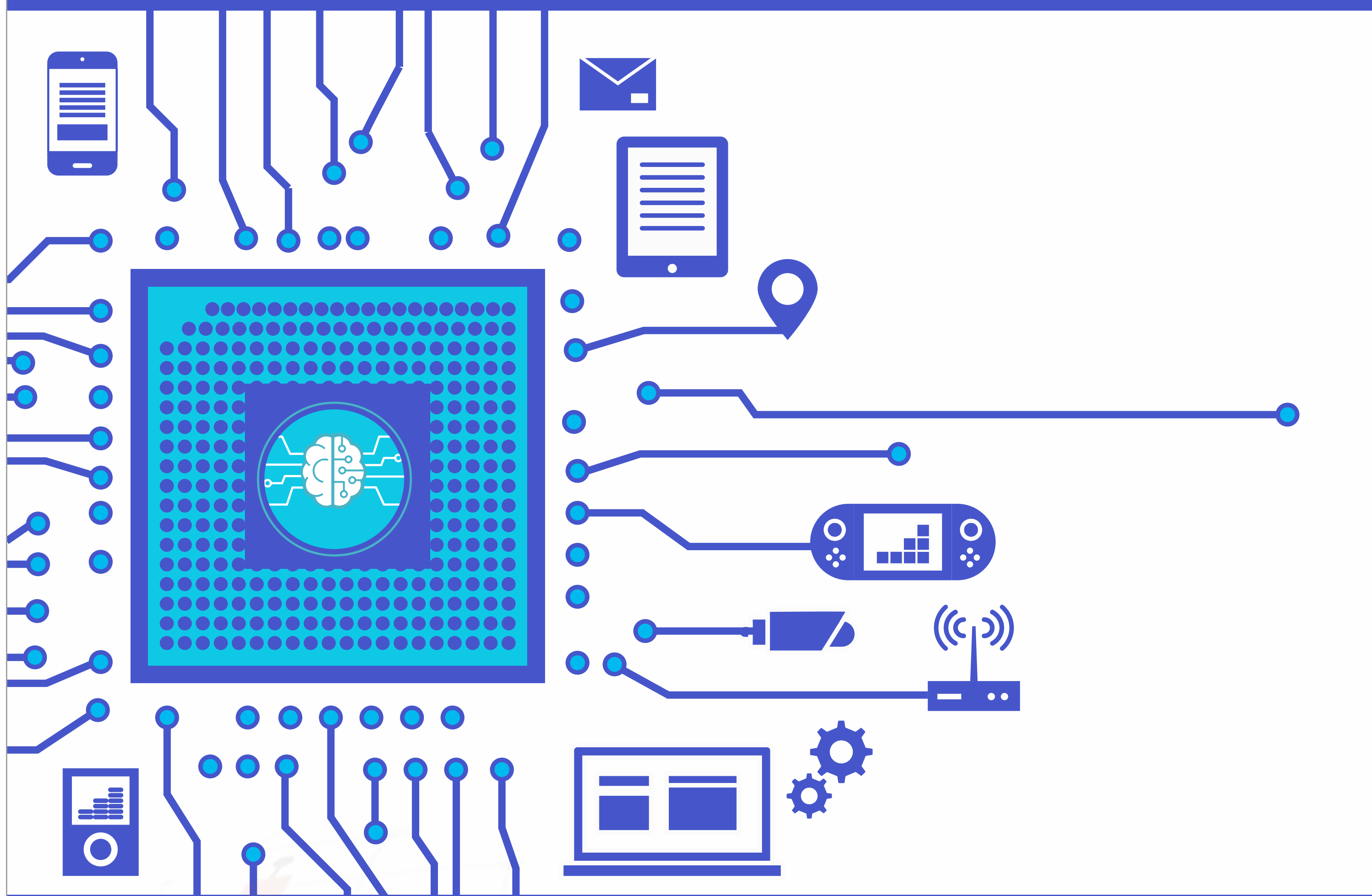


Mr. Tanmay Naik
Editor - in - Chief,
Science View,
SoS, GSFC University
Mail ID: students.magazine@gsfcuniversity.ac.in

Design Concept by:
Dr. K. Santhosh Kumar and Mr. Naren Acharya

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED
An ISO 9001:2015 Certified

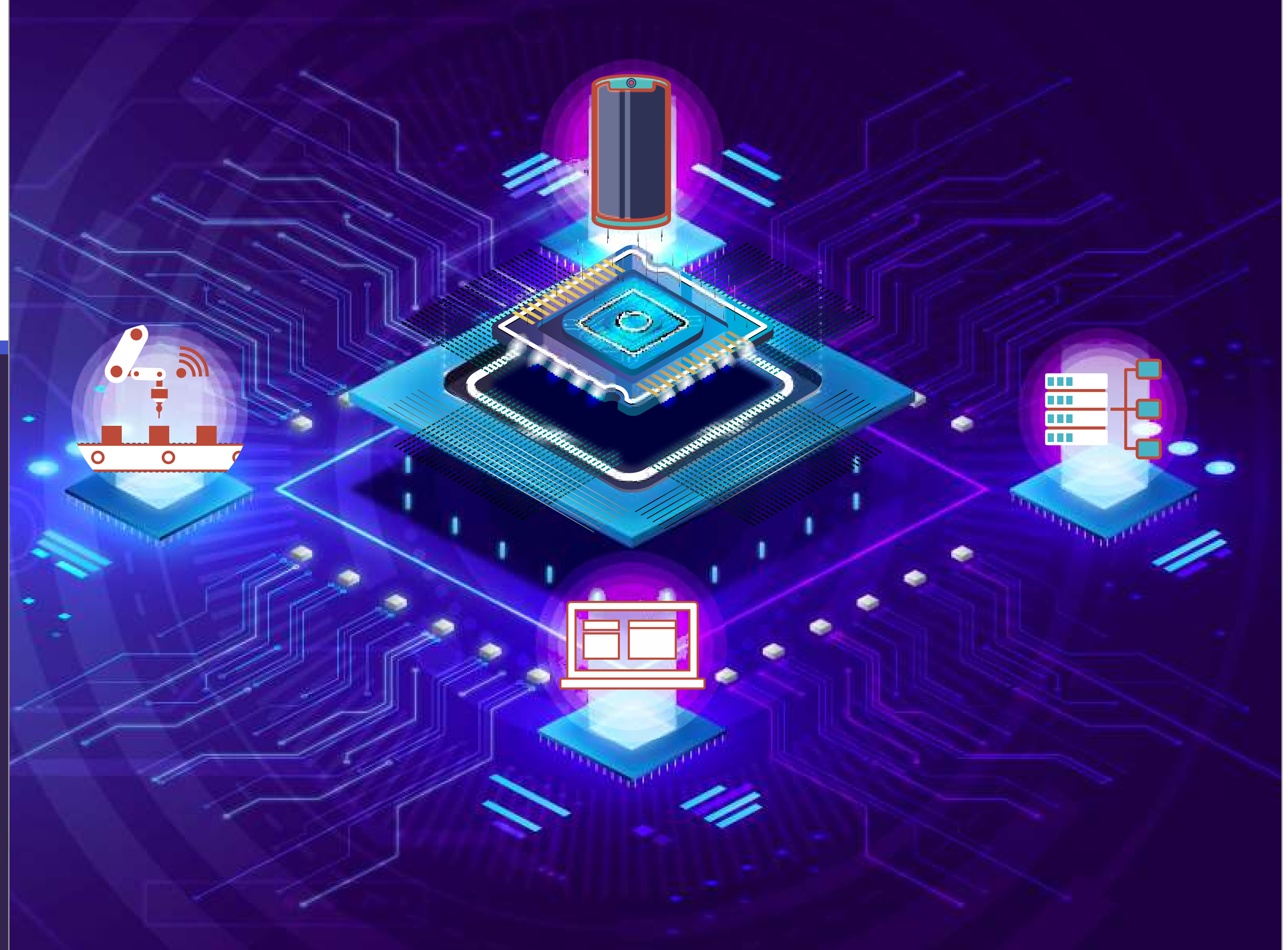
GSFC University, ANVIKSHA, P. O. Fertilizernagar, Vadodara - 391750, Gujarat, India
PH.: 0265 - 3093818 E.: info@gsfcuni.edu.in W.: www.gsfcuni.edu.in

science VIEW

Student's Magazine, Issue: 8, 2023

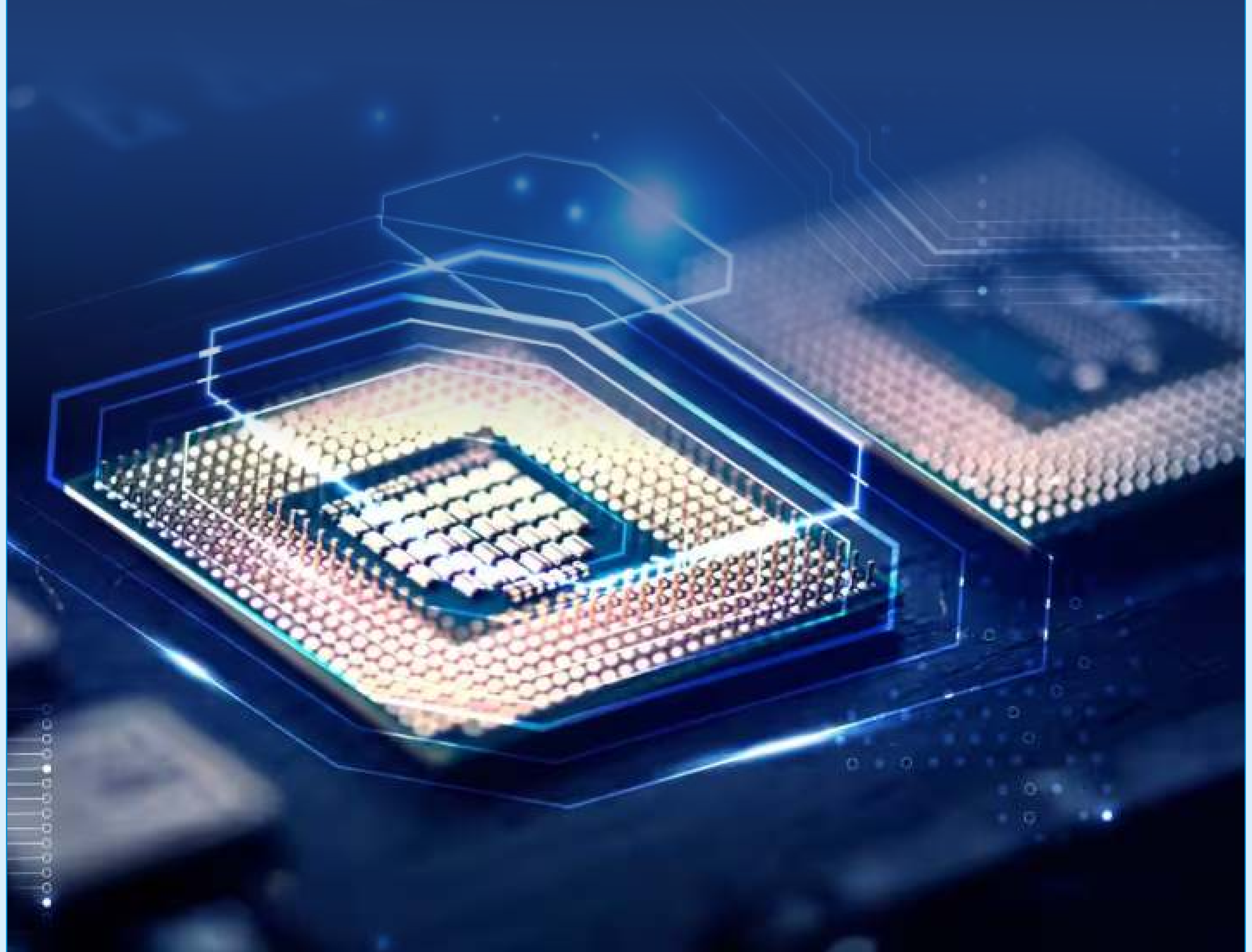
GSFC UNIVERSITY
EDUCATION RE-ENVISIONED
An ISO 9001:2015 Certified

'SEMICONDUCTORS:



THE NEW ERA OF CHIP-LET BASED ARCHITECTURE'.

India on a path to become a Semiconductor State



Dear Readers,

With great pride and joy, we announce the much-awaited launch of the inaugural issue nine of Science View Magazine, 2023 by GSFC University. I am delighted to be the part of this issue of the magazine which is posthumously called, “a magazine for the student, by the student”.

Science View Magazine aims to be a platform that showcases the brilliant minds of young researchers from the students of science background at GSFC University. We are delighted to extend our warmest welcome to all the aspiring scientists, researchers, and writers who have contributed their valuable insights and knowledge to this magazine. The sheer dedication and hard work exhibited by the young scholars in crafting their articles have left us astounded.

The purpose of this magazine is not only to disseminate scientific information but also to foster a community of learning and collaboration. We believe that the future of science lies in the hands of these young researchers, and by providing them with a platform to voice their ideas, we hope to inspire others to join in this journey of exploration and discovery.

As the Editor-in-chief, I express my utmost appreciation and thankfulness to all the contributors who have shared their intellectual articles with us. Each article demonstrates the passion and commitment our young researchers have for their respective fields of study. We are confident that Science View Magazine will serve as a catalyst for innovation and serve as a springboard for further research and breakthroughs.

Our team at Science View Magazine is committed to nurturing the spirit of inquiry among our readers. We pledge to continue supporting the scientific community and providing a platform for meaningful discussions and exchange of ideas.

On this momentous occasion, let us celebrate the freedom of thought and expression that our nation gained on Independence Day and pledge to use this freedom to advance scientific knowledge for the betterment of society and the world.

Once again, a heartfelt thank you to all our young researchers for their remarkable contributions. We look forward to witnessing the impact your work will have on shaping the future of science.

Happy Independence Day!

Sincerely,

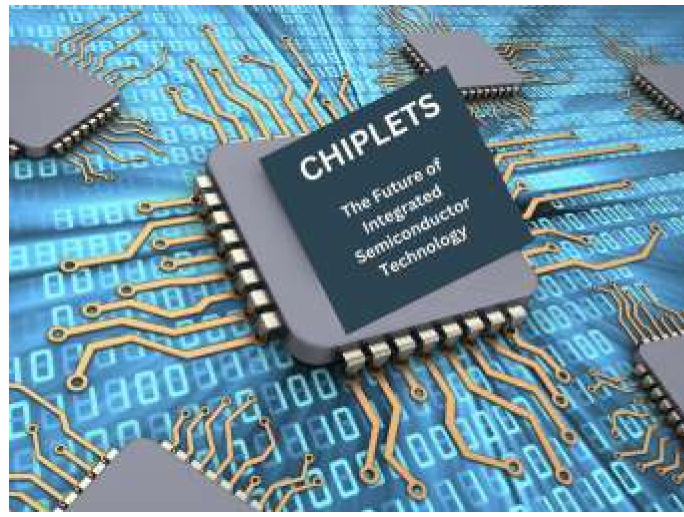
Tanmay Naik

(Assistant Professor for English)

Editor-in-chief

Science View Magazine

GSFC University, Vadodara.



"Chip-let Revolution: Unleashing the New Era of Semiconductor"

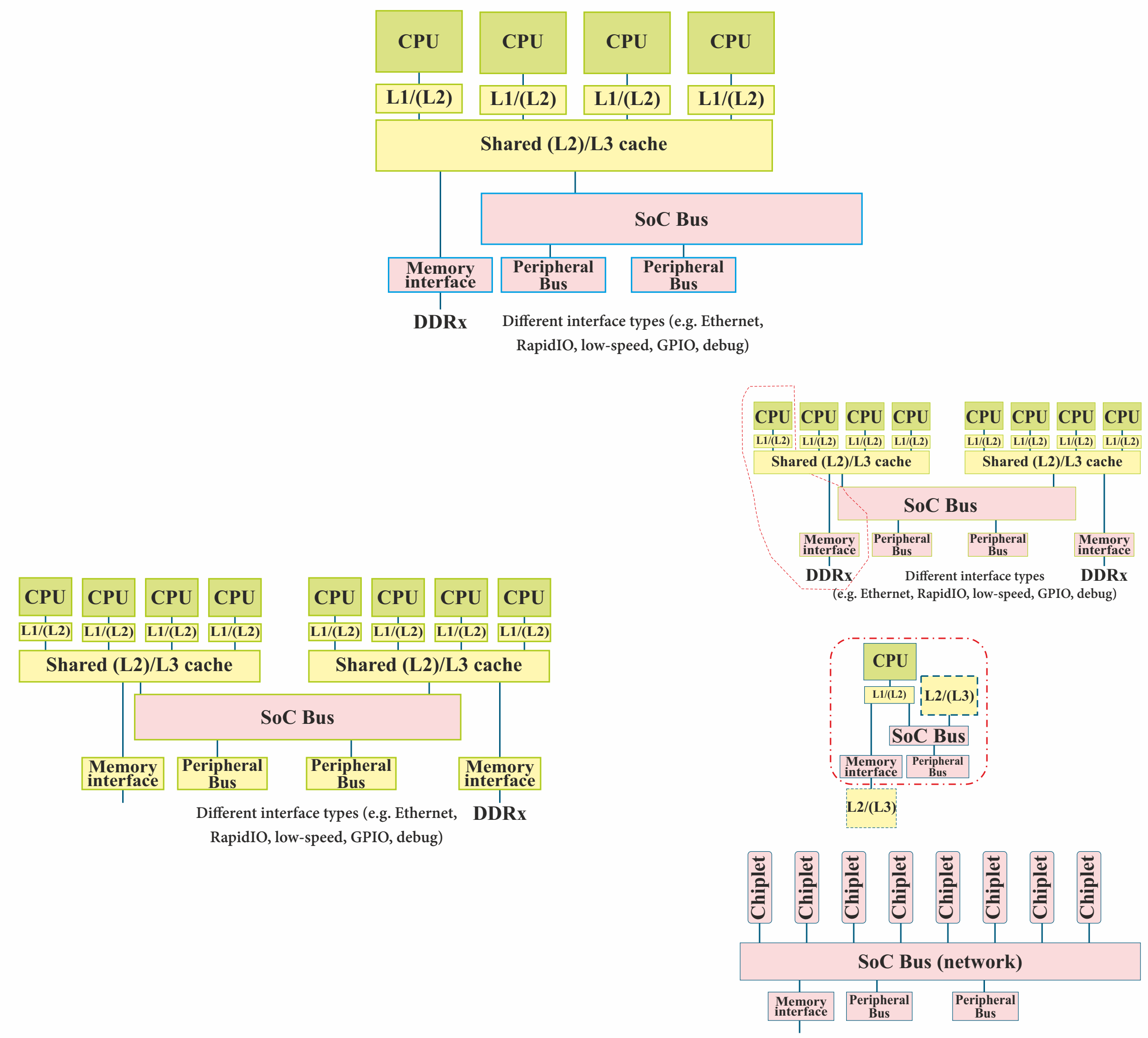
Foram Mistry and Isha Kundaliya
BSC Chemistry – Semester V - 21sc01004 and 21sc01003

History and innovations:

The first attempts were affected by the prohibition in the 1960s, it was never seen as possible to encourage the splitting of semiconductor sheets into smaller samples using electronics and testing or even wafer stacks. Whether is good or bad, Moore's Law shortened the need to implement pure time in integration (WSI) on the wafer scale.

The semiconductor industry has grown from transistors with a minimum feature size of (less than a micron) to s around 10 nanometers and more than 6 billion transistors in single ICs.

At the same time, the cost of combination (ICs) increased due to manufacturing costs, the increasing complexity of intellectual property (IP) cores, and the complexity of system design and verification. Therefore, building an IC with the highest performance, known as the System-on-Chip (SoC), outstripped all improvements (those that can deliver products on the scale except the best-priced the lineup is enough to cover the huge construction cost.



Let's take a look at what makes them special, including eight areas where semiconductor chips have the greatest impact. Before the popular silicon-based chips, computers were big machines made of tubes and dials. They are very happy but it is not easy, not to mention the heavy load because of the energy they need. Semiconductor chips replaced electron tubes, making machines run faster, cheaper, and more efficiently. Advances in design and size have allowed us to offer lightweight, stylish modern mobile phones and smart devices across a wide range of industries. An evaluation by the AFRL/NASA team of the three company's findings resulted in the synthesis of an idea and the creation of a new concept for more quickly leveraging and inserting modern computing architecture features into space-rated component development and procurement processes. The variation in modern computing architectures has exploded in recent years, thanks in large part to the exponential rise of mobile computing platforms. The AFRL/NASA team sought to take advantage of this trend. As such, the team first decomposed complex computing architecture (embellished examples of the generic concepts shown in Figures 1-2) into more fundamental computational elements. It was realized that these more fundamental elements of a full architecture, such as the use of a few clusters of computing cores with corresponding interconnect fabric, memory, and I/O, might be enough to accomplish the performance requirements set forth by the team within the cost constraints defined by the higher level government budget. After further investigation, what emerged was a concept to realize an extensible architecture that could be customized by the end user. The Chiplet Approach We next provide a brief generic sketch of how one might modularly decompose architectures of the form previously shown. As an initial example, we consider the extraction of a single core slice from Figure 2, shown in Figure 3. Figure 3a represents an example partition, resulting in the simplified Figure 3b SoC. As a degenerate “chiplet” no shared cache is necessary, and this concept of a partition would not itself remarkable when viewed against contemporary single-core architectures, except for the external hooks for an external SoC bus. It is, in fact, the notion of this bus (and the different embodiments we shall discuss) that distinguishes chiplets from other integrated circuit systems. In particular, we intend that chiplets can be connected easily to other chiplets, composable and modularly, to construct systems at larger scales of integration with less effort than taking other (non-chipsets) and creating custom glue circuitry. Correspondingly, we show a reconstituted form of the Figure 3a SoC based on the interconnection of chiplets (Figure 3c). The notions of the SoC network are a very important consideration in creating such a system, which we address in a later section. We have considered the notion of a chiplet based on the modular decomposition of a complex SoC. We term this concept “chiplet” to denote a more primitive building block, one more economically viable than a larger SoC (smaller silicon area), yet capable of being combined to approximate a larger (more expensive) SoC. Aerospace applications seek high performance, but low volumes make it difficult to justify the expense of large custom ASICs optimized for even a single application use case, much less for the diversity found in the variety of aerospace projects. With the chiplet concept, it may be possible to underwrite the creation of a smaller Figure 1. Quad-core SoC reference architecture. Figure 2. Extension of the reference architecture. 4 number of primitive blocks that can be combined in many arrangements to suit these disparate applications at a fraction of the price for many individual custom designs. Compared to contemporary radiation tolerant processors, which are built in trailing edge semiconductor technologies (e.g., 150 nm), even a single chipset built in a more advanced node (e.g., 32nm) would represent substantial performance gains. The hope in pursuing chiplets as a modular strategy, however, is to do far better than creating an incrementally better implementation of a previous processor, but rather to provide a means to efficiently scale to much higher levels of performance and much greater power efficiencies.

Happily, the chiplet concept can take gain of important developments in embedded computing. the primary of these is the advent of multicore computing. For a variety of reasons, the progression of ever more capable monolithic (single-core) computing stalled during the last 15 years (marked with the aid of a leveling off of clock speeds), driving the enterprise to partition monolithic floor plans into numerous processor factors (cores) to preserve overall performance thru parallelization. have been this now not the case, it would be hard to don't forget the way to cleanly partition a very large tightly-coupled monolithic location, and the chipset idea could be impractical. The second critical fashion in embedded computing is the fashion towards heterogeneous computing, where numerous one of the kind kinds of computation is present inside the same complex gadget. In this situation, using “style,” we noted the belief that a few sorts of computing tend to be driven via regular structure (e.g., predictable, stream-based processing that can take advantage of pipelining, “circuit-able” forms that lend toward implementation in area programmable gate arrays), even as others tend to have a much less predictable shape (extra complicated threads and randomized branching). No single processing architecture can do all thoroughly, mainly for structures that contain a combination of processing kinds. A cutting-edge cellular cellphone for instance will commonly have a multicore processor (acceptable for standard-motive computing, especially thread-in-depth processing), a photos processing unit (for extensive move-primarily based processing), and several virtual indicators processing units (extra efficaciously pipelined for audio and radio-frequency functions). Right, here again, the chiplet idea can take gain of the implicit modularity represented by using the want for those one-of-a-kind varieties of

computing to coexist in the identical ordinary system.

Conclusion:

The global chip shortage highlights the importance of semiconductor chips and why improving and increasing their supply is essential for modern life. Machines big and small rely on semiconductor chips.

You can see them not just in your hand, but outside of your internet connection and even under the steering wheel. Here are the industries and industries that revolve around small appliances.

1. Computing

Microchips and computers are often the first connections people make. Depending on the chip type, semiconductors use binary code to receive the command you load when starting programs or downloading and saving files.

Microprocessors, memory, and graphics processing units (GPUs) are common electronic components for computers. As a result, they help your machine work well, preventing your battery and whole body from burning out while playing video games,

2. Telecommunications

The principle of semiconductors used in telecommunications is the same: control the machine. The difference is the type and purpose of the chip used. At the same time, their designs differ from product to product. A mobile phone's semiconductor chips can affect its display, navigation, battery usage, 4G reception, and more. Even taking pictures and using different apps uses one or the other chip.

But it's not just about phones. Think routers, answering machines, and pagers. The spectrum of technologies based on telecom semiconductors is very wide.

3. Household appliances

Refrigerators, microwave ovens, washing machines, air conditioners, and other machines in the home and office work with semiconductors.

Different chips control temperature, timers, automation functions, etc.

Our facilities are full of equipment that facilitates daily habits, making them more useful with smart devices and the Internet of Things (IoT). As a result, semiconductor chips are constantly changing to meet ever-increasing standards and often require immediate processing, a wide range of services, and durability.

4. Crime

Once you understand what electronics do, it's easier to imagine how the high-tech world will benefit from it. Banks are big investors, especially in the best microchip designs. Online communication, digital accounting, cloud platforms, etc. Computers and bank accounts are very important. But banks also need semiconductors for ATMs, security cameras, and even automatic locking systems. Also, the more powerful the device, the better. Semiconductor chips could help banks keep money and personal information safe, especially artificial intelligence and machine learning in banking.

5. Security

From a security standpoint, semiconductors both increase and hinder security. As in other areas of technology, the development of microchips has paved the way for new threats. But these innovations also help protect them. The contribution of semiconductor chips to cybersecurity starts with hardware. The performance of any program you install later depends on how well your computer supports them. Good electronics, for example, motion-detection cameras for quick warning and security measures.

6. Treatment

Using advanced devices in treatment. Difficult and risky surgeries are becoming safer and more precise thanks to machines. Monitors and pacemakers are also popular. He can also talk to patients and diagnose symptoms only via videoconferencing. Without semiconductor chips to control power, sensors, temperature, pressure, calculations, and many other functions, none of these devices can function properly. Like safety, a lot of thought is put into designing medical devices and ensuring they don't fail. Health is where semiconductor technology shines.

They improve our quality of life, but they also protect our quality of life.

7. Transportation

Cars, buses, trains, and airplanes are larger devices that also use electricity. If you value GPS, free Wi-Fi, or a nice sound that alerts you every time you download, you'll appreciate that these little chips can improve today's habits. In general, EVs are more common than analog cars.

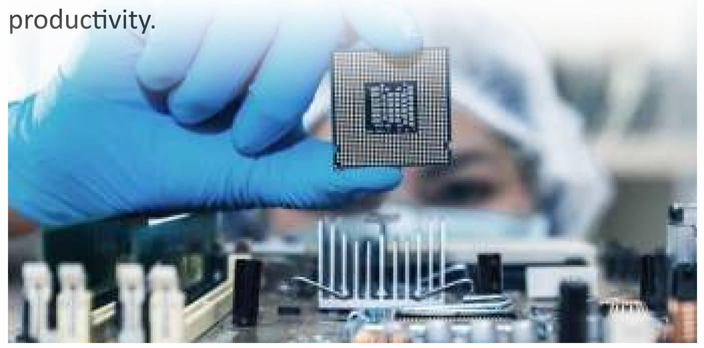
They take the stress out of travel and replace it with great information and easy tools for getting around, roadside assistance, parking, and more.

Because semiconductors are so modern, manufacturers need to specialize in the industry.

8. Manufacturing

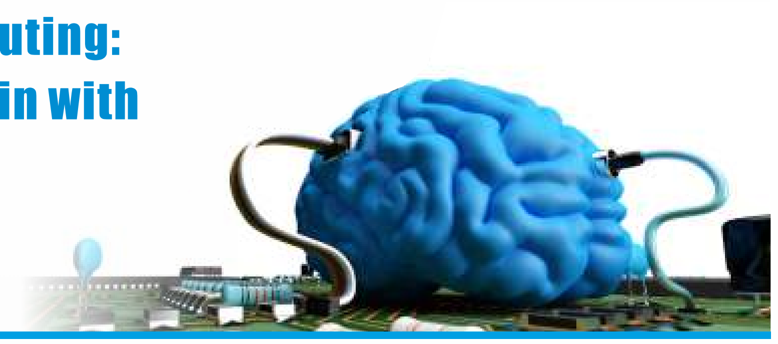
Semiconductors have the advantage of developing their designs and production of all other products. The machines in the office work on special, repetitive, carefully structured hardware and software. Also, keep in mind that each device uses some power. A bad design can shorten the production process, causing delays and unnecessary costs.

So, whether a device is self-contained or needs someone to manage it, its capabilities must be reliable, and most depend on semiconductor chips. Many efficiency and economic factors are related to smooth operation and productivity.



"Neuromorphic Chip Computing: Mimicking the Human Brain with Semiconductors"

Utsavi Patel
BSc Biotechnology – Semester V - 21sc02015



Introduction

Neuromorphic computing, an interdisciplinary field at the intersection of neuroscience and computer engineering, aims to replicate the human brain's neural architecture using semiconductor-based technologies. Inspired by the brain's extraordinary computational abilities, this cutting-edge research area holds the potential to revolutionize computing as we know it. With a focus on developing brain-like circuits and algorithms, neuromorphic computing is poised to unlock new frontiers in artificial intelligence (AI), enabling machines to emulate human-like cognitive capabilities. In this article, we delve into the research, development, and global impact of neuromorphic computing.

Research and Development: The origins of neuromorphic computing can be traced back to the late 1980s, with the pioneering work of Carver Mead, a renowned physicist and engineer at the California Institute of Technology (Caltech). Mead's influential research laid the groundwork for neuromorphic engineering, emphasizing the significance of building brain-inspired computing systems. Over the years, other institutions and researchers around the world have joined the pursuit, contributing to the exponential growth of this field. Several countries have taken significant strides in the development of neuromorphic computing. The United States, with its strong research infrastructure and numerous academic institutions, remains at the forefront. Universities like Caltech, Stanford, and MIT are among the vanguards, fostering groundbreaking research in neuromorphic engineering. Additionally, Europe has also made remarkable progress, with countries like Switzerland, Germany, and the United Kingdom actively contributing to the field. Furthermore, countries in Asia, including Japan, South Korea, and China, have invested heavily in research initiatives and facilities, making significant advancements in neuromorphic computing.

1. Brain-Inspired Algorithms and Learning Mechanisms:

- Exploring neural networks and synapse-like connections in neuromorphic systems.
- Unsupervised learning and spike-based processing for efficient information encoding.
- Comparison of neuromorphic learning approaches with traditional machine learning techniques.

2. Neuromorphic Hardware Architectures:

- Spiking neural networks (SNN) and their implementation in neuromorphic chips.
- Memristors and their potential as brain-like memory elements in hardware.
- Brain-inspired neuromorphic chips vs. traditional von Neumann architectures.

3. Brain-Computer Interface (BCI) Applications:

- Advancements in BCI technology using neuromorphic computing principles.
- Enabling communication and control for individuals with paralysis or motor impairments.
- Ethical considerations and challenges in brain-computer interface research.

4. Neuromorphic Vision Systems:

- Development of neuromorphic vision sensors for event-based visual processing.
- Applications in robotics, autonomous vehicles, and surveillance systems.
- Simulating human visual perception using spiking neural networks.

5. Cognitive Robotics and Neuromorphic Control:

- Integrating neuromorphic processors in robots for adaptive and intelligent behavior.
- Sensorimotor integration and real-time decision-making in autonomous robots.
- Implications for industries like manufacturing, logistics, and space exploration.

6. Neuromorphic Computing in Neuroscience Research:

- Collaboration between neuroscientists and engineers to study the brain.
- Using neuromorphic systems to simulate brain activity and understand cognition.
- The potential for accelerating neuroscience discoveries through computational models.

7. Challenges and Future Directions:

- Addressing hardware limitations and scaling issues in large-scale neuromorphic systems.
- Ensuring privacy and security in brain-inspired AI applications.
- Bridging the gap between neuroscience and engineering disciplines for better synergy.

8. Neuromorphic Computing and Ethics:

- Ethical considerations in developing AI systems that mimic the human brain.
- Responsible use of neuromorphic technology in society and potential biases.
- Striking a balance between AI capabilities and human values.

University Scientists and Pioneers:

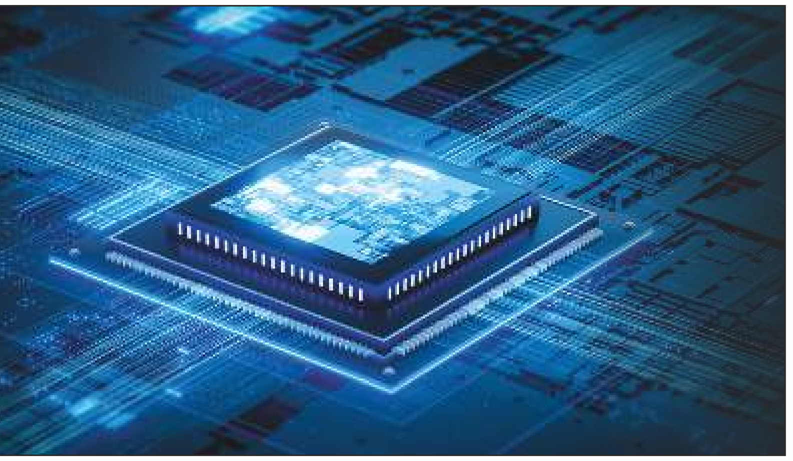
Prominent scientists and researchers have been instrumental in driving neuromorphic computing forward. Among these visionaries, Dr. Kwabena Boahen, a professor at Stanford University, stands out for his groundbreaking contributions to neuromorphic chip design and implementation. His work on the "Neurogrid" system, which simulates a million neurons in real-time, has paved the way for future developments in this domain. Additionally, Professor Karlheinz Meier from the University of Heidelberg has been a key figure in establishing the European Human Brain Project, advancing neuromorphic research across the continent.

Potential Impact and World-Changing Applications:

The potential impact of neuromorphic computing extends to various sectors, from healthcare and robotics to climate modeling and beyond. In healthcare, brain-inspired AI systems can aid in diagnosing diseases, personalized medicine, and brain-computer interfaces for individuals with disabilities. In robotics, neuromorphic processors enable machines to navigate complex environments with human-like adaptability and efficiency. Moreover, energy efficiency is a hallmark of neuromorphic computing, which can lead to significant reductions in power consumption and environmental impact compared to conventional computing methods.

Conclusion:

Neuromorphic computing represents a paradigm shift in the world of AI and computing. As researchers and scientists continue to unravel the mysteries of the human brain and implement its principles into semiconductor-based technologies, the possibilities are boundless. From medical breakthroughs to transformative advancements in various industries, the journey of neuromorphic computing is set to change the world as we know it, bringing us one step closer to unlocking the full potential of artificial intelligence and ushering in a new era of intelligent machine.



“Semiconductor Chips”

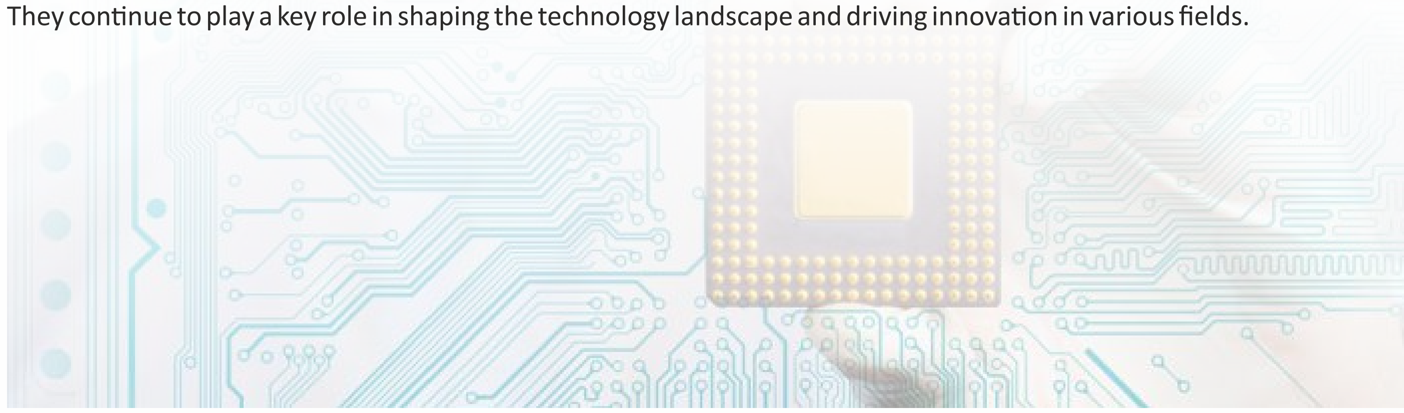
Dev Patel
BSc Industrial Chemistry – Semester V - 21sc03001

Semiconductor chips, commonly referred to as integrated circuits (ICs) or microchips, are key components used in a wide variety of electronic devices. These chips are made of semiconductor materials, typically silicon, which have unique electrical properties that allow them to control the flow of electrical currents. A semiconductor chip is a compact arrangement of electronic components such as transistors, diodes, resistors, and capacitors that work together to perform specific functions. These components are interconnected by conductive paths etched on the surface of the chip to form complex electronic circuits. The miniaturization and integration of these components into a single chip makes it possible to create powerful and efficient electronic devices.

Semiconductor chips come in a variety of forms, including:

1. **Microprocessors:** These are the central processing units (CPUs) of computers and other digital devices. They carry out instructions and perform calculations, allowing the device to run software and perform tasks.
2. **Memory chips:** These chips store data and program code. Examples include random access memory (RAM) and read-only memory (ROM).
3. **Graphics Processing Units (GPUs):** These chips specialize in handling the complex graphics calculations necessary for high-quality graphics in computers and game consoles.
4. **Application-Specific Integrated Circuits (ASICs):** These chips are designed for specific applications or tasks, tailored to perform those functions efficiently.
5. **Field Programmable Gate Arrays (FPGAs):** These are chips that users can reconfigure after manufacturing, making them flexible for different applications.
6. **Analog Chips:** These chips process continuous signals such as sound and radio frequencies and are essential in communication devices and audio systems.

Semiconductor chips are manufactured by a process called semiconductor manufacturing (semiconductor manufacturing process). The process involves several steps, including design, wafer fabrication, photolithography, etching, doping, and packaging. Advances in semiconductor technology, such as Moore's Law, have led to the continued miniaturization and increased performance of these chips, contributing to the rapid advancement of modern electronics. Semiconductor chips have revolutionized the electronics industry and are found in a variety of devices, including computers, smartphones, tablets, televisions, medical equipment, automotive electronics, home appliances, and more. They continue to play a key role in shaping the technology landscape and driving innovation in various fields.



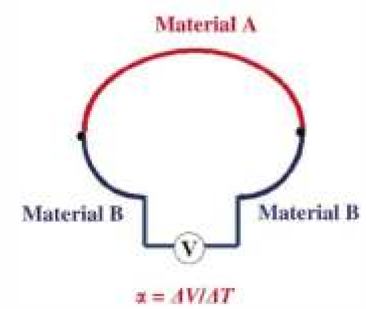
“Thermoelectric Materials”

Manan Shah
MSc Chemistry – Semester IV - 21msc01038

In the era of science and technology, the world is moving towards the development of new technologies day by day. Observing an increment in the demand for energy sources over the last few decades researchers are interested in finding new methods for energy generation other than the conventional ones. This search leads to the invention of thermoelectric material which is used in the making of thermoelectric devices. A thermoelectric device converts heat energy into electric energy. Thermoelectric material is heavily doped semiconductor materials that use the temperature difference across the device and produces electric energy. The band structure of semiconductors offers better thermoelectric effects than the band structure of metals. The Fermi energy is below the conduction band causing the state density to be asymmetric around the Fermi energy. Thermoelectric materials are based on the application of the thermoelectric effect which directly converts the temperature difference through the thermocouple to electric energy or visa-versa. A thermocouple is a thermal junction of two dissimilar metals. Thermoelectric material produces a heating or cooling effect based on the need without any movement or use of refrigerant. There are a few basic effects on which thermoelectric devices work. They are the Seebeck effect, and Peltier effect, and the Thomson effect.

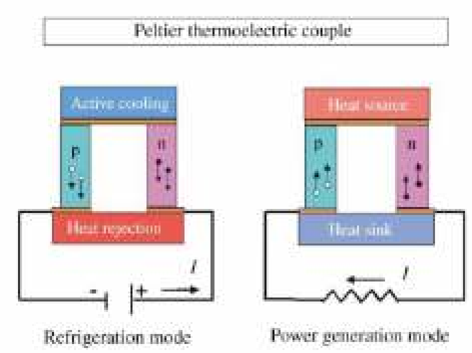
Seebeck Effect

The Seebeck Effect is first reported by Johan Seebeck. It is a thermoelectric effect that converts the thermal effect or the thermal difference to electric energy through the use of thermocouples. In the Seebeck effect, one junction is on the heating side and the other junction on the cooling provided this temperature difference electric current is produced. The Seebeck constant is calculated as the ratio of potential difference (ΔV) and temperature difference (ΔT).

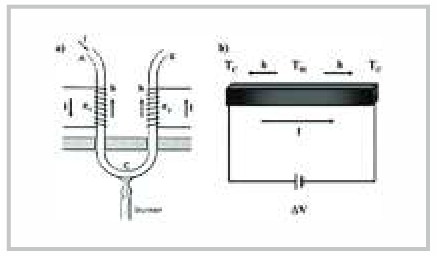


Pelter’s Effect

Peltier’s effect is a thermoelectric effect that converts electric voltage to a thermal effect or cooling effect through the use of a thermocouple. In Peltier’s effect heating takes place in one junction and cooling takes place in another junction when electric current is applied to the circuit.



Thomson Effect



The Thomson effect refers to the phenomenon where the electric potential is applied to a single material conductor having a thermal temperature difference, heat is adsorbed or dissipated based on the direction of flow of the voltage about the temperature difference.

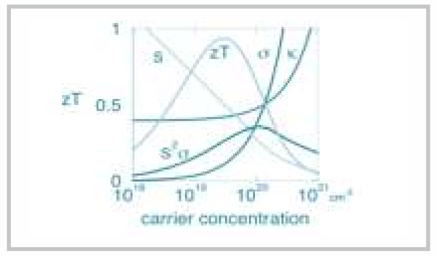
Thermoelectric Figure of Merit

The efficiency of the thermoelectric material is determined based on the properties such as thermal and electrical conductivity Seebeck coefficient and temperature difference. The maximum energy conversion is dependent on the thermoelectric figure of merit of any material. It is the basic relation of the electric conductivity, thermal conductivity, and Seebeck coefficient about the given temperature difference.

$$ZT = \frac{S^2\sigma}{\kappa}T$$

Were,
σ = electric conductivity

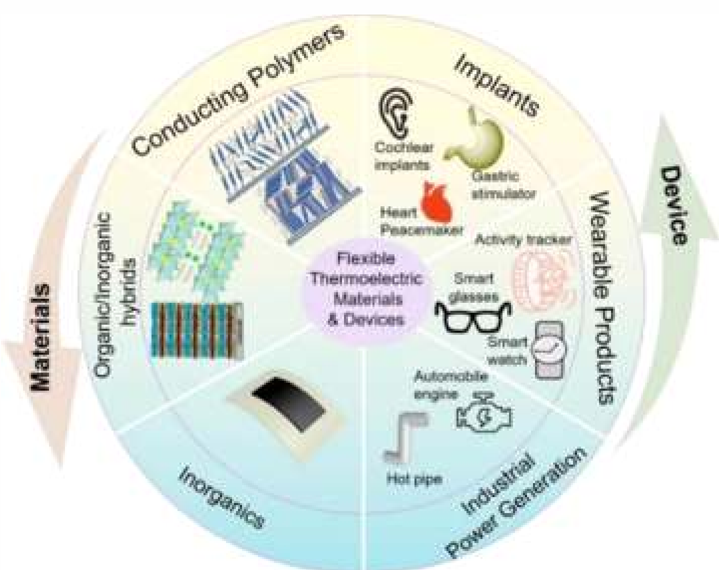
Good thermoelectric materials are heavily doped semiconductors: semiconductors that have so many free electrons that they have many properties similar to metals. The charge carrier concentration depends on intrinsic defects (such as atom vacancies) as well as extrinsic dopants (impurities). Because all the properties in zT, Seebeck coefficient, electrical resistivity, and thermal conductivity depend on charge carrier concentration in a conflicting manner (see figure) achieving high zT in a material typically requires optimizing the charge carrier concentration. Thus, the search for (or comparison of) good thermoelectric materials is a search for a material with the highest potential for high zT presuming it can be optimally doped.



Applications of Thermoelectric Materials

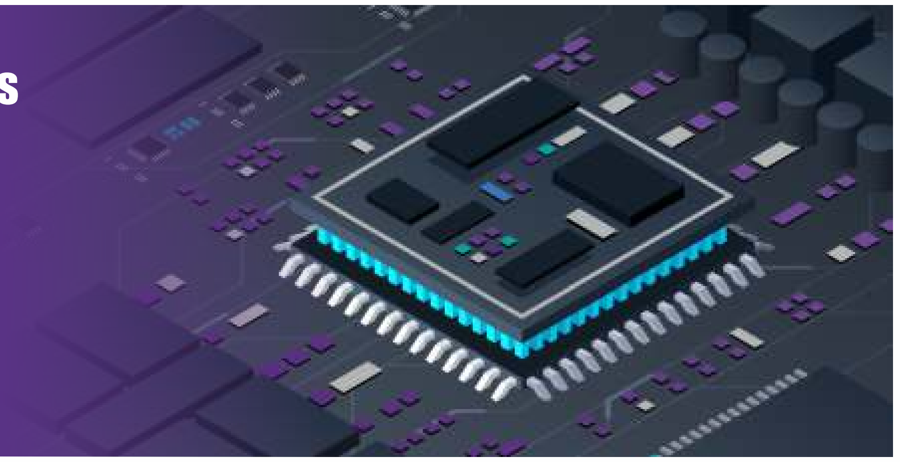
Thermoelectric devices produce electric energy without any environmental concerns. The thermoelectric field is yet to be explored for large-scale electric production, but the thermoelectric field is a promising field for the future. The current applications include using thermoelectric material in the health sector like blood sugar sensors charging themselves using the body temperature, wearable watches have a scope in self-recharging while recharging. The major advantage of thermoelectric devices is,

1. It does not include any moving parts
2. No refrigerant not included (in case of cooling)
3. They are flexible and have good strength over wear and tear.



"Redefining the Horizons of Semiconductor Technology with Multi-Die Systems"

Dr Chandra Has
Assistant Professor in Chemical Engineering,
School of Technology, GSFC University



The semiconductor business is undergoing dramatic change as it strives to fulfil the increasing need for smarter, more efficient, and networked electronic gadgets. This article goes into the realm of Multi-Die Systems or chiplets-based design, an innovative semiconductor design technique that promises to revolutionize the future of electronics. Unlike traditional monolithic chips, Multi-Die Systems divide complicated systems into specialized chipsets, each optimized for a specific purpose. Multi-Die Systems deliver unprecedented performance, flexibility, and cost-effectiveness by merging these chipsets onto a single package. This article examines the benefits of Multi-Die Systems, such as improved performance optimization, customization flexibility, cost-effectiveness, and smooth heterogeneous integration. Industry adoption and development are addressed, as are potential difficulties and future opportunities.

Integrated Circuits Evolution: From Monolithic Chips to Multi-Die Systems:

The development of integrated circuits has been a fantastic journey from the earliest monolithic chips to the most advanced multi-die systems (Table 1).

COMPARISON OF ATTRIBUTES BETWEEN MULTI-DIE SYSTEMS AND MONOLITHIC CHIPSETS. COURTESY: SYNOPSIS REPORT: (2023)

Attributes	Multi-Die Systems	Monolithic Chipsets
Design Complexity	Complex	Less Complex
Interconnects	Die-to-Die	On-Chip
Manufacturing Cost	Cost-Effective	Expensive
Performance	Higher	Generally lower
Power Efficiency	Improved	Moderate
Scalability	Highly scalable	Limited
Flexibility	Enables custom chip configurations	Fixed functionality

The first semiconductor technology, monolithic chips, had a single silicon wafer that included all of the circuitry and parts. These chips revolutionized electronics, enabling the development of smaller and more powerful gadgets. The limits of monolithic chips, however, became apparent as demands for more performance and efficiency increased. Barriers to future development included heat dissipation, connector lengths, and manufacturing difficulties. The semiconductor industry responded by embracing a paradigm change and creating multi-die systems (also known as chiplet-based architecture). With this novel method, many semiconductor dies are combined into a single box and coupled using sophisticated packaging techniques. The ability to specialize each die for particular tasks enables effective work allocation and enhanced performance. This revolutionary development has expanded the possibilities for semiconductor technology, catapulting it to new levels of computational power, energy efficiency, and diversity. Data centers, Internet of Things (IoT), and high-performance computing are just a few of the areas where multi-die systems have found use, revolutionizing how we interact with technology and presenting previously unimaginable possibilities.

In brief, a multi-die design involves breaking down a large semiconductor design into smaller dies, known as chiplets or tiles, and integrating them within a single package to meet power and form factor objectives [Larsen and Mota, 2021]. Unlike monolithic designs, where all functions reside on a single silicon piece, the multi-die approach offers product modularity and flexibility. It allows for mixing and matching separate dies in packages to cater to diverse market segments and specific needs. For instance, a product aimed at different markets, including low-end, high-end, and mid-range segments, can benefit from a multi-die approach. Additionally, multi-die designs allow for combining different process nodes, with specific functions using advanced nodes while others utilize older nodes, thus optimizing the overall technology node usage effectively.

Unleashing the Potential: The Maturity of Multi-Die System Ecosystem The maturing ecosystem surrounding multi-die systems is fostering their wider adoption, with key chipmakers like AMD, Apple, Amazon Web Services, and Intel already offering such designs [Kapoor, 2023]. Propelled by advanced tooling, standardized IP, and developments in packaging technologies like silicon interposers and 3D-stacked advanced packaging, multi-die systems demonstrate high integration density, improved power efficiency, and performance. The Universal Chiplet Interconnect Express (UCIe) specification is emerging as a critical enabler for die-to-die connectivity, supporting various package types and high bandwidth capabilities. Additionally, the emergence of silicon photonics offers energy-efficient bandwidth scaling for multi-die packages, addressing the challenges of power and data volume. With these advancements, multi-die systems are becoming a compelling solution in the semiconductor landscape. According to Electronic Technology Forecast, In 2023, the multi-die systems are expected to make significant progress in the semiconductor industry. The broader ecosystem around these architectures is maturing, with investments in design and verification tools, IP, and manufacturing converging to overcome previous barriers.

Multi-Die Systems Challenges

- Lack of Awareness: Many business leaders are unaware or have limited knowledge about chiplet-based technology. The poll conducted by MIT Technology Review Insights [Synopsis Report, 2023] showed that 62% of respondents were either uninterested, unaware, or only somewhat aware of this technology's capabilities. This lack of understanding can hinder the adoption and implementation of chiplet-based solutions.
- Interconnect Complexity: Designing efficient interconnects between chiplets is complex, limiting scalability and bandwidth.
- Thermal Management: Integrating multiple chiplets can lead to thermal challenges, affecting heat dissipation and reliability.
- Testing and Verification: Ensuring proper functionality and interaction between chiplets requires advanced testing and validation methods.
- Standardization: The absence of industry-wide standards for chiplet interfaces can hinder widespread adoption.
- Cost of Implementation: Initial implementation can be resource-intensive, requiring additional investments in design, architecture, and testing.

Future Opportunities

The emergence of multi-die systems presents a multitude of future opportunities in the realm of electronics and computing [Shan et al., 2022]. These architectures offer enhanced modularity and customization options, enabling the creation of specialized processors optimized for specific tasks and applications, ultimately improving energy efficiency and overall performance. Moreover, the versatility of chiplet-based systems allows for the integration of diverse components into a single package, leading to highly efficient heterogeneous computing systems suitable for a wide range of applications. Additionally, these architectures simplify system scalability and upgradability, making upgrades and replacements of individual chiplets easier, thus extending the lifespan of computing systems. With reduced design complexity and costs, chiplet-based architectures can accelerate innovation, resulting in faster time-to-market for new technologies. By focusing on energy efficiency and incorporating advanced packaging and memory technologies, the future of multi-die systems holds great promise in delivering greener, more powerful, and application-specific solutions for various industries.

Conclusion

Multi-die systems represent a paradigm shift in semiconductor design and manufacturing. By breaking away from the constraints of monolithic chips, multi-die systems offer increased performance, modularity, cost-effectiveness, and scalability. As the industry continues to push the boundaries of what is possible, multi-die systems are poised to define the future of semiconductors. From consumer electronics to data centers and beyond, the integration of specialized chipsets will unlock new possibilities and shape the next generation of technological advancements.

"Semiconductors Neet Biology"

Dr Akhilesh Prajapati
Assistant Professor in Biotechnology,
School of School, GSFC University

Synthetic biology's disruptive potential is as intriguing now as the first transistor's revolutionary impact during the vacuum tube era. Both technologies seem to have similar growth histories, starting with quick advances in the fundamental sciences and progressing swiftly through the process development stage to commercial viability. Additionally, there are indications that the semiconductor sector may assist SynBio and so benefit financially from the value this technology creates. SynBio is ready to upend several trillion-dollar industries. The companies that are created as a result of this technology have the potential to revolutionize ends. A trillion-dollar industry might be upended by synthetic biology, and semiconductor companies may play a role in that. markets in the chemical, chemical products, energy, and healthcare industries. And as the industry evolves, semiconductor firms could play a key role in bringing about the era of SynBio-enabled cellular computing and seizing adjacent market opportunities if they take advantage of this momentum.

What is Synthetic biology:

SynBio is the study of living things (usually basic cells or microbes) with synthetic DNA that biologists create by metabolic engineering or through other means of changing bacteria to produce a certain system, function, or good. For instance, scientists can instruct microorganisms to transform biological material into particular compounds or biofuels. Similarly, to this, biotech firms can utilize synthetic DNA to instruct bacteria or yeast to produce particular proteins that can then be used by the business to create biological drugs. Entrepreneurs working with SynBio are starting to think of creative new uses for the technology. For instance, one startup raised money through the peer-to-peer funding platform Kickstarter to develop a synthetically engineered light-emitting plant that it claims could result in a new source of lighting. In a 2013 examination of disruptive technologies, the McKinsey Global Institute (MGI) named SynBio as one of the top technologies that could create significant economic disruptions between now and 2025. In 2025, MGI projects that next-generation genomics, including SynBio, would have a combined economic impact of between $700 billion and $1.6 trillion, upending important sectors of the economy like agriculture, energy production, and healthcare. Scale-out model adaptation for the SynBio ecosystem: The vertically integrated pharmaceutical companies creating biologics and the chemical companies are the main players in the genomics-driven SynBio business. Most value chains are established internally by businesses creating bio-based products. It also covers testing processes, synthetic DNA, and organism growth tools. Some in the SynBio community are working to transform this vertically integrated development paradigm into a scale-out one, where businesses create best-in-class components for every link in the value chain and, in doing so, unleash fresh bio-application breakthroughs.

In some instances, there are many similarities between the semiconductor and SynBio sectors. In reality, SynBio's scale-out attempt is comparable to what vertically integrated systems businesses went through when they used the scaleup methodology to previously create semiconductors largely in-house. But more recently, the concept has transformed into a booming scale-out semiconductor sector that creates particular chiplets for certain use cases.

In this paradigm, the development tools are provided by the tool and design industry, and the chips are produced by the fabrication business. Here, semiconductor businesses have a huge chance to capitalize on their scale-out model experience and apply their commercial knowledge to the SynBio sector. Chip players need to look at the SynBio ecosystem and value chain and recognize how they are starting to resemble those of the semiconductor sector to comprehend why this strategy can be successful in SynBio. The recent reports on market display discuss the similarities between the semiconductor environment and the SynBio ecosystem. SynBio can assist the sector in broadening its core understanding of computing from a silicon base to a cell base, fundamentally altering expectations for what computing can do and which industries it can influence. Additionally, it raises a crucial query: what kind of ecosystem would the sector require to make biological computing a reality?

One scenario envisions SynBio developing into a thriving scale-out ecosystem of design, software, and manufacturing firms that upend numerous trillion-dollar businesses. This ecosystem would be crucial in developing the models and resources needed to build organic computers and circuits. Furthermore, the expansion of SynBio opens up a variety of innovative prospects for the creation of tools and procedures as well as the use of tried-and-true yield-accelerating techniques and services. These openings could result in actual business possibilities for semiconductor industry participants when taken as a whole. As a result, we think that semiconductor players with knowledge of tools and procedures as well as experience in mass production could be disruptive in the developing SynBio field.

"Neurotransmitters: An Incredible Biomimic Tool"

Rushali More BSc Biotechnology –
Semester V - 21sc02010

Abstract

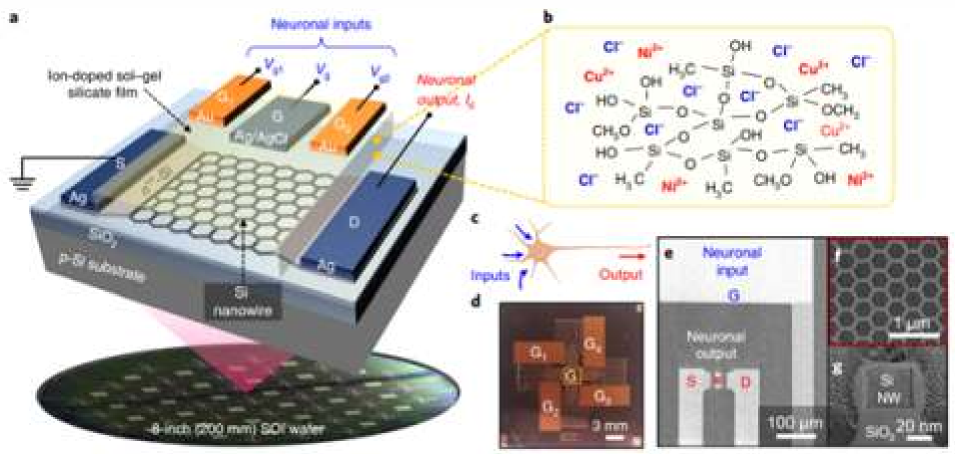
Neurotransmitter production is mainly focused on the intrinsic flexibility of neuronal membranes and the plasticity of artificial synapses. (Baek et al., 2020) A nanowire transistor coated by an ion-doped sol-gel silicate film which emulates the intrinsic plasticity of the neuronal membrane was reported to be used for neurotransmitters. Manufacturing is done by using a conventional complementary metal-oxide-semiconductor process, on around 8-inch silicon-on-insulator wafer. The plasticity of neurotransmitter is shown by mobile ions that allows the film to act as a pseudo-gate for generating memory. The input signals are non-linearly processed by sigmoidal transformation into the output current. The output current response is governed by input signal history that is stored in the form of ionic states which are stored in silicon film and hence provide learning capabilities. The major recent focus of neuromorphic computing is resistive neuronal networks. An alternative physical embodiment of neuronal networks is capacitive neural networks that feature lower static power and a better emulation of neural functionalities. Another study (Wang et al., 2018), they had developed neuro-transistors by integrating dynamic pseudo-memcapacitors which act as a gate to produce electronic analogs of the soma and axon of a neuron as well as having "leaky integrate-and-fire" dynamics augmented by a signal In gain on the output. They paired it with non-volatile pseudo-memcapacitive synapses. (Kim et al., 2020) study, which suggests the use of 3D stackable synaptic transistors for 3D Artificial Neural Networks (ANN) that would be the strongest material for future computing systems for minimizing power consumption in interconnection. They suggested the use of feasible monolithic 3D integration of synaptic devices by using the channel layer transfer method through a wafer bonding technique. The good linearity was shown when a low-temperature processible III-V and composite oxide (Al_2O_3/HfO_2)- based weight storage layer was used. The different ways of addressing the problem led to emerging new techniques and ways. Hence, bio-mimic tools have the potential to embark on our future technology and utility.

Introduction

Our brain is full of a complex network of synaptic connections between millions of neurons that are incredibly capable of learning and memorizing information. The neuromorphic architectures stand out from von Neumann machines. Von Neumann machines split memory and processing of information into two separate units, this restricts the ability to solve complex problems. Hence, cost a huge amount of energy and material consumption. The construction of any neuromorphic architecture comes from two basic fundamental units i.e., artificial synapses and artificial neurons. Artificial synapses are programmed to assure learning and plasticity by the modification of synaptic weighting. While on the other hand, neuron is specialized for learning and plasticity employing information processing using a non-linear integration implemented by its cell membrane. (Baek et al., 2020) For artificial synapses, the memristor-crossbar network is considered to be important as they emulate synaptic plasticity by building circuits for training and pattern recognition. To mimic the rhythmic activity of the brain spintronics-based concepts can be used. Hence, it could also provide memory storage. Synapse is well – a known element for storing memory and transmitting neuronal signals. Numerous experiments show the neuron plays a critical role in learning and memorizing. The ability of neurons to form networks and initiate excitability signals by changing the membrane potential or voltage gate. The activity to process information through the integration of presynaptic signals and the generation of new postsynaptic signals is known as intrinsic plasticity. The synapses are similar to a transistor if take on all the considerations. And such neurotransmitters can perform great functions as a plastic computing node which is just like a real neuron in a complex neural network. The (Baek et al., 2020) research article highlights the recently developed neurotransmitter that can perform "leaky integrate-

-and-fire" dynamics of a biological neuron by integrating memristors along with capacitors and these are used as a gate of the transistor. The sigmoidal dynamics play a vital role in filtering and identifying the important input patterns which will be further propagated to axon terminals.

1. (Baek et al., 2020) The neurotransmitter developed was based on a top-down processed silicon nanowire (Si NW) field-effect transistor (FET) which was covered with a metal-ion-doped sol gel-derived silicate dielectric film and also has multiple input gates and output nanowire channels represented in below figure 1.



The neurotransmitter's distinctive non-linear sigmoidal output response to a continuously time-pulsed input voltage is crucial to the neuronal computation process required to construct a sophisticated neural network-based computing device for temporal signal processing. The experimental results demonstrate the neurotransmitter's capacity for non-linear dynamic (time-varying) information processing and plasticity. The neurotransmitter follows a single-layer feed-forward neural network paradigm. Ion-doped silicate sheets made from sol-gel on Si NW-based neurotransmitters. Under the modulation of a presynaptic gate input, the film functions as a pseudo-gate of the transistors.

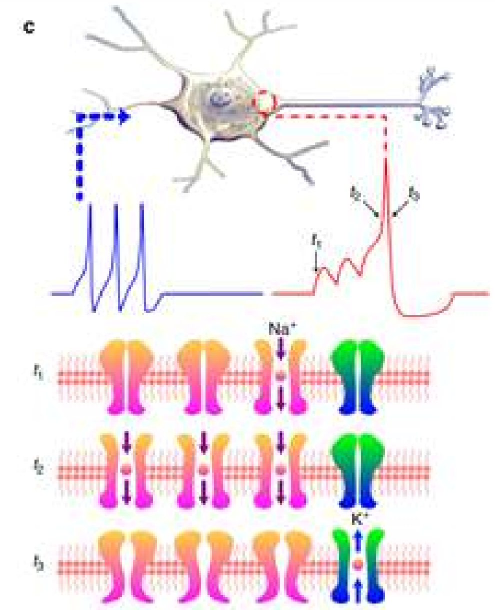
The device exhibits a non-linear sigmoidal potentiation of time-dependent inputs that mimics the dynamics of neuronal membrane integration due to the combined action of ionic polarization and diffusion in the film. Therefore, for the next generation of neuromorphic computing devices, dielectric engineering (such as controlled ion doping of the sol-gel in neurotransmitters) can enhance and complement the function of memristive materials. An architecture for a single neural device and its circuit model that uses numerous postsynaptic inputs as gate inputs and multiple axon terminals as transistor outputs to mimic the information processing of a real neuron (based on morphological and hierarchical aspects).

The neurotransmitter was created to generate and hit spike thresholds quicker or slower in specific time regimes, and to control the rate of the spike, which is the primary algorithm of neural computing, by making use of the output dynamics control of the current device. By creating numerous tiny local gates near the nanowire, it is possible to further improve the neurotransmitter's design and reduce the size of the input-to-output structure.

2. (Wang et al., 2018) The von Neumann architecture's limitations with memory and processor separation, serial execution, inefficient power use, and programming-intensive problems are no constraints on the computing architecture of the brain. Emerging technologies hold the promise of improving neuromorphic systems by realizing synaptic and neuronal functions more effectively than conventional complementary metal-oxide semiconductor (CMOS) circuits. A McCulloch-Pitts model neuron's ability to integrate and fire has been shown via memristors. Fully memristive neural networks have been constructed with synapse-neuron connections based on resistive coupling in addition to memristive synapses. However, a solely memristive circuit has a finite amount of signal gaining available. Natural neurons are exceptional in that they can send action potentials, or spikes, over vast distances while devices still lack to connect with other cells.

The study shows that neuro-transistors based on a dynamic pseudo-memcapacitive gate, which shows stochastic leaky integrate-and-fire, can better simulate neural functions at lower power consumption and footprint. In capacitive artificial neural networks with passive synapses, the neuro-transistors' active activity permits long-term signal propagation and spatial summation. In conjunction with non-volatile pseudo-memcapacitive synapses that were also established in the study, a Hebbian-like learning mechanism was shown to exhibit associative learning naturally.

3. (Kim et al., 2020) successfully proven the fabrication of 3D stackable In0.53Ga0.47As-OI synaptic transistors for M3D ANN devices. As a weight-storing layer, a composite gate insulator made of Al2O3/HfO2/Al2O3 layers provides significantly more stable synaptic operation. They demonstrated exceptional device performance with a record-high gmax/gain ratio of 6300 and very good linearity (αp/αd = 1.8/0.5). Additionally, under biassing from 64,000 pulses, the synaptic transistor operated with extremely little cycle-to-cycle fluctuation. Additionally, a single hidden layer was able to achieve a high learning accuracy of 97% for the training of 1 million MNIST images.



This can be enhanced even more by modifying the algorithm, the device topology, and the gate stack. The study anticipates that the M3D integration idea will eventually offer minimal latency and power consumption due to short connecting distances. The research continues on stacking synaptic and neural components for neuromorphic electronics that consume less power.

Conclusion

The archetypal integrated capacitive neural network with classification capabilities, which is based on these recently constructed neurons and synapses, has demonstrated promise as an alternative energy-efficient and bio-faithful procedure for the hardware implementation of neuromorphic computing. Furthermore, future studies could investigate whether an entirely neuronal processor for a spiking neural network could be built by combining the proposed neurotransmitters with a spike generator.

References

Baek, E., Das, N. R., Cannistraci, C. V., Rim, T., Bermúdez, G. S. C., Nych, K., Cho, H., Kim, K., Baek, C.-K., Makarov, D., Tetzlaff, R., Chua, L., Baraban, L., & Cuniberti, G. (2020). Intrinsic plasticity of silicon nanowire neurotransistors for dynamic memory and learning functions. Nature Electronics, 3(7), 398–408. https://doi.org/10.1038/s41928-020-0412-1 Kim, S. K., Jeong, Y., Bidenko, P., Lim, H.-R., Jeon, Y.-R., Kim, H., Lee, Y. J., Geum, D.-M., Han, J., Choi, C., Kim, H., & Kim, S. (2020). 3D Stackable Synaptic Transistor for 3D Integrated Artificial Neural Networks. ACS Applied Materials & Interfaces, 12(6), 7372–7380. https://doi.org/10.1021/acsami.9b22008

Wang, Z., Rao, M., Han, J.-W., Zhang, J., Lin, P., Li, Y., Li, C., Song, W., Asapu, S., Midya, R., Zhuo, Y., Jiang, H., Yoon, J. H., Upadhyay, N. K., Joshi, S., Hu, M., Strachan, J. P., Barnell, M., Wu, Q., … Yang, J. J. (2018). Capacitive neural network with neuro-transistors. Nature Communications, 9(1), 3208. https://doi.org/10.1038/s41467-018-05677-5

"GATEWAY TO विकसित BHARAT"

Priya Baria & Neha Chaudhary
BSC Chemistry – Semester 1 - 23sc04005 and 23sc04008

Semiconductor is the heart of the modern electronic sector. In today's world of technology where almost everything revolves around electronic gadgets, the significance of microchips, also referred to as Integrated Circuits (ICs), cannot be overlooked. These chips are primarily composed of silicon and germanium. Without these chips, there would be no smartphones, radios, TVs, laptops, computers, or even advanced medical equipment. Semiconductors are essential components in the manufacture of electronic devices. Additionally, with the rise of electric vehicles, the demand for semiconductors is anticipated to experience a significant increase. The COVID-19 pandemic has demonstrated that the need for electronic devices will only continue to go uphill in the future. As a result, the industry appears to be a promising area for early inroads into India as a global electronics sector. India's consumption of semiconductors is expected to cross USD 80 billion by 2026 and USD 110 billion by 2034. (Source-'Business Today' article dated 29 April 2023). There are only a few countries in the world that manufacture these chips. The industry is dominated by the United States of America, Taiwan, South Korea, Japan, and the Netherlands. Germany is an emerging producer of Intergraded chips. In all this, it might be a good idea for India to get on the bus early.

The manufacturing cycle of a semiconductor chip from sand to a finished product i.e. an integrated child sees it change hands approximately 70 times across international borders. It is not difficult to imagine that the chip in the various devices was made by a Japanese engineer working on Dutch machinery in an American foundry in Taiwan to produce wafers which were shipped to Malaysia for packaging before being sent to India as a finished product The majority of production in Taiwan and South Korea is concentrated in the former, accounting for nearly 92% of it. Meanwhile, 75% of production is in China and East Asia. (Source- Article from 'The Indian Express'- "How Semiconductor chip is manufactured?" dated 23 Jan 2023).

IMPORT - EXPORT STATISTICS 2022

As per Vloza's Import Data (last updated 23 July 2023), India imported $5.38B in Semiconductor Devices, becoming the 7th largest importer of Semiconductor Devices in the world. In the same year, Semiconductor Devices was the 12th most imported product in India. India imports Semiconductor Devices primarily from China ($4.25B), Hong Kong ($384M), Singapore ($284M), Japan ($95.5M), and Malaysia ($87.2M). The fastest-growing import markets in Semiconductor Devices for India were China ($2.61B), Hong Kong ($230M), and Malaysia ($57.7M) between 2020 and 2022. India imports most of its semiconductors from China, the United States, and Japan and is the 2nd largest importer of semiconductors in the World. As per Volza's India Export data, (last updated 23 July 2023) Semiconductor chip export shipments from India stood at 217, exported by 11 India Exporters to 39 Buyers. India exports most of its Semiconductor chips to Singapore, Germany, and the United States.

COLLABORATION

India and the US inked an agreement for establishing a semiconductor supply chain and innovation partnership under the framework of India - US Commercial Dialogue (Source: - The Economic Times,10 March 2023).

The agreement was signed between Commerce Minister Piyush Goyal and the visiting US commerce secretary Gina Raimondo. The agreement seeks to establish a collaborative mechanism between the two governments on semiconductor supply chain resiliency and diversification given the US CHIPS and Science Act and India's Semiconductor Mission. The MoU envisages mutually beneficial research and development as well as talent and skill development. The project aims to create 5,000 direct jobs and contribute to India's Self-Reliance in memory chip manufacturing. It aligns with the government's goal of promoting domestic manufacturing and reducing import dependency in the semiconductor sector and is expected to bolster India's position as a global semiconductor manufacturer.

As per The Economic Times' article dated Jul 20, 2023, Japan has become the second 'Quad' partner after the United States to sign an agreement with India for the joint development of the semiconductor ecosystem and maintain the resilience of its global supply chain.

The agreement was signed between Union Minister for Electronics and IT Ashwini Vaishnaw and Japan's Minister of Economy, Trade and Industry Yasutoshi Nishimura in the national capital.

CHALLENGES

(Source-From 'Semiconductor industry and its significance' article on drishtiias.com dated 20 Oct 2022)

- High Investments Required: one semiconductor fab requires an investment of anywhere between $3 and $7 billion.
- Lack of Fab Capacities.
- Insufficient Grants under the Production Linked Incentive Scheme.
- Inefficient Resource Sector Chip production is a resource-intensive and expensive process that requires a high amount of pure water and electricity.
- There are currently several issues affecting the semiconductor chipmaking industry. Firstly, there is a shortage of chips due to pandemic-related factory closures, tensions between the US and China in Taiwan, the Russia-Ukraine conflict, and increased demand. Additionally, the industry is highly concentrated, with 90% of 5-nanometer chips being produced by the Taiwan Semiconductor Manufacturing Company (TSMC) in Taiwan. So, the Indian government is trying to create a domestic chip-making industry.

NATIONAL POLICY ON ELECTRONICS 2019

The information on meity.gov.in states that the Government of India attaches high priority to electronics hardware manufacturing and it is one of the important pillars of both the "Make in India" and "Digital India" programs. The National Policy on Electronics 2019 was prepared after extensive stakeholder consultation, envisages positioning India as a global hub for Electronics System Design & Manufacturing (ESDM) with a thrust on exports by encouraging and driving capabilities in the country for developing core components, including chipsets, and creating an enabling environment for the industry to compete globally. Furthermore, NPE 2019 is the updated version of NPE 2012 where the goals and objectives of the policy have been modernized for establishing upcoming technologies in India. The Policy will lead to the formulation of several schemes, initiatives, projects, and measures for the development of the ESDM sector in the country as per the roadmap envisaged therein. Furthermore, It will enable the flow of investment and technology, leading to higher value addition in the domestically manufactured electronic products, and increased electronics hardware manufacturing in the country and their export, while generating substantial employment opportunities.

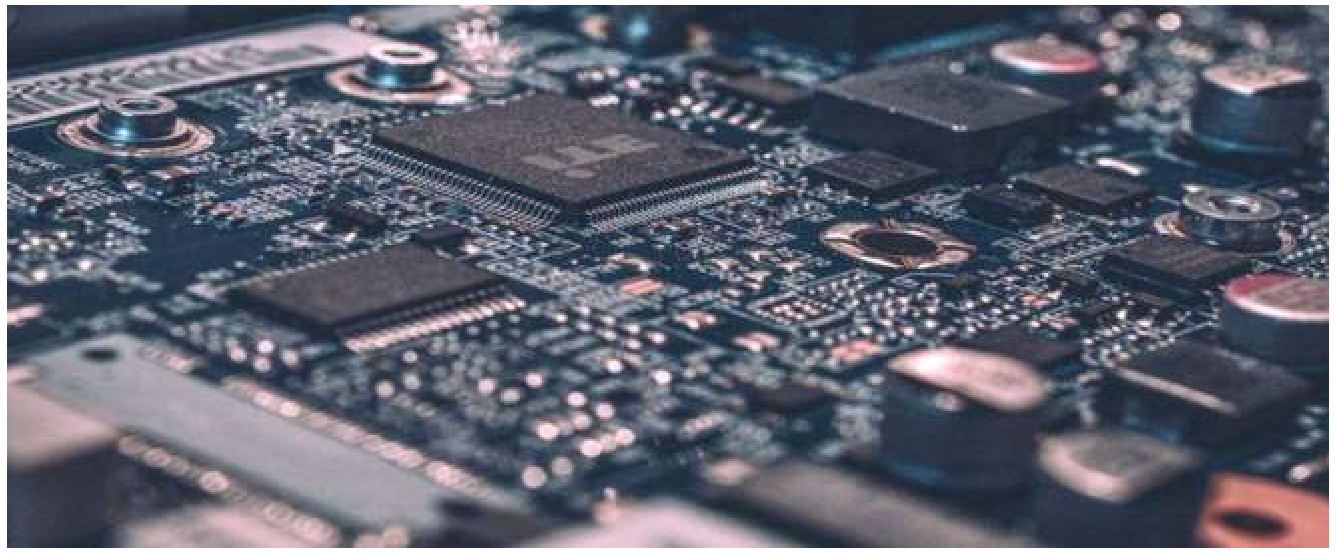
OBJECTIVES OF NPE 2019

As per the Government's data;

- It encourages startup plans in the field of 5g networking, robotics, drones, photonics, nano-based technology, virtual reality (VR), and Artificial intelligence (AI).
- Providing incentives and support for significantly enhancing the availability of skilled manpower, including re-skilling.
- Creation of a Sovereign Patent Fund (SPF) to promote the development and acquisition of Intellectual Properties (IPs) in the ESDM sector.
- Promotion of trusted electronics value chain initiatives to improve national cyber security profiles

Electronics System Design & Manufacturing (ESDM):

The Scheme aims at enhancing the skilling capacities in the ESDM sector through the public and private sectors for students/unemployed youth belonging to other disciplines by Utilizing the existing human resource who are undergoing studies in schools (IX standard onwards) /ITIs/Polytechnics/UG Colleges (non-engineering) and the school dropouts/unemployed youth by providing them with additional skills that are recognized by the industry for employment in ESDM sector. Encouraging new investments in training in the ESDM sector by industry.



Various schemes involved under ESDM:

1. Scheme for Financial Assistance to select States/UTs for Skill Development in Electronics System Design and Manufacturing (ESDM) sector

To facilitate skill development in the ESDM sector, the scheme focuses on students/unemployed youth at 9-10th standard onwards, ITI, Diploma, Non-engineering graduates, etc. to increase their employability to work in 'Manufacturing' and 'Service support' functions, a 'Scheme for Financial Assistance to select States/UTs for Skill Development in Electronics System Design and Manufacturing (ESDM) sector' was approved by DeitY in November 2013. A total of 90,000 persons are to be supported under the scheme in the selected States in 5 levels of vocational skill development courses recognized by NIELIT/Electronic Sector Skill Council/Telecom Sector Skill Council. The total outlay of the Scheme is Rs. 113.77 crore with a Grant-in-Aid of Rs. 100 crores (approx.).

2. Scheme for 'Skill Development in ESDM for Digital India'

Under 'Digital India' campaign launched by Hon'ble Prime Minister, the department has approved a Scheme for "Skill Development in ESDM for Digital India" on 09.12.2014 to cover all the States/UTs of the country to facilitate creation of an eco-system for development of ESDM sector in the entire country for facilitating skill development for 3,28,000 persons in ESDM sector at an outlay of Rs. 411 crores (approx.) in 4 years. This is in continuation of the above-mentioned 'Scheme for Financial Assistance to Select States/UTs for Skill Development in Electronics System Design and Manufacturing (ESDM) sector' approved earlier which is being implemented in 8 states. Both the Schemes are to be implemented concurrently.

INDIAN SEMICONDUCTOR MISSION:

ISM

India Semiconductor Mission

(Source: ism.gov.in)

India Semiconductor Mission (ISM) is a specialized and independent Business Division within the Digital India Corporation that aims to build a vibrant semiconductor and display ecosystem to enable India's emergence as a global hub for electronics manufacturing and design. It was launched in 2021 with a total financial outlay of Rs76,000 crore under the aegis of the Ministry of Electronics and IT (MeitY).

The program aims to provide financial support to companies investing in semiconductors, display manufacturing, and design ecosystems.

Envisioned to be led by global experts in the Semiconductor and Display industry, ISM will serve as the nodal agency for efficient, coherent, and smooth implementation of the schemes. The goal is to establish a thriving ecosystem for semiconductor and display design and innovation in India, paving the way for the country to become a leading global hub for electronics manufacturing and design.

ISM OBJECTIVES

As per the latest update in February 2023;

- Formulate a comprehensive long-term strategy for developing sustainable semiconductors and display manufacturing facilities and semiconductor design eco-system in the country in consultation with the Government ministries/departments/agencies, industry, and academia.
- Adoption of secure microelectronics and development of a trusted semiconductor supply chain, including raw materials, specialty chemicals, gases, and manufacturing equipment.
- Enable a multi-fold growth of the Indian semiconductor design industry by providing support in the form of Electronic Design Automation (EDA) tools, foundry services, and other suitable mechanisms for early-stage startups.
- Promote and facilitate indigenous Intellectual Property (IP) generation.
- Encourage, enable, and incentivize the Transfer of Technologies (ToT).
- Establish suitable mechanisms to harness economies of scale in the Indian semiconductor and display industry.
- Enable cutting-edge research in the semiconductors and display industry including evolutionary and revolutionary technologies through grants and global collaborations in academia/research institutions & industry. Through establishing Centres of Excellence (CoEs).
- Enable collaborations and partnership programs with national and international agencies, industries, and institutions for catalyzing collaborative research, commercialization, and skill development.

SCHEMES UNDER ISM

- Scheme for setting up Semiconductor Fabs in India:

  It provides fiscal support to eligible applicants for setting up Semiconductor Fabs which is aimed at attracting large investments for setting up semiconductor wafer fabrication facilities in the country.

- Scheme for setting up Display Fabs in India:

  It provides fiscal support to eligible applicants for setting up Display Fabs which is aimed at attracting large investors for setting up TFT LCD / AMOLED-based display fabrication facilities in the country.

- Scheme for setting up of Compound Semiconductors / Silicon Photonics / Sensors Fab and Semiconductor Assembly, Testing, Marking, and Packaging (ATMP) / OSAT facilities in India:

  The Scheme provides fiscal support of 30% of the Capital Expenditure to the eligible applicants for setting up Compound Semiconductors / Silicon Photonics (SiPh) / Sensors (including MEMS) Fab and Semiconductor ATMP / OSAT (Outsourced Semiconductor Assembly and Test) facilities in India.

- Design Linked Incentive (DLI) Scheme:

  It offers financial incentives, design infrastructure support across various stages of development and deployment of semiconductor design for Integrated Circuits (ICs), Chipsets, Systems on Chips (SoCs), Systems & IP Cores, and semiconductor-linked design.

- Semiconductor Laboratory (SCL), MeitY will take the requisite steps for the modernization and commercialization of the Semi-conductor Laboratory (SCL).

  For Compound Semiconductors: The government will support fiscal support of 30% of capital expenditure to approved Compound Semiconductors units.

  Production Linked Incentives: Incentive support to the sum of Rs.55,392 crore (7.5 billion USD) has been approved under Product Linked Incentive (PLI) for Largest Scale Electronics Manufacturing, PLI for IT Hardware, SPECS Scheme and Modified Electronics Manufacturing Clusters (EMC 2.0) Scheme.

  As per PTI, the government has reached out to foreign semiconductor companies and invited them to set up semiconductor and display manufacturing facilities in the country. As a result, India Semiconductor Mission, a Nodal Agency set up for implementation of the program has received proposals under all schemes which are currently under consideration. ISM has been working as a nodal agency for the Schemes approved under Semicon India Programme. The applications were received by ISM and are being appraised by ISM. It has also been engaging with various stakeholders of the Semiconductors and Display ecosystem to attract investments in India. So far INR 13 crore has been released to ISM.

  So far, the events organized under ISM are Semicon India 2022 conference and Semicon India 2023 conference. The former took place from April 29 to May 01, 2022, and was inaugurated by Hon'ble Prime Minister, Shri Narendra Modi. The agenda of the conference was subjected to catalyze India's semiconductor ecosystem. Whereas the later conference was held in Delhi for the Electronics Manufacturing supply chain ecosystem on February 18.

SEMICON INDIA 2023:

(Source- ism gov. in > Semicon India 2023)

The electronics industry is a massive and rapidly expanding global sector, valued at USD 2.9 trillion in 2020. The growth of economies worldwide has been significantly influenced by the increase in productivity, trade, and investment in the electronics industry. Over the past few decades, there has been a significant increase in demand for laptops, computers, mobile phones, tablets, laboratory instruments, and medical devices across the globe. India has a high demand for electronic devices, but importing them from different countries incurs additional transportation costs. This leads to an increase in the prices of electronics in the country, which makes it difficult for the average person to afford them. Therefore Indian government has launched an exciting project called "SemiconIndia 2023," which aims to boost the semiconductor industry in the country. This initiative is being carried out in partnership with various industries and associations, with the visionary leadership of our honorable Prime Minister, Shri Narendra Modi. His vision is to reach a production capacity of USD 300 billion by 2026 through sustainable electronics manufacturing and development for the entire population value chain in the country, while also expanding exports.

The program aims to establish India as a leading global hub for semiconductor manufacturing and design. Through a focus on innovation and development, we strive to achieve significant growth in the semiconductor industry. India has taken several serious steps towards achieving its goal, resulting in a rise in its share of global electronics manufacturing from 1.3% in 2012 to 3.6% in 2019. By 2025, India is likely to generate USD 1 trillion in economic value in the electronics sector.

Gujarat has become the first and only state in India to initiate the SemiconIndia policy(2022-27). The government of Gujarat is offering significant subsidies to support the establishment of a semiconductor plant in the state to attract global investors. Entrepreneurs who invest in Semicon are eligible for benefits on sustainable energy, land, and water tariffs (water rate). The seventeenth former chief minister Mr. Bhupendra Patel has recently announced the launch of Semicon India, an initiative aimed at creating two lakh job opportunities within the next five years in the semiconductor manufacturing industry. The government is implementing strategic policies to improve infrastructure, focusing on advanced research and innovation in the electronics industry. The government plans to create "SemiconCity" in Dholera as a component of the Dholera Special Investment Region. The main goal is to establish Gujarat as a leader in creating and producing electronic systems with an innovative and sustainable ecosystem, known as ESDM.

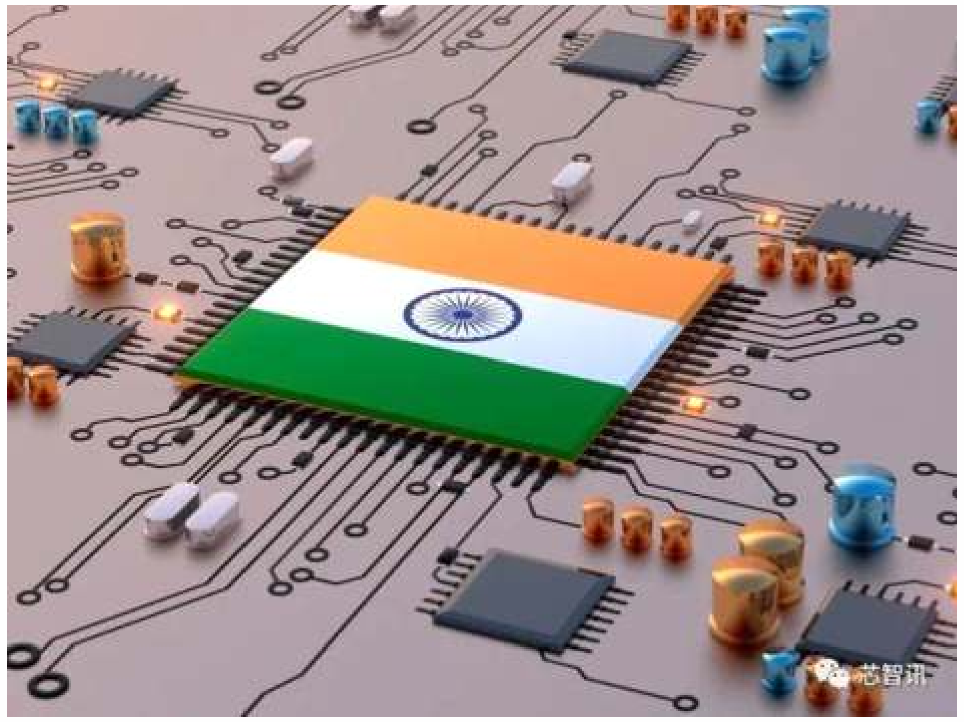
A senior officer in the state's Science and Technology department has announced a new policy to facilitate the timely and effective execution of eligible projects. This policy aims to establish a strong semiconductor and display fabrication ecosystem. To provide effective support in establishing large plants or industries for electronics and display fab projects and suitable ecosystems have been introduced.

A grand event took place in Gandhinagar from July 28th to July 31st, which aimed to showcase India's semiconductor capabilities and chip design innovation, among other important topics related to the electronics sector. The event was inaugurated to elaborate on these key areas.

The dignitaries who attended the event were our honorable prime Minister Mr. Narendra Modi, Minister of Electronics and Information Technology Mr. Rajeev Chandrasekhar, Chief Minister of Gujarat Bhupendra Patel, Minister of Railways and Communication Ashwini Vaishnav, and Minister of External Affairs Subrahmanyam Jaishankar. The government has declared this event a prestigious national-level event and promises it will be a catalyst for the semiconductor industry's progress. The event plans to offer a wide range of networking opportunities, technology demonstrations, and lucrative business prospects.

At the event, several institutions identifying themselves as academic organizations were present, including IIT Bombay, IIT Madras, BITS Pilani, Ganapat University, and Nirma University. The state also offers aspiring students, a platform of vulnerable opportunities to gain deep knowledge in semiconductor chip or electronics manufacturing. In addition to India, 23 other countries were represented at the Semicon India Event 2023, where 150 stalls represented 80 companies showcased their innovations and products. They shared stalwarts in semiconductor chips, display fabs, chip design, and assembling with all resources available. Numerous companies such as Foxconn, Micron, AMD, IBM, Vedanta, and others have demonstrated a keen interest in the event and are willing to invest in this mission. Micron has announced its intention to establish semiconductor assembly and testing facilities in Gujarat, investing a total of USD 2.75 billion (approximately Rupees 22,540 crores) in Sanand. Additionally, Applied Materials has pledged $400 million towards an engineering and collaborative center in Gujarat. Other companies, such as Vedanta and Foxconn, were originally considering a joint venture to establish a $19.5 billion chip manufacturing project in Dholera, Gujarat. However, the government has since announced that both companies will invest independently in Semicon at Dholera.

SEMICON INDIA 2023: KEY



Objectives:

- The goal is to foster a thriving electronics manufacturing industry that generates $30 billion in exports. This will not only create new opportunities for forex (foreign exchange) through import substitution and export promotion but also support economic growth and development.
- There will be 1 million job openings in the electronics industry by 2028.
- The objective is to promote the expansion of electronics manufacturing sectors, regardless of whether they receive financial support from the government or not.
- To actively collaborate with stakeholders and investors in the semiconductor industry to improve the availability of skilled workers. This will allow India to enhance overall productivity and success.
- It aims to advance research and development in the fields of ecosystems and electronics, with a focus on innovation and finding more advances as compared to current technologies.
- India is a global semiconductor or electronics hub in manufacturing and designing them. It will maintain a sustainable design ecosystem, ensuring that the environment is not harmed in the process.

ELIGIBILITY CAPEX FOR INVESTORS

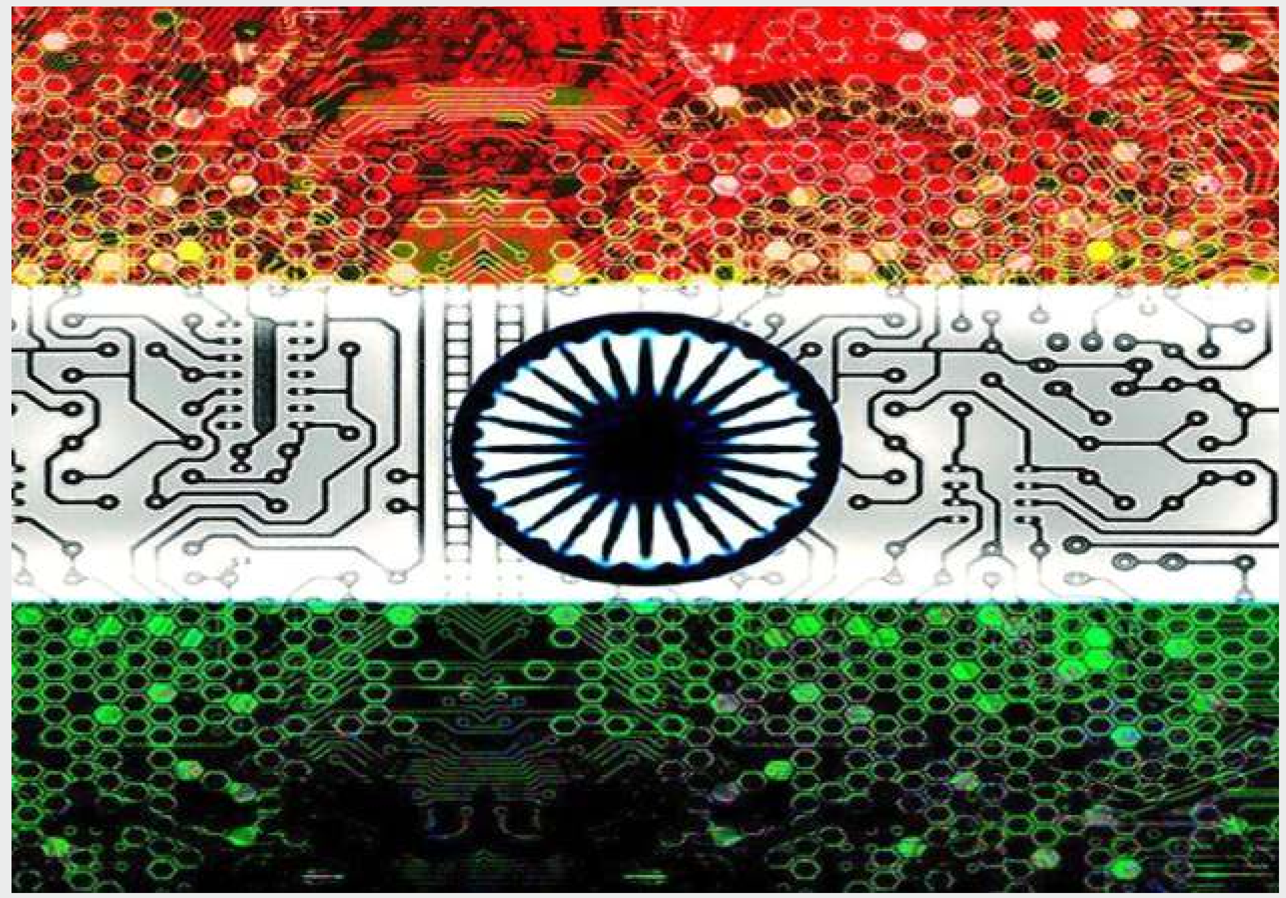
- This program requires expenditure for various aspects of producing electronics, including manufacturing, design, assembly, testing, packaging, and distribution. It also covers the cost of installing necessary infrastructure such as plants, machinery, equipment, manpower, molds, and tools. Additionally, operational areas with clean rooms, air curtains, suitable temperature, and air quality control systems, as well as compressed air, water, power supply, and control systems are necessary and must be included in the expenditure.
- Expenditure in the construction of industries has to produce products or services by eligible units excluding the price of land and the cost of making infrastructure.
- Projects that fall under the Design Linked Incentive Scheme of the government are not eligible for the policy recently declared by the state government.
- As per the policy, only one project will be supported. However, if there are multiple applications, a high-powered committee appointed by the state government will make the final decision.

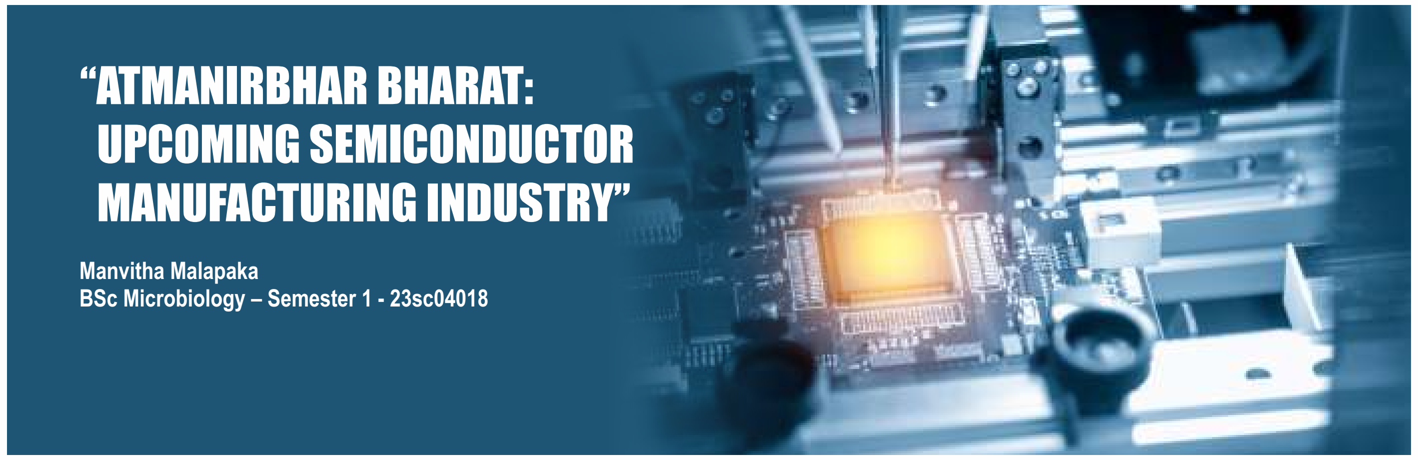
SUBSIDIES UNDER SEMICON INDIA

- Gujarat will offer extra capital assistance amounting to 40% of the capex assistance provided by the central government for projects approved under the ISM. The capital support will be provided in annual instalments over five years.
- The government is offering a 75% subsidy on the procurement of the first 200 acres of land. Additional land for upstream and downstream activities will receive a 50% subsidy on land expenditure.
- The government will offer a one-time reimbursement of 100% stamp duty. Note that the registration fee will be covered by the government.
- The government has announced that fixed water tariffs of 12 rupees per cubic meter will be granted for five years.
- A 50% capital subsidy will be provided for desalination plants.
- The government is providing an electric subsidy of 2 rupees per unit to the plants as well.

CONCLUSION

Semiconductors and displays fab are the foundation of modern electronics driving the next phase of digital transformation under Industry 4.0. India's Public Sectors Enterprise (PSE) such as Bharat Electronics Ltd or Hindustan Aeronautics Ltd can be used to set up a semiconductor fab foundry with the help of Semicon India 2023 campaign and thus become the most trusted supply chain for Semiconductors and its derivative product across the world. India needs to drop the dream of Swadeshi semiconductors. Instead, it should aim to become a key player in a trusted, semiconductor ecosystem that keeps key adversaries out.





"ATMANIRBHAR BHARAT: UPCOMING SEMICONDUCTOR MANUFACTURING INDUSTRY"

Manvitha Malapaka
BSc Microbiology – Semester 1 - 23sc04018

Introduction

India is experiencing a period of transformation and progress across several sectors under the inspirational leadership of Prime Minister Narendra Modi. The semiconductor sector is one such critical area that has caught the attention of PM Modi.

The Government of India, led by PM Modi, has been assiduously trying to position India as a global powerhouse for semiconductor manufacture and research after realizing the country's enormous economic potential. In this article, we will review PM Modi plans for the Indian semiconductor industry as well as the measures the administration is taking to carry out this audacious objective.

While there might be a multiplier effect towards creating employment opportunities in the healthcare, payments, and e-commerce sectors, this is not the same as creating openings in the manufacturing sector. Semiconductor manufacturing in particular is critical for India. Another compelling rationale is the irreplaceable role that they learned through manufacturing plays in the long run. Meanwhile, according to the report by Indian Times the global semiconductor industry is now facing a significant skills gap, with an estimated 10,000 open positions in the USA alone.

According to the resources, the industry will require more than one million skilled professionals by 2025 to keep up with the growing demand for semiconductors.

As per the report published by the India Brand Equity Foundation (IBEF) on 2 nds May 2023, India is home to over 200 semiconductor design and embedded software companies and therefore it is an opportunity, presenting itself. As the country's demand for semiconductors continues to grow at a rapid pace, meeting this demand can be a challenge and thereby a dire need to increase its pool of skilled manpower to support the industry.

Prime Minister Modi is aware that creating an atmosphere that encourages innovation, research, and investment is necessary for the growth of a semiconductor sector of the highest caliber. To do this, the government has put in place several steps to build an environment that will support semiconductor manufacture in India.

Semiconductor chips: what are they?

Semiconductors are substances with conductivities intermediate between those of conductors and insulators. They could be compounds like gallium, arsenide, or cadmium selenide or pure elements like silicon or germanium. Semiconductor chips are important because they are the fundamental components that make up the brain and heart of all current electronics and information and communications technology goods.

These chips are now a standard component of modern cars, household appliances, and crucial medical equipment like ECG machines.

What Function Do Semiconductors Have?

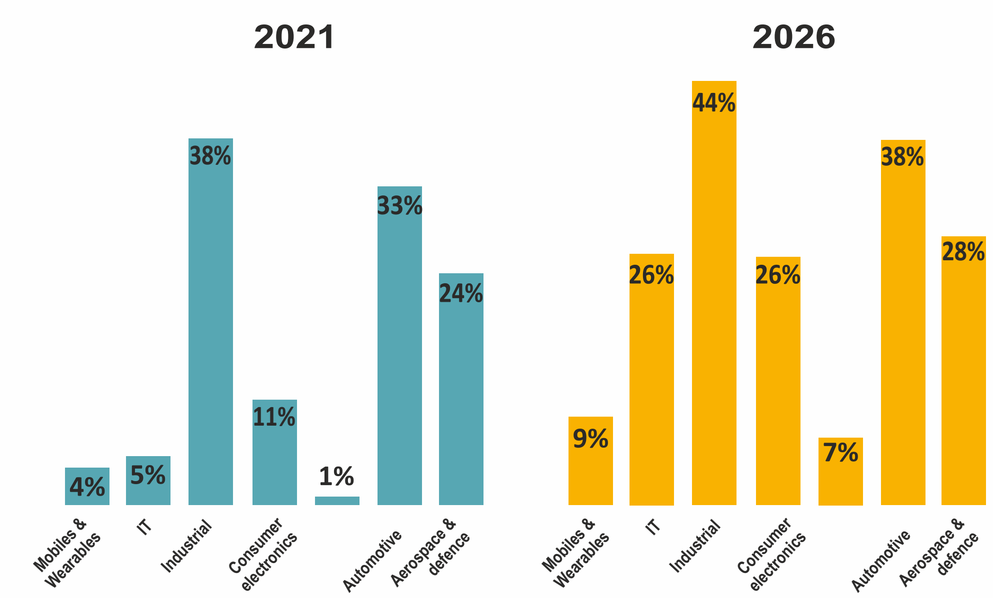
Almost every industry, including aerospace, transportation, communications, clean energy, information technology, and medical equipment, depend on semiconductors.

Demand for these essential components has outpaced supply, resulting in a global chip shortage, which has stunted economic growth and cost jobs. Under the Production-Linked Incentive (PLI) plan, the central government approved 76,000 crores in December 2021 to promote the production of various semiconductor products in India. Modern electronics, which are the backbone of Industry 4.0 digital transformation, are built on semiconductors and screens.

Government financial incentives:

According to ICRA, the governments recently announced PLI and DLI schemes, launched to encourage the production of semiconductors, is expected to draw a capex of roughly $4 trillion over the next five years and has the potential to create over 3 million jobs (for both skilled and unskilled labour) in India. In addition to this, there will also be a new generation of IT and managerial roles as well as employment chances inside the unaccounted-for industries. Additionally, there would be benefits from a decrease in net imports because additional earnings are anticipated to be between Rs. 35 trillion and Rs. 40 trillion during the following five years. At this time, 40% of all imports are made up of the sectors covered by the PLI scheme. The plan, which spans 14 industries, has the potential to increase India's annual manufacturing investment by 15 to 20% starting in FY23.

India Locally Sources Semiconductor Components by Segments



Source: Counterpoint Research & IESA

To complete the course curriculum, the government is now collaborating with the All-India Council for Technical Education (AICTE). With all of these efforts, we will have a new generation of engineers and technology professionals prepared for the fifth industrial revolution in three to five years. The Indian government has made plain that it wants to dominate the semiconductor manufacturing industry and is taking all necessary steps to realize that goal. To advance their growth and complete their objective, numerous MNCs and start-ups are collaborating.

The Make in India campaign, which was introduced by Prime Minister Modi and attempts to draw in international investors and make it easier for semiconductor manufacturing facilities to be established in the nation. It places a strong emphasis on assuring ease of doing business, offering incentives, and removing administrative roadblocks to enable seamless foreign and local investment in India's semiconductor industry.

As reflected in the report by ET Telecom, on the demand side, the growth of the semiconductor industry in India is expected to be driven by the increasing semiconductor content across consumer electronics and automobiles including EVs (Electronic Vehicles), increasing demand for smartphones as the number of smartphones in India is projected to reach a billion by 2026. The world now wants to diversify the Global Supply Chain of Semiconductor Chipset and even Indian Government are now encouraging new startups in India.

The top 10 semiconductor Manufacturing Companies in India are:

1.	Saankhya Labs	Semiconductor Solutions	Bengaluru
2.	ASM Technologies Stock Listed: 526433 (BOM)	Semiconductor Engineering	Bengaluru
3.	Broadcom Inc	Semiconductor and Infrastructure Software Solutions	Bangalore
4.	Chiplogic Technologies	Semiconductor Design Services	Bangalore
5.	CDIL	Semiconductor Manufacturer	New Delhi
6.	MosChip Semiconductor technologies	Fabless Semiconductor	Hyderabad
7.	Einfochips	Semiconductor Design Servies	Ahmadabad
8.	Tata Elxsi	AI. Machine learning, NLP	Bangalore
9.	Semi-Conductor Laboratory	R&D in Semiconductor Technology	Mohali
10.	NXP Semiconductors	Semiconductor Startup Incubation	Bangalore

The administration of Prime Minister Modi has placed a strong emphasis on developing homegrown capabilities because it understands the critical role that plays in the semiconductor industry. To promote innovation and cutting-edge research in semiconductor technology, the government has established centres of excellence and worked with top international research institutes such as the Indian Institute of Technology (IIT) Bombay, IIT Madras, BITS Pilani, Ganpat University, and Nirma University.

With the use of programs for vocational training and certification, PM Modi Skill India The program seeks to develop a skilled labour force. Developing competence in cutting-edge semiconductor technologies, such as chip design, fabrication, testing, and packaging, are being given special attention. India wants to create a talent pool that can sustain itself and help the semiconductor industry thrive, therefore it is encouraging skill-building initiatives.

Conclusion:

India has started a bold path to become a major player in the semiconductor industry on the world stage under the direction of PM Modi. The proactive actions taken by the government, such as building an enabling ecosystem, strengthening talent development programs, and enhancing capacities, show PM Modi's dedication to making India a centre for semiconductor manufacture and research.

The continued rise of India's semiconductor industry would not only boost the country economy and employment prospects but also its technological capability. To make India a major player in the global semiconductor market, PM Modi is determined to turn the nation into a worldwide manufacturing and innovation hub. This is evident in his vision for the semiconductor industry.

"Technology Innovator: Semiconductor"

Tiya Patel
BSc Microbiology – Semester 1 - 23sc04039

From automotive technology to medical technology, everywhere semiconductors play a crucial role. During Semicon India, the Prime Minister of India, Mr. Narendra Modi unveiled that India is becoming a grand conductor for investments in the semiconductor sector. Semicon India 2023 reveals India's semiconductor strategy and policy which intends in making India a global fulcrum for semiconductor design, manufacturing, and technology.

Semiconductors are materials that have conductivity somewhere between an insulator and a conductor. Conductors are the substances that allow electricity to pass through it while insulators are just the reverse of conductors as they do not allow electricity to pass through it. Semiconductors that have been around us since the 1700s were invented in the US. In 1901, the very first semiconductor device "CAT WHISKER" was patented by Karl Brown

Source: Antique Radio

Silicon, germanium, gallium, and arsenide are the elements near the metalloid on the periodic table. SILICON is a very common element used as a raw material because of its stable structure. Purification of silicon consumes a large amount of power. In Japan refined silicon with purity of at least 98% is imported from Australia, China, and Brazil where electricity is relatively inexpensive. Taiwan produces over 60% of the world's semiconductors and over 90% of the most advanced ones. Most are manufactured by a single company, Taiwan Semiconductor Manufacturing Corporation (TSMC). Until now, the most advanced have been made only in Taiwan. Taiwan's industry makes it more important.

Source: all.accor.com

Japan has one of the most powerful semiconductor ecosystems in the world. It has 102 chip producing facilities spread across the nation. India is all set to roll out its first indigenous microchip by December 2024. The MOSFET {metaoxide semiconductor field effect transistor} is the most common semiconductor.

Source: fineartamerica

Samsung and intel retaining the top two spots as consumers of semiconductors. Examples of semiconductor technology:

- **DIODES:** They are like one-way gates that allow control of the direction of the current.
- Microprocessors are used as the brains of many electronic devices such as computers, smartphones, and home appliances.
- **Solar-cell:** used in charging batteries, detecting light.

Source: IRF510 Nch MosFET

- Led lights: light emitting diode has a wide range of applications from our mobile phones to large advertising billboards.

SOURCE: visual.electro-matic.com

Career in semiconductors:

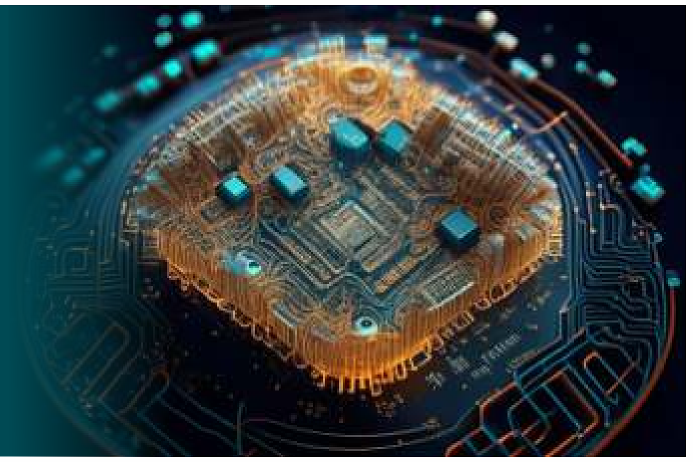
Individuals possessing significant semiconductor expertise can earn a high income with the potential to reach six-figure salary as they progress in their careers.

ASML estimated that in 2020, 932 billion chips were produced and sold globally. That number climbed to an unprecedented 1.15 trillion chips shipped worldwide in 2021 as companies raised production rates to meet a worldwide microchip shortage caused by supply chain issues and the impact of the COVID-19 coronavirus.

Over 80 % of semiconductors are made in Asia. 92 % of the world's most advanced semiconductors are manufactured in Taiwan. The Taiwan Semiconductor Manufacturing Limited (TSMC) is the biggest producer of semiconductors in the world and holds 54 % of the global market share. In 2022, TSMC and its subsidiaries produced over 15 million semiconductor wafers.

"Semiconductors: Empowering the Digital Revolution"

Nakshatra Parekh
BSc Biotechnology – Semester 1 - 23sc02038

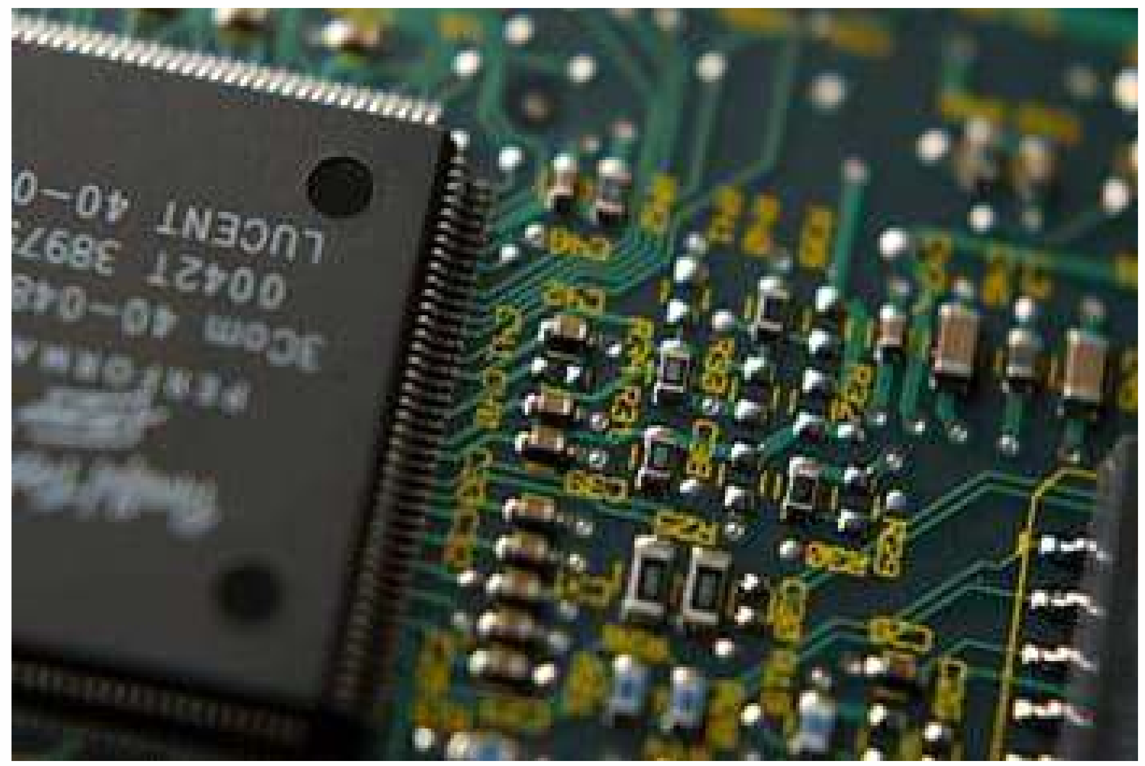


Semiconductors have become a ground-breaking element in the field of contemporary electronics, supporting a wide range of products and technologies. Semiconductors are essential to define the world we live in today from micro-processors that run our smartphones to solar cells that produce sustainable energy. The basics of semiconductors, their characteristics, and their importance in advancing technology are examined in this article. Semiconductors are substances with an electrical conductivity that is somewhere between that of insulators like rubber and conductors like metals. Contrary to insulators and conductors, which readily let the flow of electric current through them, semiconductors have the unusual trait that their conductivity may be changed or regulated. They are essential in electronics because of their capacity to control electrical flow. Basic Semiconductor Properties are;

1. Band Gap: The energy band gap is a semiconductor's primary feature. The band gap is the energy difference between the valence band where electrons are attached to atoms and the conduction band from where electrons can flow around freely as current carriers. Electrons in a material are organized into energy bands. In comparison to insulators, semiconductors have a smaller band gap, making it possible to manipulate them into a conducting condition.

2. Doping: Pure semiconductors are less conductive than semiconductors that have been doped yet their characteristics can still be dramatically changed. Doping is the process of introducing particular impurities into the semiconductor crystal structure, which either creates "holes" (p-type doping, electron vacancies) or additional electrons (n-type doping). The conductivity of the material is improved by these extra or absent charge carriers.

3. Temperature Sensitivity: Electrical conductivity in semiconductors is temperature-sensitive. More electrons may flow into the conduction band when the temperature rises, improving the conductivity of the substance. Thermistors and temperature sensors make use of this property.



Semiconductors have become a crucial aspect of India's technology landscape, playing a significant role in the country's growth as a global player in the electronics and IT industries. Over the years, India has emerged as one of the major semiconductor markets and a significant hub for semiconductor design and manufacturing.

Electronics Manufacturing:

The Indian government's initiatives like "Make in India" have aimed to promote electronics manufacturing within the country. With a focus on semiconductor fabrication facilities (fabs), India seeks to reduce its dependence on imports and strengthen its semiconductor manufacturing capabilities. While challenges remain, progress has been made, and the establishment of fabs in India could potentially give a boost to the semiconductor sector and the broader electronics industry.

Economies of scale: Manufacturers can benefit from economies of scale by producing semiconductors on a large scale. The average cost per unit falls as production volume increases, making it more efficient from a financial standpoint.

Cost-effectiveness: By investing in cutting-edge production equipment and facilities, semiconductor companies may increase automation and efficiency. Large-scale manufacturing can lower semiconductor chip prices, making them more accessible to customers and encouraging a wider uptake of electronic gadgets.

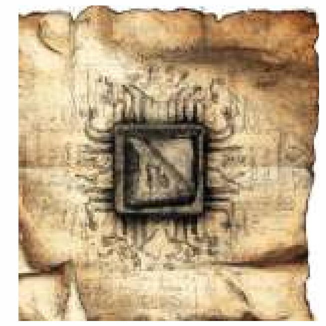
Innovation and Research: Semiconductor businesses can increase their R&D spending thanks to the financial resources made possible by large-scale operations. This makes it easier to develop cutting-edge semiconductor technology, which results in quicker and more effective devices.

In conclusion, India's semiconductor industry has come a long way, evolving into a vital part of the country's technological advancement. With a growing focus on semiconductor design, research, and manufacturing, India is positioning itself as a key player in the global semiconductor market and contributing to the innovation and development of cutting-edge technologies. As the industry continues to mature, collaboration between the government, industry players, and academia will be crucial in realizing India's full potential in the semiconductor domain.

"The Enigma of Semiconductors Unveiled: A Renaissance View of a Modern Marvel"

Madhav Trivedi
BCA - Semester 1 - 23bca098

The researcher would like to present the perspective of a humble time traveler from the Renaissance period, with the knowledge of a wondrous innovation of the current age - the enigmatic realm of semiconductors. In a realm where natural laws are harnessed by the hand of man, these elusive materials have unlocked the gates to an extraordinary world of technological prowess. With reverence for your present intellect, the research shall strive to elucidate their nature and significance, adorned with relevant research from contemporary scholars.



In essence, semiconductors are substances neither resolutely conductive nor impervious, residing in a twilight betwixt metals and insulators. Their capacity to control the flow of electrons bequeaths unto them the power to serve as the core of electronic devices. Unlike the antiquated dichotomy of on and off, semiconductors manipulate the very heartbeat of modern contrivances, enabling the seamless transmission of information and the metamorphosis of ideas into reality.

Verily, it was the valiant efforts of scientists like Sir William Shockley, John Bardeen, and Walter Brattain (1947) that ushered in the first practical semiconductor, the transistor. Such a triumphant achievement was heralded by the grandiose symphony of progress and innovation that now permeates our age. With each passing day, fresh research unfolds, as contemporary minds delve deeper into the unfathomable cosmos of semiconductors.

The researcher would like to present a selection of four resplendent pieces of research that shed light on the significance of semi-conductors:

Research by Li et al. (Journal of Applied Physics, Vol. 130, 2021) - Delineates the potential of gallium nitride (GaN) as a superior semiconductor material, affording high electron mobility and thermal conductivity, propelling the development of power electronics and optoelectronic devices.

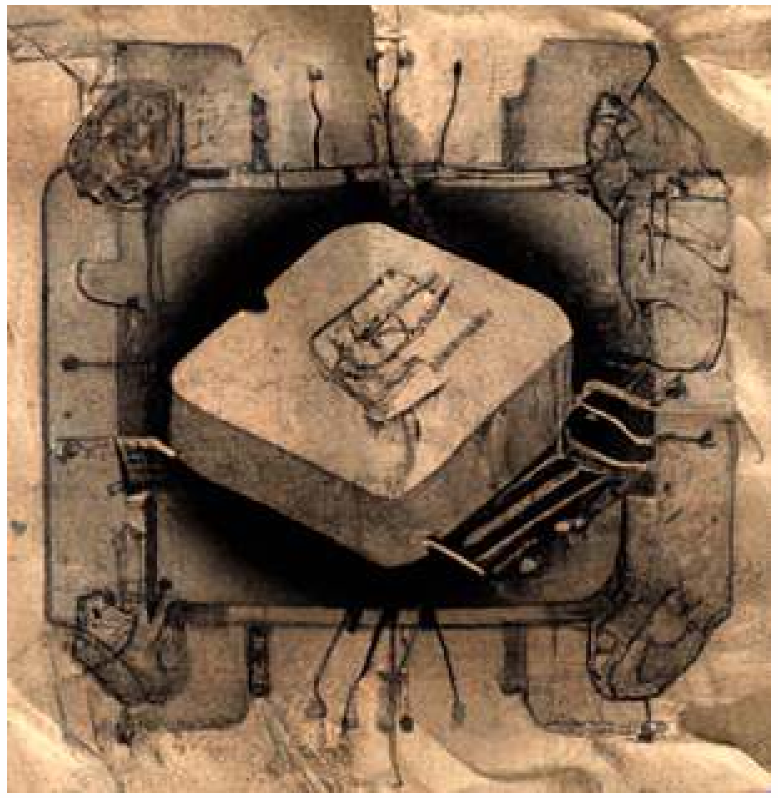
An investigation by Chaudhuri and Mukherjee (Journal of Electronic Materials, Vol. 129, 2022) - Explores the viability of two-dimensional (2D) materials such as graphene and transition metal dichalcogenides (TMDs) in nanoelectronics, unearthing their exceptional electronic and mechanical properties.

A study by Sharma et al. (Materials Science in Semiconductor Processing, Vol. 128, 2021) - Examines the use of organic semiconductors in flexible electronics, illuminating their potential in wearable devices and futuristic technologies.

Research by Nair et al. (Semiconductor Science and Technology, Vol. 132, 2022) - Investigates the burgeoning field of spintronics, which harnesses electron spin in semiconductors, promising breakthroughs in quantum computing and data storage.

Unfurling the tapestry of the Indian economy, concerning this ethereal realm of semiconductors, The researcher has observed that India, the land of spiritual enigma and technological transformation finds itself at the cusp of an economic renaissance. With a burgeoning population and a voracious appetite for advancement, the Indian economy stands poised to embrace the intricacies of the semiconductor domain.

In recent years, the Indian government has shown immense sagacity in recognizing the paramount importance of domestic semiconductor manufacturing. With initiatives like the National Policy on Electronics and the Production Linked Incentive (PLI) Scheme, India aspires to bolster its semiconductor ecosystem by attracting substantial investments. This verily resonates with the Renaissance spirit of fostering creativity through patronage and encouragement.

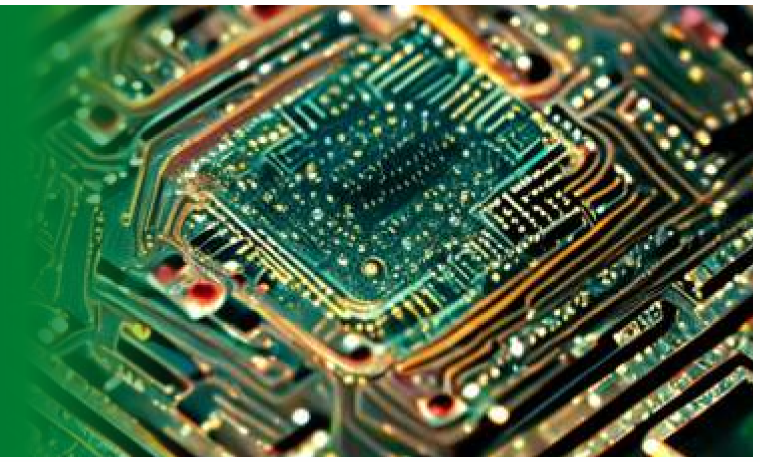


The researcher finds that these sylvan fields of the Indian economy shall bloom with an influx of jobs and opportunities as the semi-conductor sector burgeons. An entire gamut of employment shall unfurl for skilled technicians, engineers, researchers, and visionaries, nurturing a new generation of technocrats. Moreover, a thriving semiconductor industry shall act as a catalyst, propelling ancillary sectors such as telecommunications, information technology, and renewable energy, and thus, augmenting the national prosperity.

In summation, the realm of semiconductors is an unfathomable ocean of potential, both scientific and economic. Like the Renaissance, where art, science, and intellect danced in a harmonious symphony, so too shall the Indian economy flourish in embracing this cutting-edge technology. The researcher wishes that the symphony of progress continue to resonate through the corridors of time, for the enigma of semiconductors shall continue to shape the destinies of generations yet unborn.

"Semi-conductors and India's Leadership"

Shambhavi Vyas
BCA – Semester 1 - 23bca078



What is a semiconductor, but in an easy way?

Scientifically, semiconductors are substances that conduct electricity at specific threshold values. But if it does not reach that threshold value there is no conduction. You can compare them with ambiverts for easy understanding, they talk with people if you are the one who started the conversation but, if you do not start the conversation, they are introverts.

Are semiconductors really a new epoch for the country?

Sometimes it is slothful to even brush our teeth but to assist us and let us be in our energy-saving mode for a longer time we have electrical toothbrushes, untangling the earphones used to be so tedious but we got Bluetooth earphones, fascinating from the day we start to the day we end we use one or the other appliances made up of semiconductors. The era of computers is been followed up by the era of semiconductors.

Imagine not even having a fresh, oxygen-enriched cool breeze is surly a misfortune still we have our hopes that semiconductors will help us knock off the pollution by assisting in renewable energy projects, voltage regulators and etc.

Career opportunities coming hand in hand with semi-conductor.

In the era of computers, we got many more career opportunities and more job opportunities too. With the coming new revolution of semiconductors, we got more job opportunities.

- Semiconductor Engineers
- Process engineers
- Product engineers
- Applications engineers
- Research scientists

The critical role of multi-faced semiconductor in India

- **Semiconductor Supply Chain Resilience:** strategies to enhance the resilience of the semiconductor supply chain. This could involve exploring ways to diversify supply sources, strengthen domestic manufacturing capabilities, and promote international cooperation.
- **Technology Competitiveness and Innovation:** positive completion is to necessitate efficiency in the market, fostering innovation in the semiconductor industry we could bring young enterprisers and adroit businessmen together by promoting collaboration between academia, businesses, and government agencies
- **Semiconductor Workforce Development:** Developing and nurturing a skilled semiconductor workforce, including promoting STEM education, providing training programs, and encouraging industry-academic partnerships could be of great help due to the new emergence of semiconductors in the industry.
- **Environmental Sustainability and Semiconductor Manufacturing:** With semiconductor manufacturing being energy-intensive, we may explore ways to promote cleaner and more sustainable practices within the industry. As we have already been using the bright sunshine silicon solar panels for solar energy there are yet more to be discovered with the help of semiconductors.

- **Semiconductor Standards and Regulation:** Leaders may discuss the role of international standards and regulations in ensuring interoperability, safety, and fair competition in the semiconductor industry.

Semiconductor Leadership: Challenges and Opportunities for Political Leaders

Let us talk about what the most popular leader of the globe has to say about how diversly would he see India with the upcoming semiconductor project.

Narendra Modi's leadership, the Indian government has been pushing for the growth of the semiconductor and electronics manufacturing sector within the country. The "Make in India" initiative, launched in 2014, aims to promote domestic manufacturing across various sectors, including electronics and semiconductors.

PM says:

"Earlier, people were questioning our aim to make chips and were asking 'why to invest (in India)'. Now, the question has changed to 'why not invest,'" PM Modi said.

"India realises semiconductor is not just our need but that the world needs a trusted supply chain. Who could be a better partner than the world's biggest democracy," Modi added.

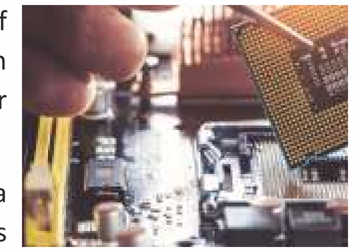
"A few years ago, India was an emerging player in the electronics sector. Today our share has increased multiple times... In 2014 electronics production in India was less than $30 billion, and today it is over $100 billion," Modi said.

I strongly believe that the global leader has seen a very bright future of semi-conductor nurturing the electronic production in the country as with more investors-investing, and researchers-researching, He aims to make India the THIRD largest economy. We wish that his vision and implementation promoting innovation and entrepreneurship, sustainable development, and enhancing global collaborations for technological advancements and economic progress would flourish for Indians

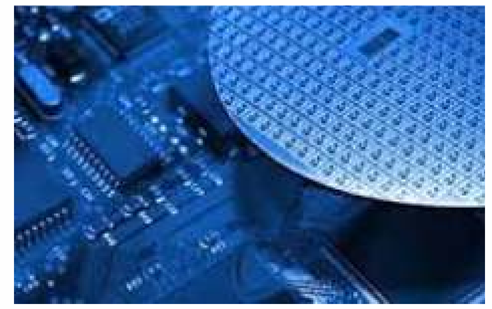
Prime Minister and the government's vision regarding semiconductors:

- It would be a significant development for India's semiconductor industry and a boost to the country's efforts to strengthen its domestic semiconductor manufacturing capabilities.

- The Indian semiconductor industry in 2022 was US USD 27 Billion, with over 90% imported, and therefore a significant external dependence for Indian chip consumers. this is very similar to other key markets like the USA and the EU which have a high dependence on imports primarily from Taiwan and China where there is a major concentration of semiconductor manufacturing.
- the Government of India announced a US USD 10 billion program for the development of the semiconductors and display manufacturing ecosystem in India covering both manufacturing and design with an objective of attracting investments in semiconductor manufacturing and design to position India as a major hub for semiconductors.



- the Indian semiconductor market is expected to reach USD 55 Billion by 2026, growing a CAGR of 20% CAGR during the period 2022-2026. the global demand for semiconductors is envisaged to grow exponentially with advancements in technology.



- As we know that semiconductors are widely used in the chips of our mobile phones and laptop, this makes us conclude that semiconductor is very important for networking and therefore the smartphone industries networking of 5G increase shift to IoT would increase the application of smart devices. India should get two high-quality proposals in semiconductor fab in the next 12 months, said communications and IT minister Ashwini Vaishnav in an interview.
- IT minister says that according to him Micron would bring other companies along with it and other companies wanted to evaluate India as the potential destination for their investment.
- Micron Technologies is a major player in the semiconductor industry, and establishing a unit in Gujarat would likely have positive implications for the state's economy and the country as a whole. Recent news says that "After the investment from Micron Technologies, Gujarat has taken a tectonic jump in the world of semiconductors and has left all states behind," said Chandrasekhar.
- Vedanta-Foxconn project in advanced stage of appraisal by Centre, says Gujarat govt. The Vedanta-Foxconn semiconductor project in Gujarat – set to become the first semiconductor manufacturing facility in India – is at an "advanced stage of appraisal"
- Foxconn's chairman said "Taiwan will partner with India. What kind of cooperation would India like from Taiwan"
- Taiwan produces over 60% of the world's semiconductors and over 90% of the most advanced ones. So, I firmly believe that cooperation with Taiwan is always going to result in a win-win situation for us because with such a great experience in this work they would be of a great help to India.

Breaking New Ground: Addressing the Research Gap in India??

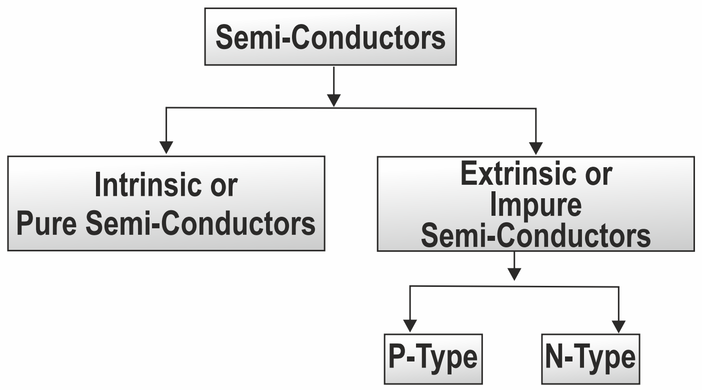
- Infrastructure and Capacity: Insufficient infrastructure and research facilities in some areas might have hindered the growth of research activities in those fields.
- Regulatory Environment: Sometimes, bureaucratic hurdles and complex regulatory processes can slow down the pace of research projects and deter potential investors.
- Brain Drain: India has faced the issue of "brain drain," where talented researchers and scientists move abroad for better opportunities and resources, leading to a loss of potential research contributions within the country.
- Focus on Applied Research: The emphasis on applied research over fundamental or basic research could also impact the overall perception of research funding in the country.

"Semiconductor: General Idea"

Pranjal Dave
BSc Microbiology – Semester 1 - 23sc04010

Introduction:

As per the ThoughtCo. Ltd. (2020), "In 1874, Karl Braun discovered and documented the first semiconductor diode effect." Semiconductor are materials which have conductivity between conductors and insulators. Semiconductor can be compounds such as Gallium, Arsenide or pure elements, such as Germanium or Silicon. Silicon is used in electric circuit fabrication and Gallium or Arsenide is used in solar cells, laser diodes etc.



(Image Source: Tutorialspoint.com)

Semiconductor are divided into two types; intrinsic semiconductor and extrinsic semiconductor. Intrinsic are pure form of semiconductor without any impurity and doping whereas Extrinsic semiconductor are prepared by adding certain amount of impurities.

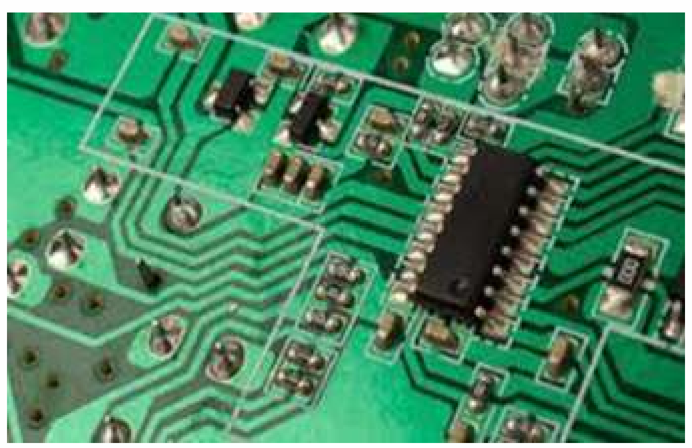
(Image credit: Shutterstock.com)

Importance of Semiconductor:

Semiconductor are an essential component of electronic devices enabling advances in:

- Communication
- Computing
- Healthcare
- Transportation
- Military Systems
- Clean energy

And countless other applications.

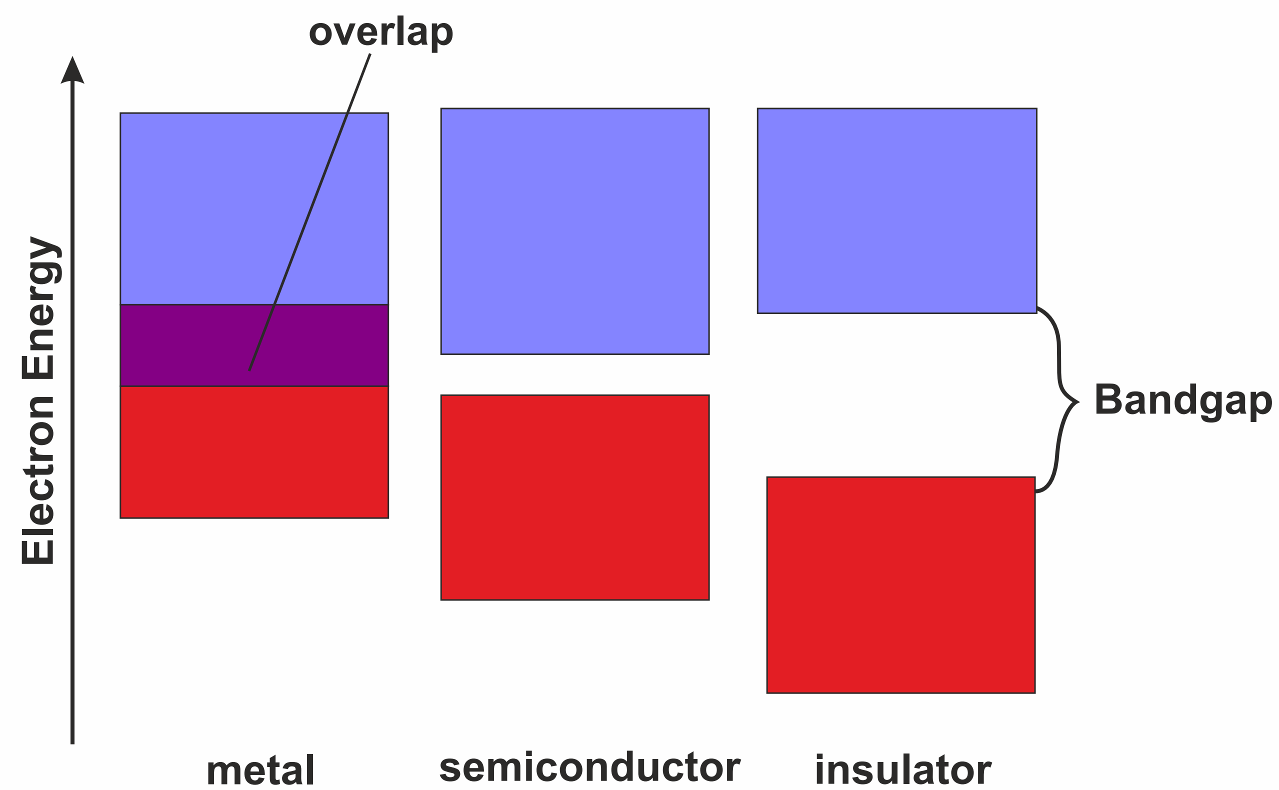


(Source: Semiconductors Industry Association)

How does semiconductor work?

As temperature increases electrons in valence band acquires sufficient energy to be promoted across the energy gap into the conduction. When this occurs, these promoted electrons can move and conduct electricity semiconductor properties are controlled by adding small number of impurities in the semiconductor through a process called doping. Different impurities and concentrations produce different effects.

(Source: idealpower.com 28th Jan,2022)



(Image source:Solarcellcentral.com)

World and Semiconductor:

According to an article by world population review(2023),"Taiwan, the tiny East Asian country whose diplomatic status is disputed by china is leading the world in terms of semiconductor manufacturing. This is largely due to the work of single company, Taiwan Semiconductor Manufacturing Co." Some of the other leading countries apart of Taiwan in terms of semiconductors are South Korea,Japan,United States and China. (Source: worldpopulationreview.com)

As per report by Economist.com Taiwan produces over 60% of the world's semiconductor and over 90% of the most advanced ones. (Source: economist.com 6th March 2023)

Where does India stand?

India is poised to become a major global hub in semiconductor manufacturing over the next 10 years.

It has to continue working consistently to ensure that a vigorious ecosystem is in place to achieve that goal. India's semiconductor market is forecast to grow from $15 Billion in 2020 to $110 Billion in 2023, putting it among the world's fastest growing semiconductor markets.

(Image source:orfonline.org)

Conclusion:

As it is an era of electronics and digital communication the need of semiconductor will also increase many of the item are manufactured with the help of semiconductor. It is high time we should learn more about this developing field and how it will help us to develop more.