INDIA'S GRAPHENE MARKET – ECONOMY

NEWS: *In February 2024, a US-China research team achieved a major milestone by successfully synthesizing a functional semiconductor from graphene. This development is poised to revolutionize several industries, including electronics, energy storage, and medical devices.*

- **Implications for Multiple Sectors**: This innovation has the potential to reshape computing technologies and impact numerous other sectors, offering new possibilities for advancements in digital technologies, energy solutions, and medical treatments.

WHAT'S IN THE NEWS?

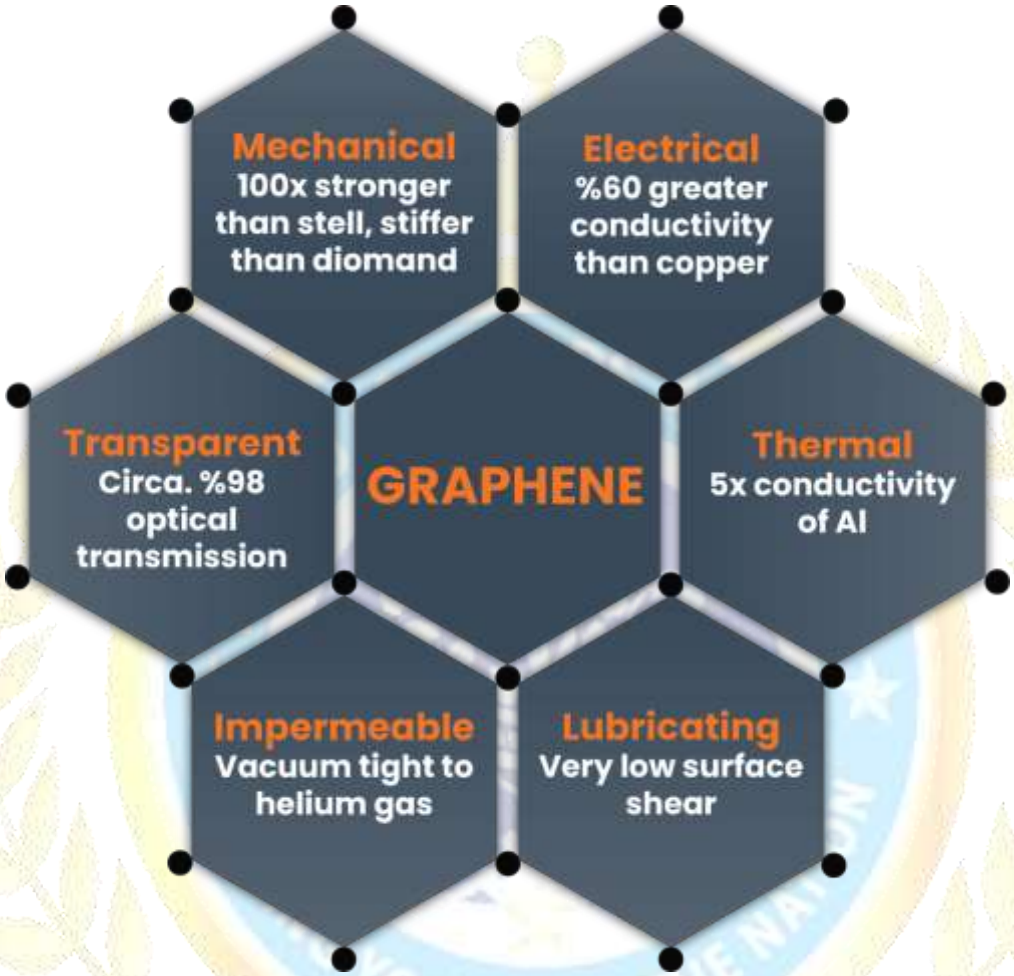
China's Dominance in the Graphene Market

- **Global Market Control**: By 2023, China dominated the global graphene market, controlling over 70% of global production. This has positioned the country as the leading force in the development and distribution of graphene worldwide.
- **Government Investment and Policies**: China has made strategic investments in research, infrastructure, and production to support its dominance in graphene. National policies like 'Made in China 2025' have been critical in advancing graphene technologies, fostering innovation, and scaling production capabilities.
- **Market Growth Projections**: The global graphene market is expected to reach a value of $6.25 billion by 2031, with China remaining a central player in driving this growth.
- **Resource Dependency**: China's dominance highlights the increasing importance of securing critical resources such as graphite, which is necessary for graphene production. This also underscores the geopolitical challenges related to resource access.

India's Progress in Graphene Research

- **Academic and Industrial Advancements**:
  - **IISc Bangalore**: Researchers at the Centre for Nano Science and Engineering at IISc Bangalore have developed a chemical vapor deposition (CVD) system that is capable of producing various 2D materials, including graphene. This marks a significant step in India's graphene research capabilities.
  - **Tata Steel's Efforts**: Tata Steel has made notable contributions to graphene research by growing graphene on steel surfaces and investigating its potential in applications like plastic recycling.
  - **Log 9 Innovations**: IIT Roorkee-incubated company Log 9 has patented graphene-based ultracapacitors, which demonstrate the material's potential in enhancing energy storage and power delivery.
  - **Other Key Companies**: Companies such as Tirupati Graphite and Nanomatrix Materials are contributing to the production of graphene and exploring its use in various applications, including antiviral technologies.

- **Collaboration with Tata Steel and C-MET**: Digital University Kerala, in partnership with Tata Steel and C-MET, has established the India Innovation Centre for Graphene. This center plays a crucial role in driving research and development in the field.



What is Graphene?

- Graphene is a **one-atom-thick layer of carbon atoms arranged in a hexagonal lattice**. It is the building-block of Graphite, but graphene is a remarkable substance on its own with a multitude of astonishing properties.
- It is the **thinnest, most electrically and thermally conductive material in the world**, while also being **flexible, transparent and incredibly strong.**
- Often referred to as a **wonder material for its extraordinary electrical and electronics properties**, graphene could **replace Indium and thereby bring down the cost of OLED** (organic light-emitting diode) screens in smartphones, studies have shown.
- Graphene has a lot of promise for **additional applications**: anti-corrosion coatings and paints, efficient and precise sensors, faster and efficient electronics, flexible displays, efficient solar panels, faster **DNA sequencing**, drug delivery, and more.

India's Growing Graphene Market

- **Rapid Growth Expected**: The Indian graphene market is expected to grow at a compound annual growth rate (CAGR) of 20.1% from 2017 to 2027, driven by the increasing demand for graphene in industries like electronics, energy storage, aerospace, and construction.
- **Electronics Sector Demand**: Electronics holds the largest market share for graphene, with growing applications in devices such as sensors, transistors, and energy-efficient technologies.
- **Government Initiatives Supporting Growth**: India's government has introduced initiatives such as **Make in India** and **Production Linked Incentives**, which have helped foster growth in sectors like electronics. These initiatives are creating a favorable environment for the application of graphene in the country.
- **Patent Activity in India**: Although patent filings for graphene-related innovations are still limited in India, the majority of filings come from foreign companies such as Lockheed, BASF, and PPG Industries. However, some notable domestic filings have emerged, such as **PCBL's patent** for graphene-based rubber compounds (Patent No IN544320), highlighting India's potential for innovation in this field.

Challenges Faced by India in Graphene Production

- **Global Competition**: India is still far behind global leaders like China and Brazil in terms of graphene production capacity and market share. These countries have well-established infrastructures and greater resources for scaling production.
- **Industrial Scalability Issues**: India faces challenges related to fragmented infrastructure and the lack of large-scale production facilities. Overcoming these obstacles is crucial for India to establish a strong foothold in the global graphene market.
- **Skilled Workforce Shortage**: The limited availability of skilled professionals in nanotechnology and material science is another barrier to the country's growth in graphene production.
- **High Production Costs**: The production of high-quality graphene at a competitive cost remains a significant hurdle. The high cost-to-volume ratio of producing graphene at scale means that production may remain concentrated in just a few global hubs, similar to the semiconductor industry.

Strategic Path Forward for India

- **Building Graphene Industrial Parks**: One of the key steps for India is to establish dedicated **graphene industrial parks**, which could focus on research, production, and commercialization of graphene products. These hubs would allow for better integration between research institutions, industries, and government agencies.
- **Increasing R&D Investment**: The Indian government must ramp up investment in **research and development** to accelerate advancements in graphene technology. Strengthening R&D funding would also encourage innovation and the development of cost-effective production methods.

- **International Collaborations**: Collaborating with leading international institutions, such as the **National Graphene Institute** at the University of Manchester, could significantly boost India's graphene research capabilities. Such partnerships would also help India gain access to cutting-edge technologies and expertise.
- **Forming National Graphene Industry Alliance**: Establishing a **National Graphene Industry Alliance** would help unify stakeholders in the graphene sector, advocate for industry needs, and provide incentives for the adoption of graphene-based solutions across various industries.
- **Educational and Awareness Initiatives**: Promoting awareness about the unique properties and benefits of graphene through **workshops, educational initiatives**, and industry events will help generate demand for graphene-based products and technologies.

India's Potential in the Global Graphene Market

- **Emerging as a Global Player**: With the right policies, investments, and international partnerships, India has the potential to become a **key player** in the global graphene market, contributing to advancements in sectors such as electronics, energy, construction, and medical technologies.
- **Technological Innovation**: India's advancements in graphene research suggest that the country can play a significant role in the global technological revolution, which is increasingly driven by materials science and nanotechnology.
- **Economic Growth and Global Competitiveness**: By tapping into the full potential of graphene, India could not only strengthen its industrial base but also enhance its economic growth and global competitiveness. The future of graphene in India looks bright, especially if the country can overcome existing challenges and strategically invest in the sector's development.

Source: https://www.thehindubusinessline.com/opinion/india-can-make-a-mark-in-global-graphene-market/article69092906.ece#:~:text=The%20Indian%20graphene%20market%20is,holds%20the%20largest%20market%20share.