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## India and Graphene

### Why in news?

India needs to catch up in the area of graphene to be among the leaders in AI and a potential challenger in quantum computing.

### What is graphene?

- Graphene is an allotrope of carbon consisting of a single layer of atoms arranged in a hexagonal lattice nanostructure.
- Graphene was discovered in 2004 for which the scientists received the Nobel Prize in Physics in 2010.
- It is the world's thinnest, strongest, and most conductive material of both electricity and heat.
- **Properties** - It is 200 times stronger than steel but 6 times lighter.
- It is almost perfectly transparent as it absorbs only 2% of light.
- It is impermeable to gases, even those as light as hydrogen and helium.
- It has the potential to absorb and dissipate electromagnetic waves.
- It is highly sensitive to environmental changes.

### What are the applications of Graphene?

- Graphene in itself has huge potential to revolutionise electricity, conductivity, energy generation, batteries, sensors and more.
- Graphene composites are used in aerospace, automotive, sports equipment and construction.
- It is used for high-performance batteries and [super-capacitors](#), touchscreens, and conductive inks.
- Graphene-based sensors are used for environmental monitoring, healthcare and wearable devices.
- Graphene oxide membranes are used for water purification and desalination.
- Graphene has an attractive potential in defence and aerospace as a promising material for armour and ballistic protection due to its exceptional strength.

### What are the global trends towards graphene?

- It was difficult to produce high-grade large-scale graphene at the time of its discovery.
- Now over 300 companies are producing graphene or its derivatives.

*As per a report, at least one graphene-enhanced product was launched every week in 2022.*

- China and Brazil are global leaders in the commercial production of graphene.
- China, the U.S., the U.K., Japan, South Korea, Russia, and Singapore are among the leading countries in graphene research.
- Beijing Graphene Institute was set up in 2018, where several companies produce industry-grade graphene products.
- China declared graphene a priority in its 13th Plan.
- Europe has set up the Graphene Flagship, with a budget of 1 billion Euro in 2013.
- In 2018, China filed 218 graphene-related patent while the other leading countries together filed 79.
- India had eight graphene-related patent filings.

### **How is India's progress in graphene industry?**

- India's progress has been better than many nations towards graphene.
- India produces about one-twentieth of graphene products compared to China and one-third compared to Brazil.
- Some start-ups and foreign subsidiaries have started graphene or graphene derivatives in India.
- The India Innovation Centre for Graphene in Kerala is being setup and implemented by the Digital University Kerala in partnership with Tata Steel.
- India's niche is going to be innovation using graphene.
- It figured out how graphene oxide-based wrappers loaded with preservatives can increase the shelf life of fruits and vegetables.
- Indian companies have patented for a technology for graphene-based ultra-capacitors and developed applications of graphene-based nanotubes.

### **What should India do to progress in graphene industry?**

- India missed the semiconductor bus in the mid-1990s, now it has to step on the graphene.
- Like other countries, Centre needs to become the nodal point to spur large-scale innovation activity around graphene.
- A nodal Ministry needs to be entrusted with the responsibility of 'National Graphene Mission'.
- India needs to be among the leaders in graphene to get benefitted the most from the industry and to excel in AI and quantum computing.

### **Reference**

1. [The Hindu - Is India missing the graphene bus?](#)



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