DIAMOND CHIP

Introduction

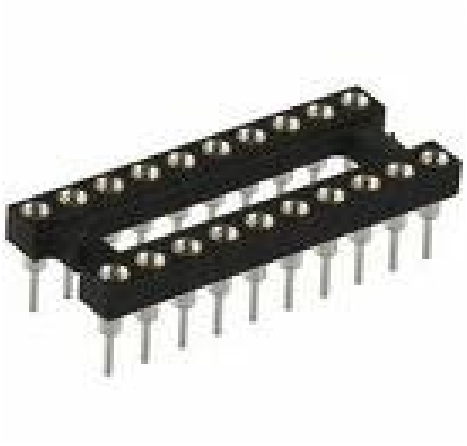
- Electronics without silicon is unbelievable.
- Disadvantages when used in power electronics application, such as:

  1) bulk in size

  2) slow operating speed, etc.

What is diamond chip?

- In a single definition, Diamond Chip or Carbon Chip is an **Electronic Chip** manufactured on a diamond structure Carbon wafer



How is it possible ?

- Diamond structural carbon is non conducting in nature.
- To make it conducting, doping process is performed.

  Boron-- as the p-type.

  Nitrogen--as the n-type.

Some facts…

- Carbon is not a semiconductor.
- Some of the carbon allotropes acts as semiconductor.

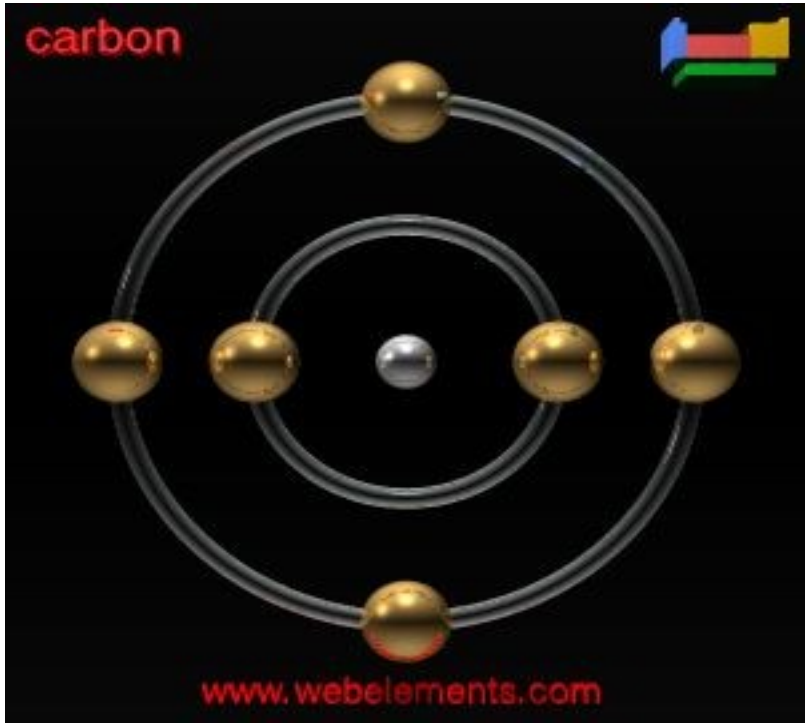


Fig: Carbon atom.

What is carbon nanotube?

- Just fold the graphene sheet into a tube like structure
- It is a nanosize cylinder of carbon atoms.
- It has less than one nanometer diameter.

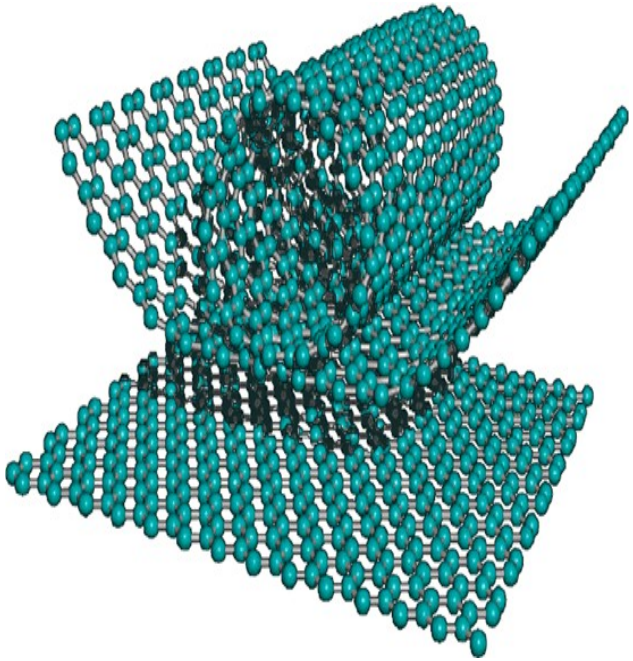


Fig:Carbon nanotubes made step by step.

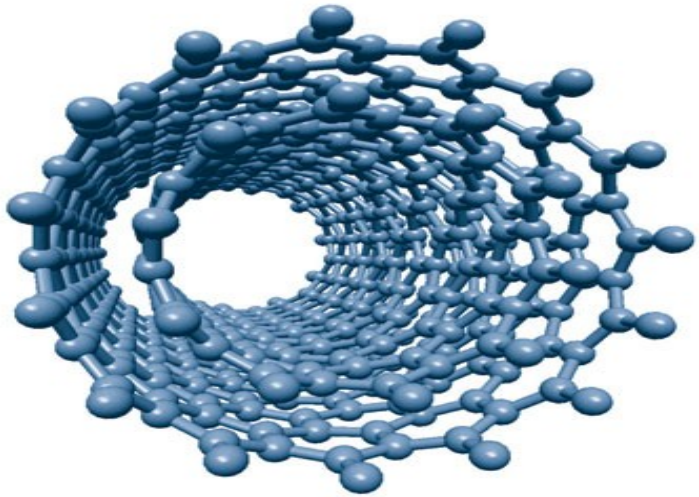
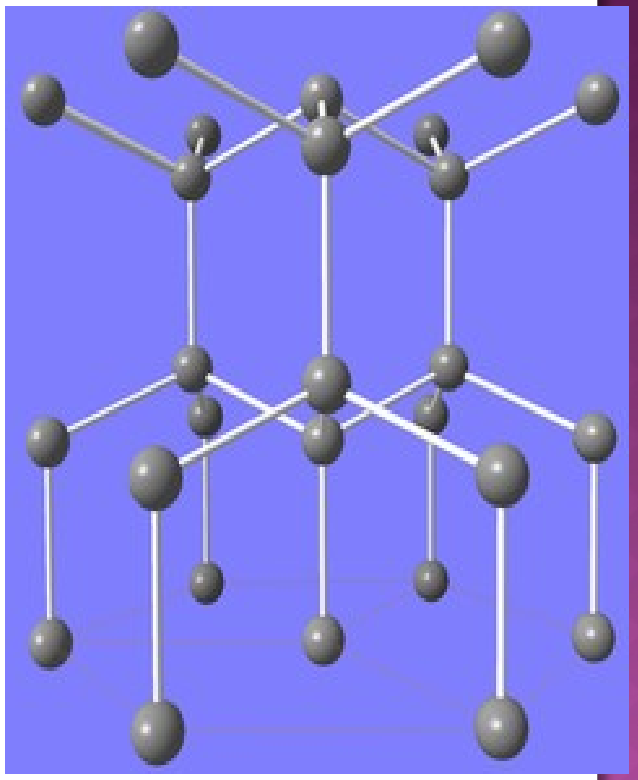


Fig :View of CNT.

Why the name DIAMOND CHIP?

- **Lonsdaleite** is an sp3 bondage allotropic form of carbon i.e. 3-dimentional CNT.
- Crystal structure of **Lonsdaleite** looks exactly like diamond.

(a)



(b)

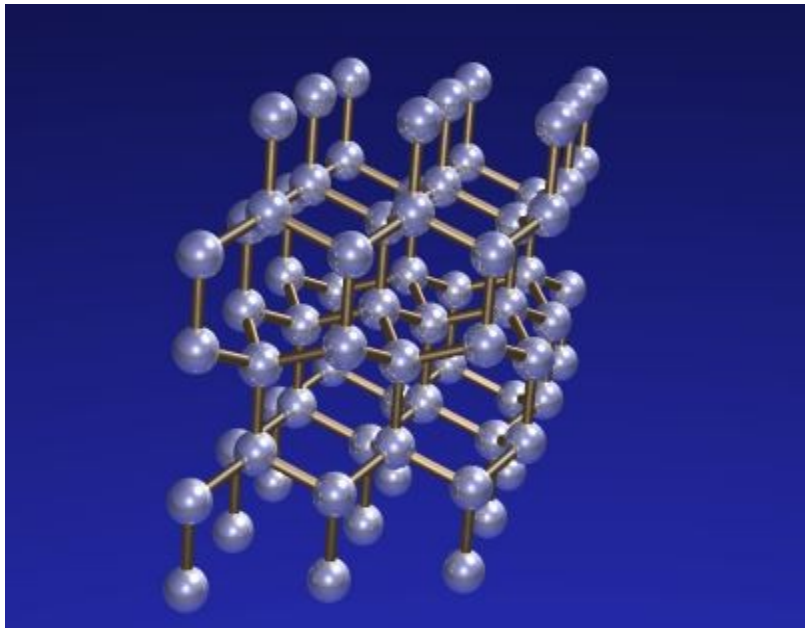


Fig (a): **Lonsdaleite** Structure**.**
(b):crystal structure of **Lonsdaleite.**

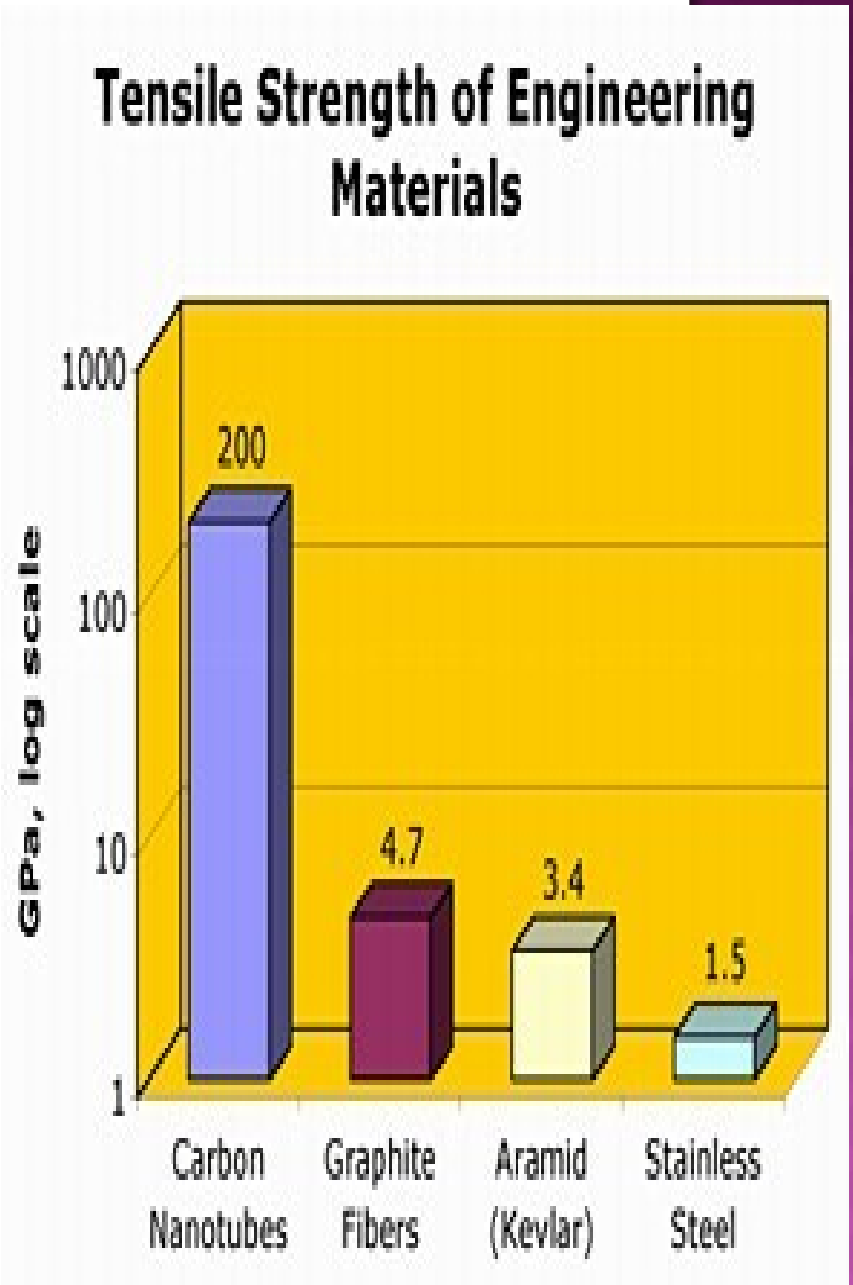
Properties of CNT

- Properties
  - 1 Strength
  - 2 Hardness
  - 3 Electrical
  - 4 Thermal
  - 5 One-dimensional transport

Properties...

- **HARDNESS :**
  - It can withstand a pressure up to 24GPa without deformation.

- **STRENGTH :**
  - Carbon nanotubes are the strongest and stiffest materials yet discovered in terms of tensile strength and elastic modulus respectively.



Properties…

- **ELECTRICAL :**
  - High electrical conductivity (10^{-6} ohm).
  - Do not suffer from electro migration or atomic diffusion and thus can carry high current densities (10^{7} -10^{9} A/cm^{2}),which is 1000 times that of copper.
  - Both metal and semiconductor can be formed.

Properties…

- **THERMAL :**
  - The temperature stability of carbon nanotubes is estimated to be up to 2800 °C in vacuum and about 750 °C in air.

- **ONE DIMENTIONAL TRANSPORT :**
  - Because of the nanoscale dimensions, electrons propagate only along the tube's axis.
  - Carbon nanotubes are frequently referred to as “one-dimensional”

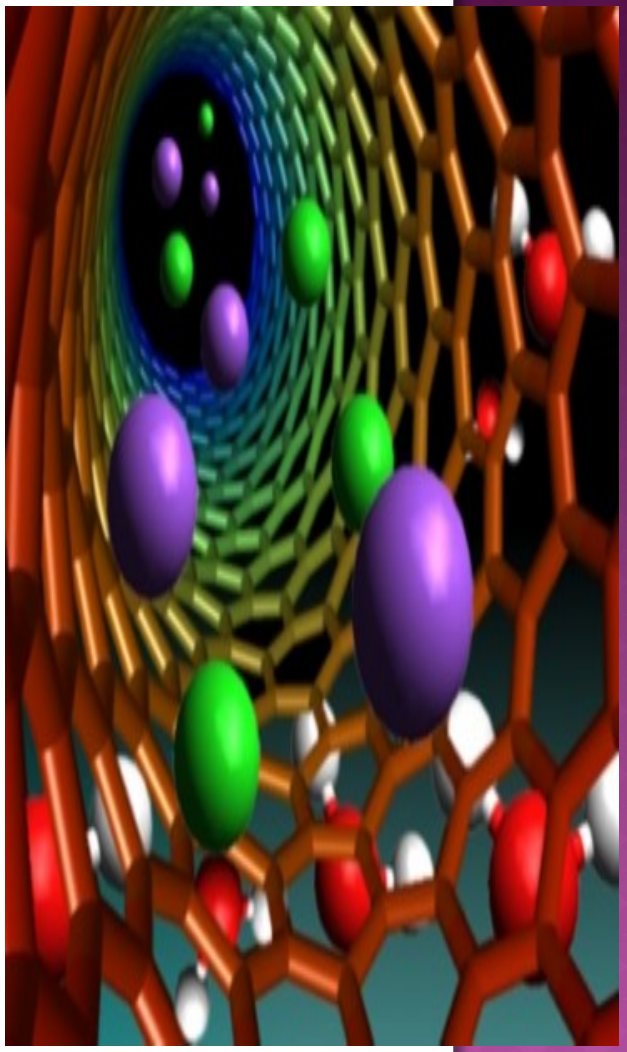


Fig: Flow of electrons In Carbon Nanotubes.

ADVANTAGES

..OF DIMOND CHIP OVER SILICON CHIP

- Smaller components are possible.
- It works at higher temperature.
- Faster than silicon chips.
- Larger power handling capacity.

CARBON NANOTUBE APPLICATIONS

- Information and Communications,
- Materials and Manufacturing,
- Biomedical,
- Energy and Environmental,
- Transportation
- Consumer goods.

LIMITATIONS

- Much more expensive than silicon.

- Doping process is very hard to perform due to the diamond structure , than in silicon.

CONCLUSION

Thus diamond chip replaces the need of silicon in every aspect in future generation.

QUERIES

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Thank You!