



# Material for Energy Harvesting and Power Generation

[Source: PIB](#)

## Why in News?

Recently, scientists have come up with a recent study that **explores the electronic mechanisms governing chemical bonding in a new class of materials called incipient metals**, with a focus on Metavalent Bonding (MVB) within a single 2D layer of Group IV chalcogenides.

## What are the Key Highlights of the Study?

### ▪ About:

- The study was conducted at Theoretical Sciences Unit at Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR).

### ▪ Findings:

- The study discovered that group IV chalcogenide materials can transition from **amorphous to crystalline forms** in less than 100 nanoseconds when heated or cooled.

### ▪ Significance:

- The **new material** can have applications in various fields like efficient **energy harvesting, and power generation**.
- Also, the research connects with the emerging field of **quantum materials** which will help in [India's national mission on quantum technology](#).

### ▪ Related Terms:

- Incipient Metals:

- They exhibit electrical conductivity similar to metals, with **high thermoelectric efficiency** characteristic of **semiconductors**, and unusually **low thermal conductivity**, creating a triad of properties that cannot be explained by traditional chemical bonding concepts.

- **Chalcogenides:**

- **Chalcogenides** are compounds containing at least one chalcogen elemental ion (such as **Sulphur, Selenium, and Tellurium**) and at least one metallic element.
  - Group IV chalcogenides possess intriguing properties making them suitable for technological applications.
- Chalcogenides are important in energy harvesting and power generation due to their **high electrical conductivity and effective thermal-to-electrical energy conversion**.
- Chalcogenides are **already used in computer flash memories**, leveraging their ability to change optical properties during transitions between crystalline and amorphous states.

- **Metavalent Bonding:**

- The bonding, **which defies the classical octet rule** (the tendency of atoms to prefer to have eight electrons in the valence shell) in chemistry, has properties of both the bonding present in metals and those found in glasses.

# NATIONAL QUANTUM MISSION

Aims to put India among the top six leading nations involved in the R&D in quantum technologies

Presently, R&D works in quantum technologies are underway in the US, Canada, France, Finland, China and Austria

- Duration: 2023-24 to 2030-31
- Nodal Ministry: Ministry of Science & Technology
- Highlights of the Mission:
  - Four Thematic Hubs (T-Hubs) in different domains across the country
  - Wide-scale applications ranging from healthcare and diagnostics, defence, energy and data security
- Strengthening of indigenously building quantum-based computer
- Help develop magnetometers with high sensitivity in atomic systems and atomic clocks
- Support design and synthesis of quantum materials

A huge boost to National priorities like digital India, Make in India, Skill India, Stand-up India, Start-up India, Self-reliant India and SDGs

## Quantum Technology

Works by using the principles of quantum mechanics (the physics of sub-atomic particles), including quantum entanglement and quantum superposition

### Quantum Superposition

The ability of a quantum system to be in multiple states simultaneously

While digital computers store data as bits (the ones and zeros of binary), quantum computers use qubits that exist as one, zero or both at the same time

This superposition state creates a practically infinite range of possibilities, allowing for fast simultaneous and parallel calculations

### Quantum Entanglement

It means the two members of a pair (Qubits) exist in a single quantum state

If you change the properties of one of them, the other changes instantly

This can be used to create a secure encryption key in quantum cryptography

If an eavesdropper tries to intercept the transmission, the entangled state of the particles will be disturbed, making the attempt detectable



## UPSC Civil Services Examination, Previous Year Question (PYQ)

### Prelims

Q. What is the difference between a CFL and an LED lamp? (2011)

- To produce light, a CFL uses mercury vapour and phosphor while an LED lamp uses semiconductor material.
- The average life span of a CFL is much longer than that of an LED lamp
- A CFL is less energy-efficient as compared to an LED lamp.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only

**(d)** 1, 2 and 3

**Ans: (c)**

**Q. With reference to solar power production in India, consider the following statements: (2018)**

1. India is the third largest in the world in the manufacture of silicon wafers used in photovoltaic units.
2. The solar power tariffs are determined by the Solar Energy Corporation of India.

**Which of the statements given above is/are correct?**

**(a)** 1 only

**(b)** 2 only

**(c)** Both 1 and 2

**(d)** Neither 1 nor 2

**Ans: (d)**

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