



# Two Dimensional Electron Gas

## Why in News

Scientists at **Institute of Nano Science and Technology (INST)**, Mohali, Punjab have produced an **ultra-high mobility Two dimensional (2D)-electron gas (2DEG)**.

## Key Points

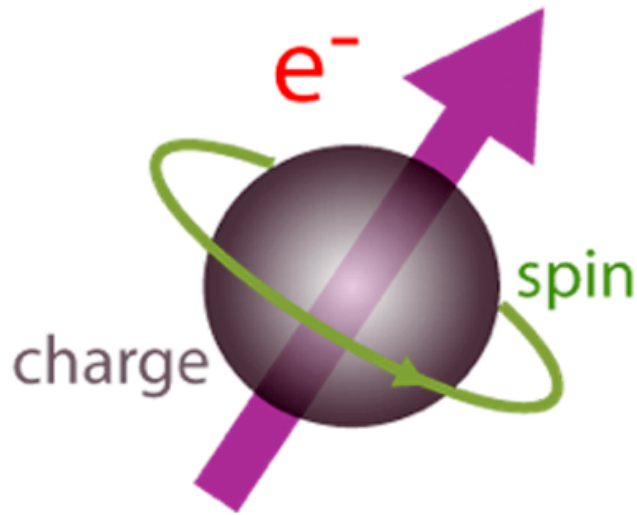
### ▪ Two Dimensional Electron Gas (2DEG):

- It is an electron gas that is free to move in **two dimensions**, but tightly **confined in the third**. This tight confinement leads to **quantized energy levels for motion in the third direction**. Thus the electrons appear to be a **2D sheet embedded in a 3D world**.
- One of the most important recent developments in **semiconductors**, has been the achievement of structures in which the electronic behavior is essentially **two-dimensional (2D)**.
- Most 2DEGs are found in **transistor-like structures** made from **semiconductors**.
- 2DEG is a valuable system for exploring the physics of **superconductivity magnetism and their coexistence**.
  - Superconductivity is a phenomenon whereby a **charge moves through a material without resistance**. In theory this **allows electrical energy to be transferred between two points** with perfect efficiency, losing **nothing to heat**.

### ▪ Cause for Development of 2DEG:

- The need for attaining new functionalities in modern electronic devices has led to the **manipulation of property of an electron** called **spin degree of freedom along with its charge**. This has given rise to an altogether new field of spin-electronics or '**spintronics**'.
- The manipulation of **electron spin** offers **new dimensions for basic and applied research**, and the potential for **new capabilities for electronics technology**. This motivates studies of spin polarized electrons in a **high mobility two dimensional electron gas (2DEG)**.
  - Spintronics is the study of the **intrinsic spin of the electron** and its associated **magnetic moment**, in addition to its fundamental electric charge, in solid-state devices. [//](#)

# Spintronics



◦ It has been realized that a phenomenon called the '**Rashba effect**', which consists of splitting of spin-bands in an electronic system, might play a key role in spintronic devices.

• **Rashba Effect:** Also called **Bychkov-Rashba effect**, it is a **momentum-dependent splitting of spin bands** in bulk crystals and low-dimensional condensed matter systems.

▪ **Mechanism and Importance:**

- Due to the **high mobility of the electron gas**, electrons **do not collide** inside the medium for a **long distance** and hence **do not lose the memory and information**.
  - Hence, it can speed up transfer of quantum information and signal from one part of a device to another and increase data storage and memory.
- Since they collide **less during their flow**, **their resistance is very low**, and hence **they don't dissipate energy as heat**.
  - So, such devices **do not heat up easily and need less input energy** to operate.

[Source:PIB](#)

PDF Reference URL: <https://www.drishtias.com/printpdf/two-dimensional-electron-gas>