

# Spintronics and 2D Electron gas

January 13, 2021

## In news

Recently, the Scientists at Institute of Nano Science and Technology (INST), Mohali have produced an ultra-high mobility 2d-electron gas(2DEG)

## Key highlights of 2d-electron gas(2DEG)

- Scientists have produced electron gas with ultra-high mobility, which **can speed up transfer of quantum information and signal from one part of a device to another and increase data storage and memory.**
- 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'. 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.
- Scientists at Institute of Nano Science and Technology (INST), Mohali (Punjab), an autonomous institution of Department of Science and Technology (DST), Government of India, have **produced an ultra-high mobility 2d-electron gas(2DEG) at the interface of two insulating oxide layers.**
- Aided by a grant from the DST-Nanomission in the form of a sophisticated, custom-made instrument called a combinatorial pulsed laser deposition setup, Dr.SuvankarChakraverty Associate Professor at Institute of Nano Science and Technology (INST), Mohali (Punjab),

have produced 2DEG with ultra mobility at the novel interface composed of chemicals EuO and KTaO<sub>3</sub>.

- The strong spin-orbit coupling and relativistic nature of the electrons in the 2DEG resulted in the 'Rashba field'.
- The research was published in the journal 'Advanced Quantum Technologies'.

### Why is 2d-electron gas(2DEG) significant?

- 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, such a system can **easily remember and transfer its memory for a long time and distance**.
- In addition, 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.
- According to the INST team, realization of large Rashba-effect at such oxide interfaces containing highly mobile electron gas may open up a new field of device physics, especially in the field of quantum technology applicable for next-generation data storage media and quantum computers.

### What are sprintonics?

- Sprintonics also known as spin electronics, is the study of the intrinsic spin of the electron and its associated magnetic moment, in addition to its fundamental electronic charge, in solid-state devices.
- The field of spintronics concerns spin-charge coupling in metallic systems; the analogous effects in insulators fall into the field of multiferroics.
- Spintronics fundamentally differs from traditional electronics in that, in addition to charge state, electron spins are exploited as a further degree of

freedom, with implications in the efficiency of data storage and transfer.

- Spintronic systems are most often realised in dilute magnetic semiconductors (DMS) and Heusler alloys and are of particular interest in the field of quantum computing and neuromorphic computing

### **about Institute of Nano Science and Technology (INST)**

- INST, Mohali (Punjab), an autonomous institution of Department of Science and Technology (DST), has been established under the umbrella of NANO MISSION, initiated by DST to boost research and development in the field of Nanoscience and Nanotechnology in India.
- INST started its activities on 3rd January 2013
- INST brings together biologists, chemists, physicists, materials scientists and engineers having interest in nanoscience and technology.
- INST scientists, having strengths in basic science together with more application oriented mind from different backgrounds, work together by joining hands as a cohesive unit, under a congenial work environment, on a common platform apart from carrying out their individual research.
- The aim is to generate processes, technologies and devices directed towards national priorities especially in sectors like Agriculture, defence, healthcare, energy, environment and water.
- INST encourages outstanding research resulting in publications in the best internationally acclaimed journals , develop processes for strategic materials for indigenous production (import substitution), generate devices and advanced technology for defence and for commercialisation and also develop low-cost affordable devices especially in healthcare for the socially deprived section of our society.

### **NANO MISSION**

- The Government of India launched the Nano Mission in May 2007 as an “umbrella capacity-building programme”.
- As a result of the efforts led by the Nano Mission, today, India is amongst the top five nations in the world in terms of scientific publications in nano science and technology (moving from 4th to the 3rd position as in 2014)
- The Department of Science and Technology is the nodal agency for implementing the Nano Mission.