GMR SENSOR

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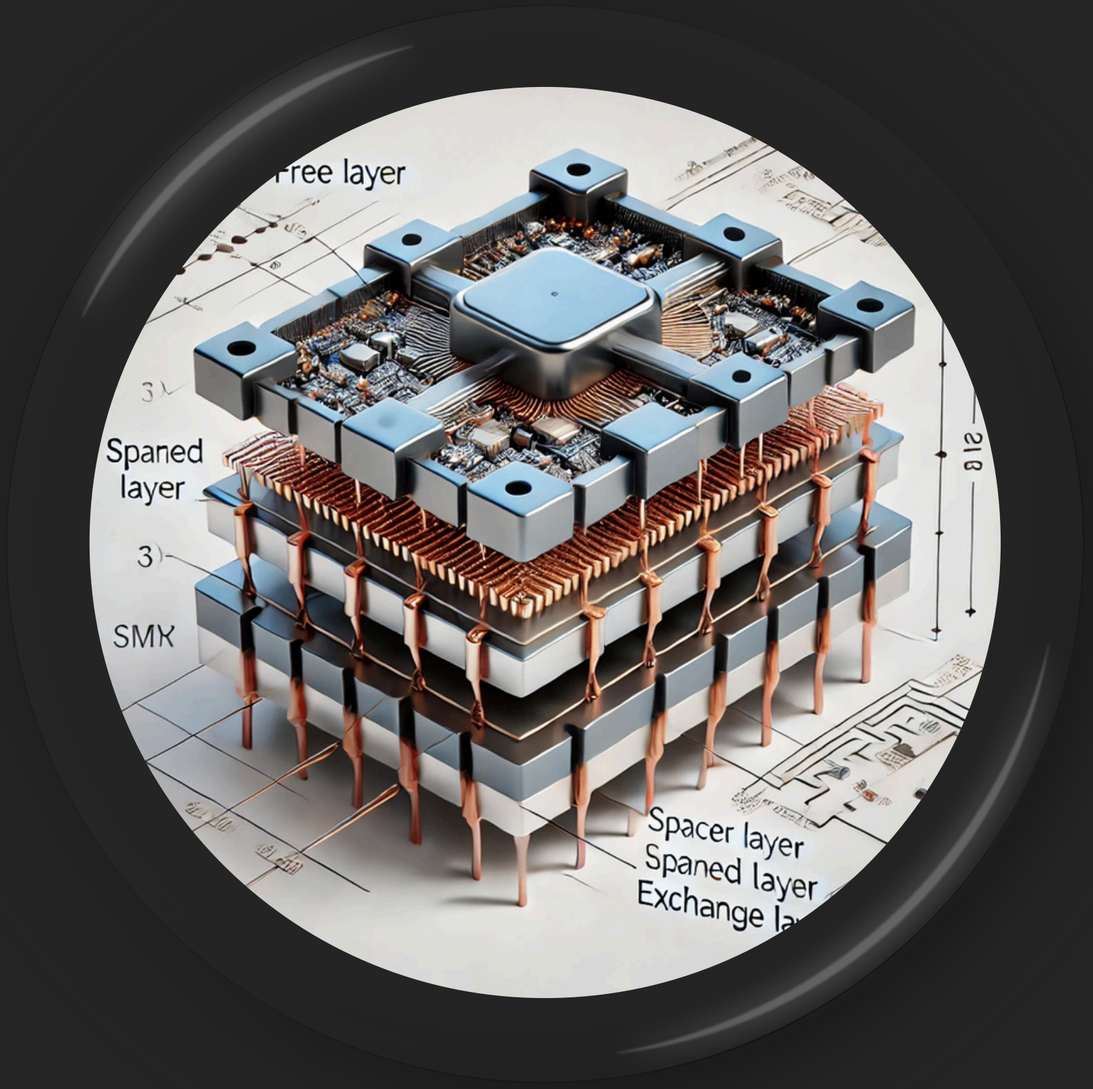

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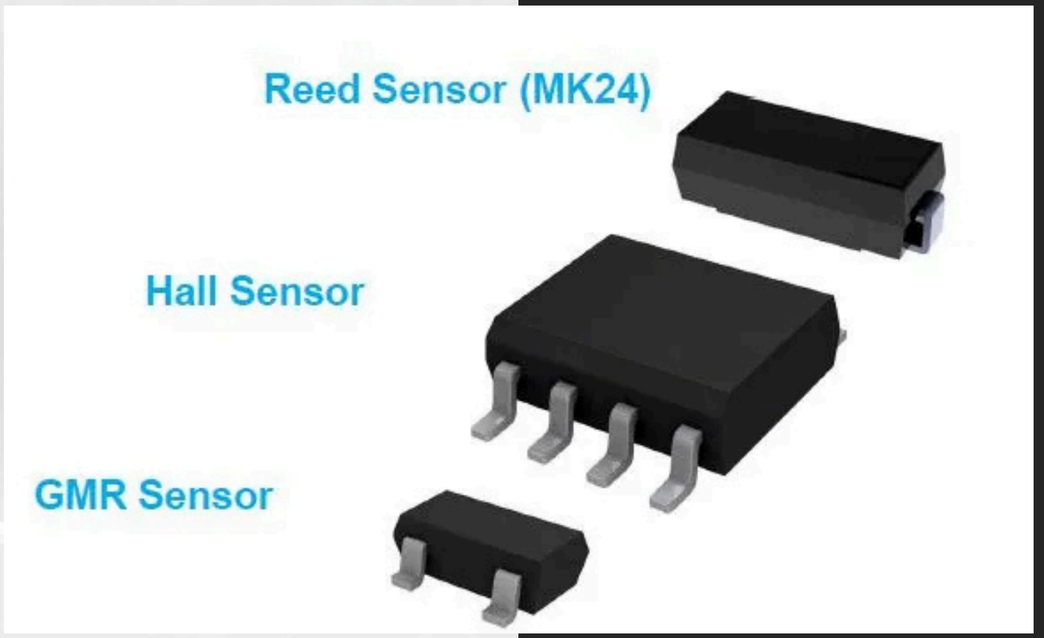
Introduction

A GMR (Giant Magnetoresistance) sensor detects changes in magnetic fields by measuring how the electrical resistance of a material changes when exposed to a magnetic field. It uses layers of magnetic and non-magnetic materials, and the resistance changes based on their alignment. GMR sensors are used in many devices like hard drives, cars, and medical tools because they are small, accurate, and energy-efficient. They can detect even small magnetic changes, making them valuable for various modern technologies.

WHAT IS GMR

The GMR concept typically refers to Giant Magnetoresistance (GMR), a quantum mechanical effect observed in thin film structures composed of alternating ferromagnetic and non-magnetic conductive layers. It plays a crucial role in the field of spintronics.



GMR SENSOR

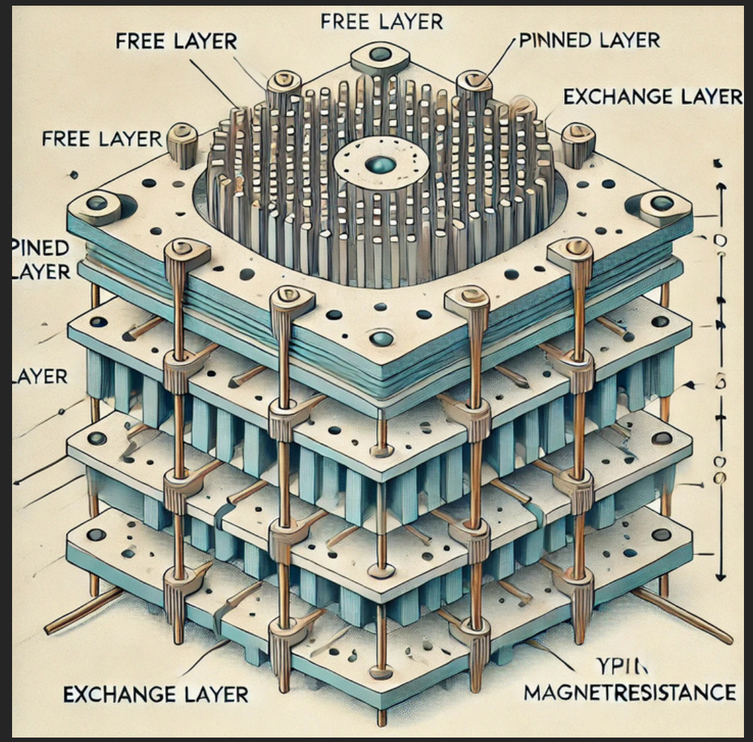
- A GMR sensor (Giant Magnetoresistance sensor) is a device that exploits the Giant Magnetoresistance effect to detect magnetic fields. It is a highly sensitive magnetic field sensor used in various applications due to its ability to detect small changes in magnetic fields with high precision.

Principle

GMR sensors exploit the quantum nature of electrons, which have two spin directions-spin up and spin down. Conduction electrons with spin direction parallel to a film’s magnetic orientation move freely, producing low electrical resistance. Conversely, the movement of electrons of opposite spin direction involves more frequent collisions with atoms in the film, producing higher resistance.

CONSTRUCTION

- **Free Layer:**
  A ferromagnetic layer whose magnetization can freely align with an external magnetic field.
- **Pinned Layer**:
  A ferromagnetic layer with a fixed magnetization direction, typically stabilized by an adjacent antiferromagnetic layer.
- **Exchange Layer (Antiferromagnetic Layer)**:
  A layer that "pins" the pinned layer's magnetization through exchange bias, preventing it from changing direction easily.
- **Spacer Layer:**
  A non-magnetic conductive layer (e.g., copper) separating the free and pinned layers, crucial for the GMR effect.

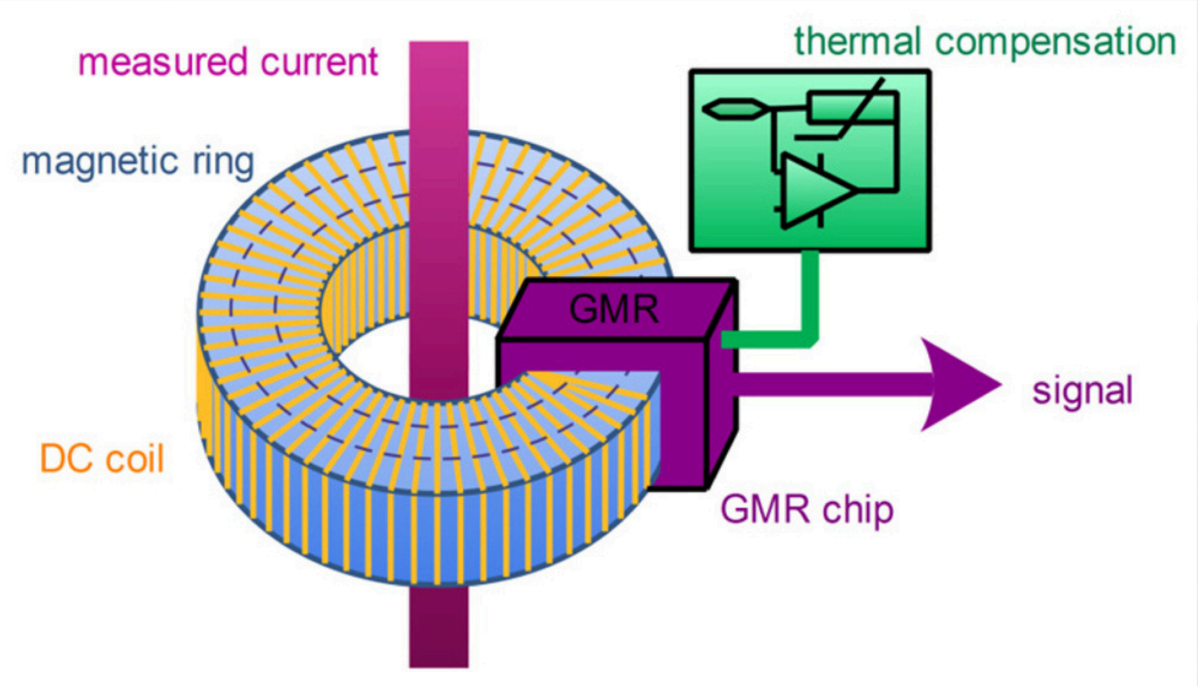


WORKING

- When the sensor head passes over a magnetic field of one polarity, the electrons on the free layer turn to align with those on the pinned layer, creating a lower resistance in the head structure.

- When the head passes over a field of opposite polarity, the free layer electrons rotate so that they are not aligned with the electrons on the pinned layer. This causes an increase in the structure's resistance.

- Because the resistance changes are caused by changes to the spin characteristics of electrons in the free layer, GMR heads are also known as spin valves.



Magnetic Hard Disc (GMR SENSOR)

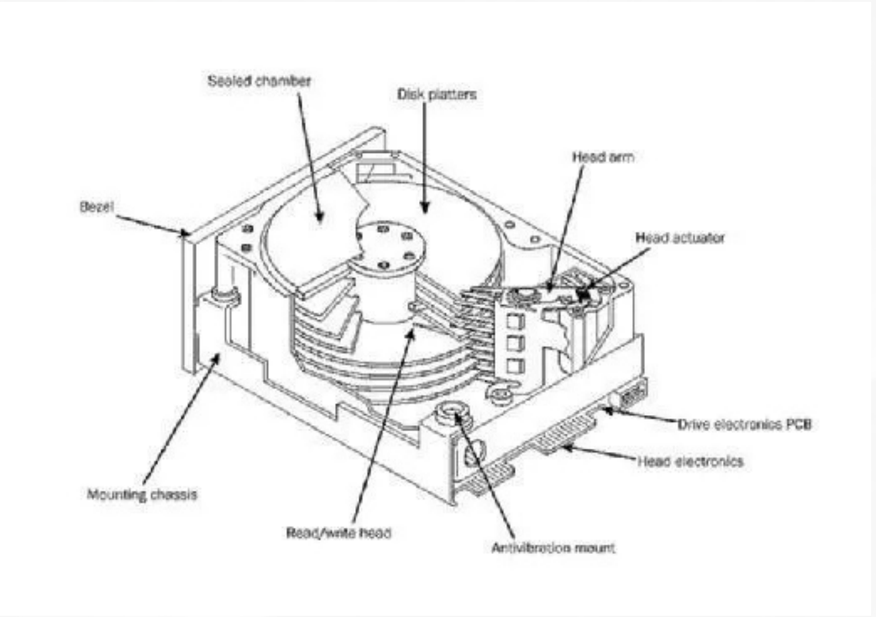
A magnetic hard disc is a non – volatile computer memory device that uses GMR effect to store vast amounts of information.

CONSTRUCTION

A typical hard disk drive design (fig.)consists of a central shaft called spindle and a GMR sensor which acts as a read/write head.

The spindle holds one or more flat circular disks called platters onto which the data is recorded.

The platters are made from non – magnetic material, (aluminum alloys or glass) and are coated with a thin layer of magnetic materials, with an outer layer of carbon for protection.



WORKING

- The platters are spun at very high speeds.
- Information is written to the platters as they rotate, with the help of read and write heads which operate very close over the magnetic surface.
- Information is encoded in magnetic domains in the platters with spin up/down corresponds to logic levels 0 and 1.
- The GMR sensor detects the magnetization pattern of the material and relay information from which the data can be retrieved.

Thank You