

## Unit 3-Magnetic properties of materials

### 3.6 GMR devices

#### Principle

In hard disk drives, the binary data in terms of zero's (0) and one's (1) are stored by inducing magnetic moment in a thin magnetic layer and GMR effect is used as the principle to read the data in HDD. Here zero (0) represents missing transition and one (1) represents transition in the medium.

#### Construction

The HD consists of recording medium made up of thin layer of magnetic garnets grown over the substrate. The GMR sensor, which is made up of ferrites and antiferromagnetic materials is used as reading element. The writing element is made up of inductive magnetic transducer. The writing element and the GMR sensor shall be made to slide over the recording media in the longitudinal direction as shown in figure. Hence this method is also called as longitudinal recording. The flow of current through the GMR sensor and writing element shall be adjusted and the magnetization is sensed (or) controlled in the recording media.

#### Working Writing /

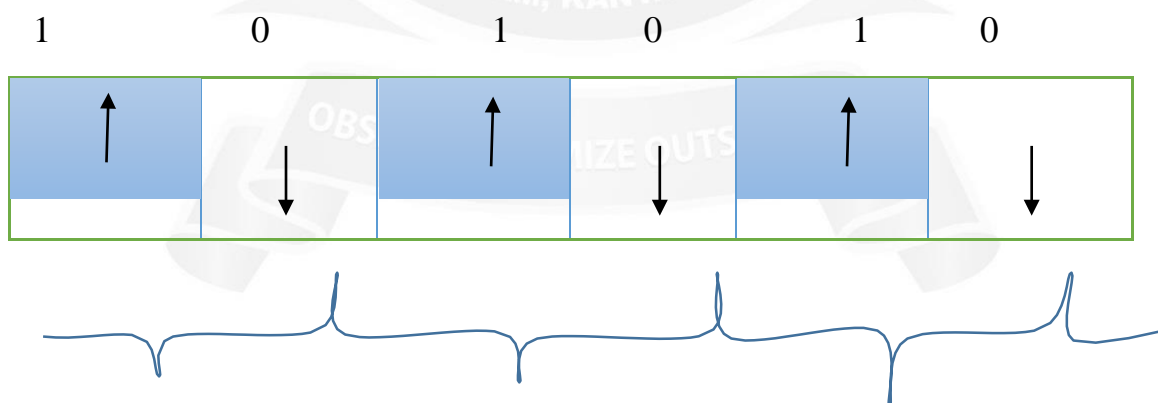
#### Storing

1. Initially the current is passed through the writing element and a magnetic field is induced in between the gap of the inductive magnetic transducer.
2. During writing, the amplitude of current is kept constant, and the direction of current is reversed.
3. Due to reversal of current, the magnetization orientation is reversed in the recording medium i.e., from south → North as shown in figure
4. When the induced magnetic field is greater than the coercivity of the recording media, then data is recorded in the form of 1.
5. Thus one (1) is stored as data in the recording medium as a magnetic transition.

6. When there is no magnetic transition, then it is referred as zero (0).
7. In this way the zero's (0's) and one's (1's) are stored in the recording medium.

### Reading / Retrieving

8. Giant Magnetoresistive (GMR) effect is the principle used to read / retrieve the data from the recording medium.
9. When the GMR sensor is made to move near the recorded medium, then the resistance of the GMR sensor varies with respect to the orientation of the magnetic moments as follows.
10. When the layers are magnetised in parallel manner, then the resistance in the GMR sensor is minimum and therefore maximum current flows through the sensor, which represents the data as one (1)
11. When the layers are magnetised in antiparallel manner, then the resistance in the GMR sensor is maximum and therefore minimum(or) almost no current flows through the sensor, which represents the data as zero (0)
12. Therefore with the help of the reading current, the zero's (0's) and one's (1's) can be retrieved from the magnetic hard disk drive.



### Advantages

- HDD can store the data in terabytes
- It has very large storage capacity
- It is compact in size and can be easily transferred from one place to another.

- The size of recording medium is reduce up to few nano meter range using nanotechnology
- GMR sensor are non-diffusive and are very sensitive in reading

### **Disadvantages**

- HDD is slower than soli state drives
- Consume large power
- Data may be corrupted due to thermal radiation
- HDD has bulkier form factor
- GMR noise ratio is high for nano size recording media

### **Applications**

- Used as storage devices in cloud applications
- Used in coding and signal processing units
- Used in control systems, Nano electronics, etc.,

