STUDYING MAGNETORESISTANCE AND HALL EFFECT OF BISMUTH

Aritra Mukhopadhyay
National Institute of Science Education and Research
Bhubaneswar, Odisha 751005, India
3rd year, Integrated M.Sc. Physics
Roll No.: 2011030
(Dated: January 17, 2023)

In this experiment we will study the various solid properties of Bismuth like Magnetoresistance and Hall Effect.

Magnetoresistance: When the magnetic field is turned on, the resistance of a sample varies. Magnetoresistance is a material's capacity to alter the value of its electrical resistance when subjected to an external magnetic field. The amplitude of the impact is fairly small ($\approx 1\%$) at normal temperature, but increases to roughly 50% at low temperatures in gigantic magneto resistive multilayer systems. In certain perovskite systems, effects of more than 95% change in resistivity have recently been discovered.

Hall Effect: The Hall effect is the phenomenon of appearance of a potensial difference perpendicular to the direction of curent flow if a perpendicular magnetic field is applied. In the operating region, the Hall effect is a linear effect, which means that the voltage is proportional to the current and the magnetic field. The Hall coefficient is a measure of the Hall effect. It is defined as the ratio of the Hall voltage to the product of the current and the magnetic field. The Hall coefficient is a material property and is independent of the geometry of the sample.

I. THEORY

A. Magnetoresistance

Under the influence of a magnetic field, the resistance of some materials change significantly. This effect is popularly known as magnetoresistance of the material. This effect can be observed due to the fact that the drift velocity of the carriers is not same. In the presence of the Magnetic field, the carriers drift in the direction of the field. In this condition, the hall voltage compensates the lorentz force for carriers with average velocity. The slower carriers are overcompensated and the faster carriers are undercompensated. This disturbs the flow of electrons along the direction of flow of current; hence reducing the mean free path and increasing the resistance of the material. In this condition, the hall voltage is given by the formula:

$$V = E_y t = |v \times H|$$

where E_y and H are the electric field and the magnetic fields, t is the thickness of the sample, and v is the drift velocity of the carriers.