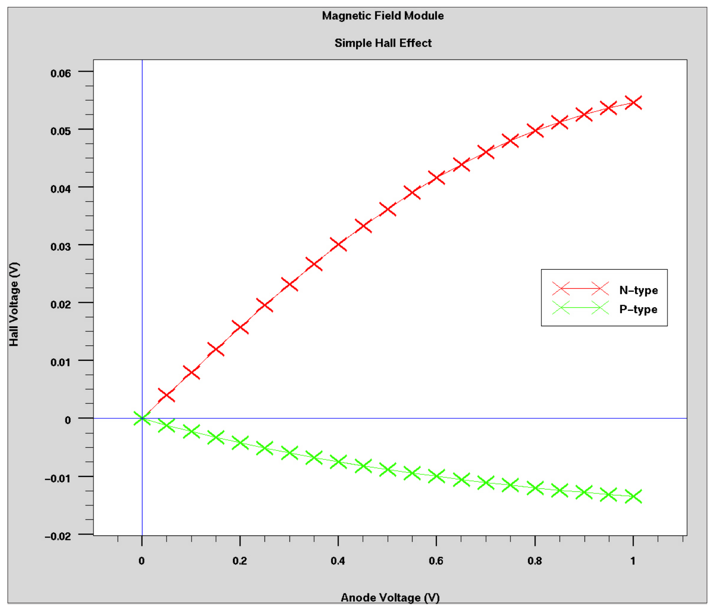
Magnetic

2D MAGNETIC DEVICE SIMULATOR

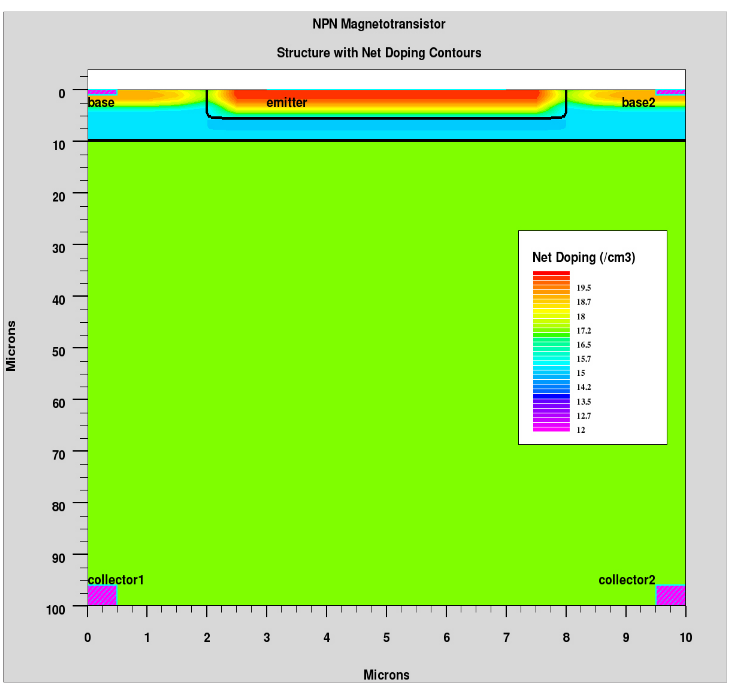
The Magnetic module enables the ATLAS device simulator to incorporate the effects of an externally applied magnetic field on the device behavior. The dynamics of the charge carrier motion are modified by the addition of the Lorentz force. This force is proportional to the vector product of the carrier velocity and the applied magnetic flux density vector. The Magnetic module allows the consequent changes to current flow and potential distributions to be calculated. It can be used to simulate a large range of magnetic field sensitive devices, such as magneto transistors and Hall effect magnetic field sensors. It also permits estimation of the effects of a magnetic environment on semiconductor device characteristics. Magnetic assumes that the uniform Magnetic field is perpendicular to the plane of the device.

Features

- A uniform external magnetic field can be specified
- Drift-diffusion equations are modified by the presence of the Lorentz force
- Hall Voltages can be calculated
- Current deflection caused by magnetic field can be observed
- Magnetic field sensors can be simulated
- Effect of stray magnetic fields on device performance can be modeled



Shows the Hall voltage generated across a simple semiconducting resistor as a function of the bias applied along the resistor. The simulation includes field dependent mobility and the Hall voltage consequently varies sub-linearly with applied voltage. The opposite carrier types give opposite signs for the Hall voltage.



A simple NPN magnetotransistor structure showing net doping contours and the position of the p-n junctions. It is biased in a common emitter arrangement, with 10 V bias applied to the collector contacts. The base contacts are then biased from 0.0 V to 0.65 V. Results are obtained without a magnetic field and also with a uniform magnetic field of 1 Tesla applied perpendicular to the device.

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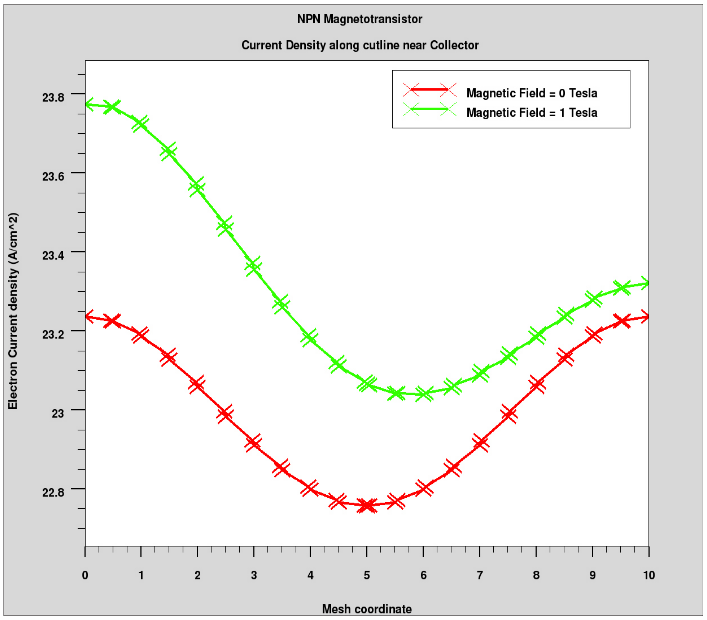
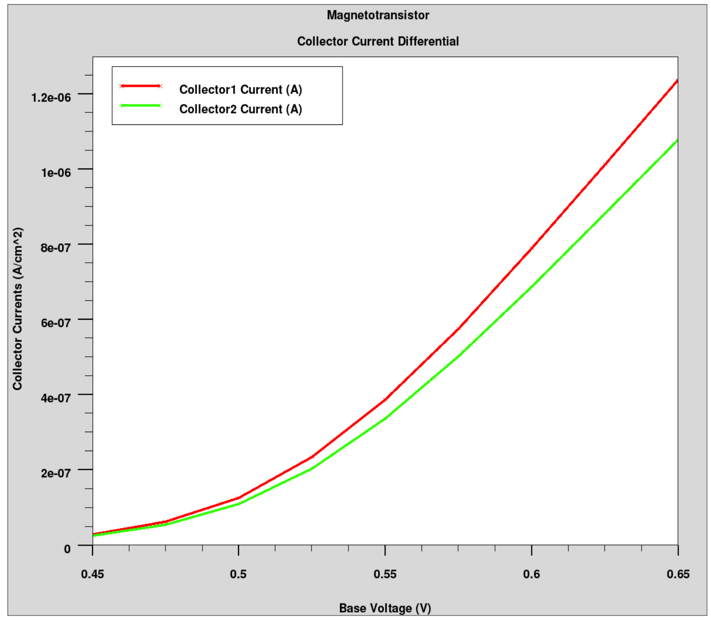
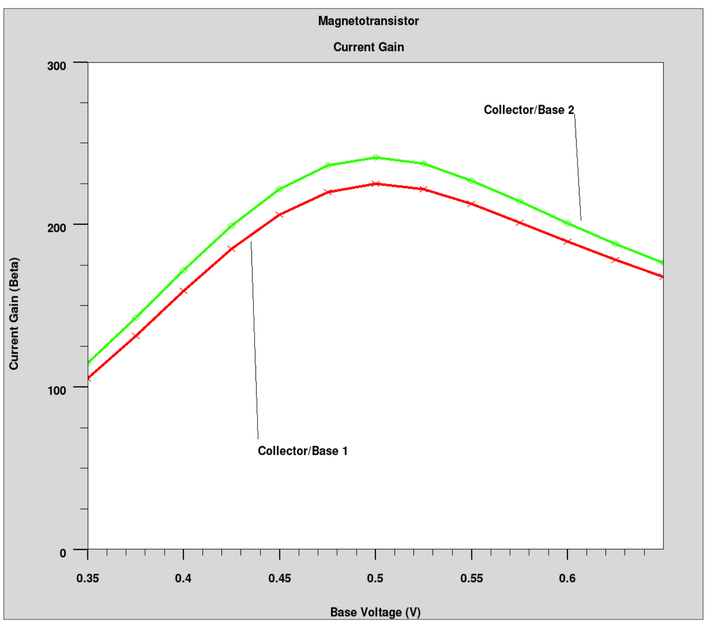


The electron current along the horizontal cutline at 90 microns in the magnetotransistor. Without an applied magnetic field it is symmetric about the device centerline, but the magnetic field gives an asymmetry which results in a current differential between collector 1 and collector 2. This is due solely to the deflection of the current flowlines by the applied magnetic field.



The collector currents in the magnetotransistor for an Applied field of 1.0 Tesla. The difference between them allows the magnetic field to be measured. Both collector currents are identical when the magnetic field is absent.



The current gains of the structure, obtained by dividing collector 1 current by base 1 current and collector 2 current by base 2 current. One is enhanced relative to the zero magnetic field case and the other is diminished.

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