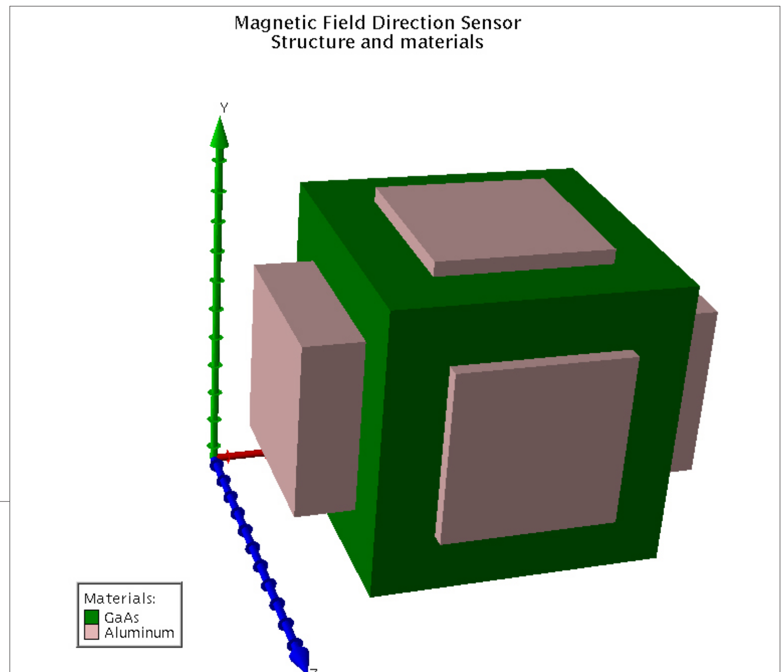
Magnetic3D

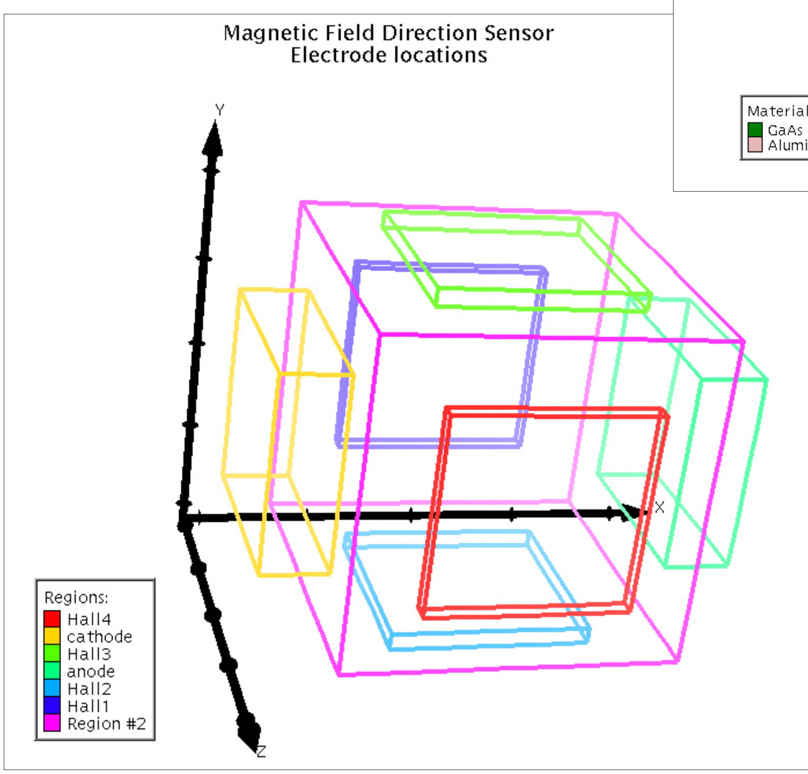
3D MAGNETIC DEVICE SIMULATOR

The Magnetic3D module enables the ATLAS device simulator to incorporate the effects of an externally applied magnetic field on the device behaviour. The dynamics of the charge carrier motion is 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 Magnetic3D 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 magnetotransistors and Hall effect magnetic field sensors. It also permits estimation of the effects of a magnetic environment on semiconductor device characteristics. In Magnetic3D a uniform magnetic field with any orientation in space permitted.

Features

- A uniform, constant, external magnetic field with any direction in space 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 magnitude sensors can be simulated
- Magnetic field direction sensors can be simulated
- Effect of stray magnetic fields on device performance can be modeled





A simple sensor which can detect the direction of a magnetic field. In the above configuration current is passed in the x-direction between anode and cathode. The relative size of magnetic field components in the y and z-directions can be measured from the voltage differences between the probe electrodes Hall1 up to Hall4.

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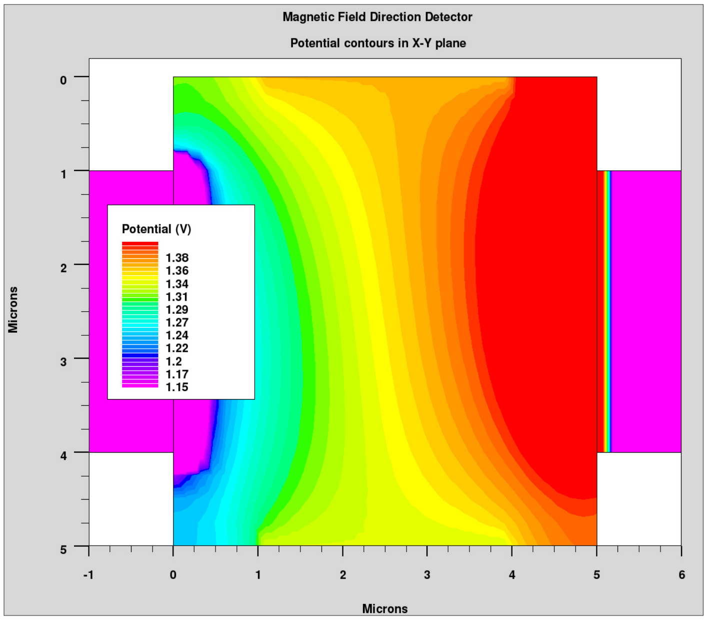
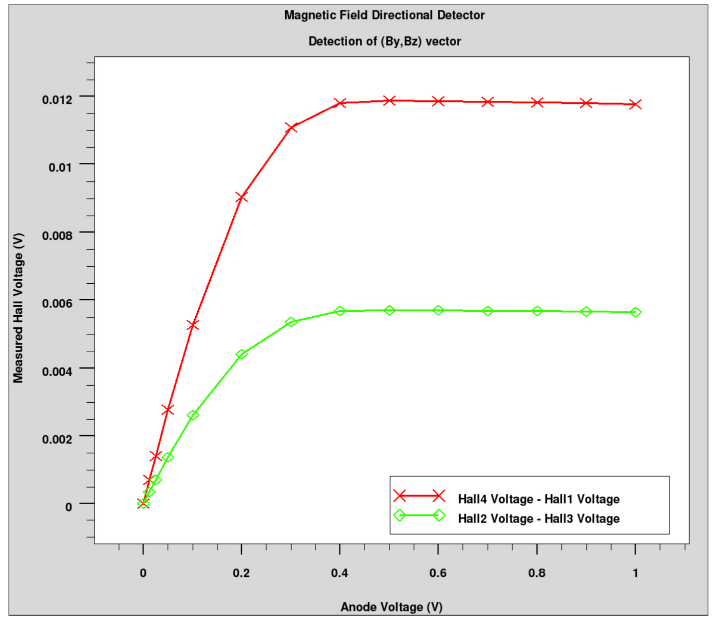
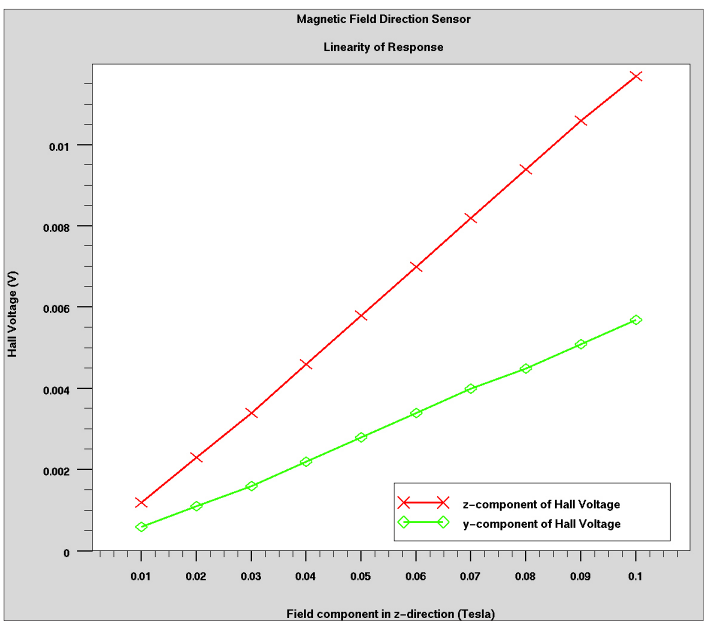


Example of potential contours in an x-y plane at the centre of the device. In this example the magnetic field component in the z-direction is 0.5 Tesla. In the absence of a magnetic field the contours would all be vertical.



Measured Hall Voltages for the above device when the magnetic field y-component is 0.2 Tesla and the z-component is 0.1 Tesla. This results in a Hall field in the z-direction twice as large as that in the y-direction.



Hall Voltages for the above device generated at an Anode bias of 1.0 V. The y-component of magnetic field is maintained at twice that of the z-component. As the magnetic field is increased the resulting Hall voltages show a good linearity of response.

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