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S/N Study of Si-Implanted InP Hall Devices

Yoshinobu Sugiyama

Electrotechnical Laboratory
1-1-4 Umezono, Tsukuba 305, Japan

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A low-noise Hall device fabricated of $^{28}Si^{+}$-ion-implanted InP was developed. The device has a typical impedance of 1.3 kΩ, a product sensitivity of 182 V/AT with the temperature coefficient of 0.35%/°C and high magnetic sensitivity of 4.7 V/T with temperature coefficient of 0.19%/°C. The S/N ratio defined by the magnetic sensitivity to the Hall terminal noise at 1 Hz is more than 100 dB/THz$^{1/2}$ which enables high resolution of a few microtesla. An InP Hall device is promising for the monolithic integration of magnetic sensors and signal processing circuits.

1. Introduction

Semiconductor magnetic sensors fabricated of Si, GaAs and InSb are widely used for many applications such as the detection of a magnetized rotor in a brushless motor and the discrimination of banknotes in a vending machine.[1] The monolithic integration of magnetic sensors and signal processing circuits for intelligent sensing[2] could be achieved with a nonconductive substrate such as semi-insulating GaAs and InP, or p-Si. Many attempts have been made to develop a magnetic sensor on semi-insulating semiconductor substrates such as GaAs and InP. The GaAs Hall device with an ion-implanted channel layer is used in high-temperature applications.

We have developed new magnetic sensors made of III–V compound semiconductors with quantum well structures of AlGaAs/GaAs grown on the semi-insulating GaAs substrate[3–5] and InAlAs/InGaAs grown on the semi-insulating InP substrate.[6,7] The former devices have a GaAs channel layer and the latter ones have an InGaAs channel layer, both of which have very high sensitivity. Furthermore, a