Sensors and Materials, 4 (1988) 233–244
MYU, Tokyo

S & M 0023

On the Injection Modulation Effect

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(Received January 30, 1989; accepted April 6, 1989)

Key words: magnetotransistor, injection modulation, carrier deflection

The relative importance of the injection modulation effect in the operation of a CMOS-based magnetotransistor is discussed and an experimental analysis of the role of injection modulation is given. Two different bias arrangements and a number of devices differing in geometry were used to determine the relative role of the injection modulation effect. A Hall voltage is found to be present in the base region of the device, but carrier deflection is the dominant mechanism of operation.

1. Introduction

The basic effect of applying a magnetic field to a transistor is to produce a Lorentz force acting on each electron or hole as it flows through the device. Three basic manifestations of this effect have been noted: carrier deflection,[1,2] injection modulation[3] and magnetoconcentration.[4] The first mechanism is the deflection of carriers as they flow through the device, either in the base or collector region. The injection modulation effect involves the establishment of a Hall voltage in the base region near the emitter base junction. This Hall voltage causes an asymmetrical injection of carriers into the base from the emitter. Magnetoconcentration is the asymmetrical buildup of carriers in the device due to the magnetic field. This in turn results in a local modulation of the conductivity. The relative importance of each effect is dependent on the configuration of the device being tested.

In this paper, we present a theoretical and experimental study of the relative importance of the injection modulation effect in a CMOS-based lateral magnetotransistor (LMT). The investigation of the injection modulation still represents a challenge for researchers because of the dispute it caused in the early 1980s.[5,6] This paper first presents a theoretical model of the operation of the device assuming that