5-6

Electron Mobility in an MOS Inversion Layer*

Y.C. Cheng
Bell-Northern Research
Ottawa, Ontario, Canada

SYNOPSIS

Since free carriers in an MOS transistor are confined to flow in a very narrow channel of the order of 100Å or less, it is conceivable that the surface will play an important role in determining the transport properties of these carriers. The scattering of these carriers by surface roughness and phonons (both surface and bulk) is studied theoretically.

It is proposed that at very low temperatures, when electrons or holes are drawn closer to the interface, surface roughness provides the dominant scattering mechanism, causing the carrier mobility to drop at high gate voltages. A simple way[1] to describe the surface irregularity is to translate the potential by various amounts of deviation, $\delta(x,y)$, along the surface, and the perturbed Hamiltonian is

$$H = -\frac{\hbar^2}{2m}\nabla^2 + V[z + \delta(x,y)]$$

A gaussian distribution is assumed for the deviation function, δ, i.e.,

$$S^{-1}\int\int \delta(\vec{R}+\vec{R}')\,\delta(\vec{R}')\,d^2R' = \overline{\delta^2}\exp(-R^2/L^2)$$

where S is the surface area and L is the correlation length of the surface roughness.

* Work supported in part by the Defence Research Board of Canada through its Directorate of Industrial Research