

Beyond CMOS: HEMT is a prospective device

ABSTRACT:

HEMT is considered as a potential device to use in high frequency communication circuit where CMOS has the limitation. Analysing the device and circuit characteristics of such device has important now-a-days as the experimentalist needs few theoretical results before fabrication. For this purpose, the speaker group has developed a self-consistent charge control model to solve Poisson's equation and Schrodinger's wave equation self consistently. The device heterointerface properties like surface charge density, Piezoelectric effect, determination of 2DEG (Two Dimensional Electron Gas) density, conduction and valence band profiles of typical quantum structure, Subband energy levels in terms of Eigen values, Envelope functions for the subbands, Doping profiles and concentration of free electrons, quantum confined charge density profiles and Sheet charge density for different kind of HEMT structures are determined. The speaker will speak about how the model has developed. The output of the self-consistent developed program used as input for the determination of mobility which will lead to the determination of DC, small-signal and high frequency characteristics of the device. We develop a program to calculate the electron mobility by considering a quantum well structure in which more than one subband is occupied. We adopt the Boltzmann transport equation from which the relaxation time τ_n can be obtained and thus the mobility determine considering all kind of scattering mechanism. The obtained mobility is used as input in TCAD tool to study of high frequency characteristics like Maximum Available Gain (MAG), Maximum Stable Gain (MSG), Mason's Unilateral power Gain (MUG), Cut-off frequency (f_T), maximum frequency of oscillation (f_{max}), short circuit current gain ($h_{21}=1$) etc, to see the potential usability of the device in high frequency communication circuits for HEMT. The proposed kind of devices is used experimentally in circuit to see the potentiality to use it as an amplifier. The speaker will show and speak few words about their recently fabricated IC also.