

Summary

This SERC/MOD grant was awarded to Dr R A Abram in April 1992 to carry out research on the modelling of heterojunction bipolar transistors (HBTs) using Monte Carlo methods. The main objectives of the research were (i) to develop a two-dimensional model of HBTs based on Monte Carlo simulation of carrier transport and realistic band structure, and (ii) to use the model to investigate methods of enhancing the high frequency and high current capabilities of HBTs. The research grant provided funds for an HP730 workstation and one postdoctoral research assistant for three years. We were fortunate to be able to appoint a very able researcher for the full period of the grant. An important feature of the project was the informal collaboration with GEC-Marconi Materials Technology (GMMT Caswell) as described in the original grant application.

During the course of the project we developed a two-dimensional simulation of an HBT using realistic band structure and a self-consistent Monte Carlo description of the dynamics of electrons and holes, and used it to investigate the properties of a number of transistors. The simulation model went beyond our earlier work, not just in terms of dimensionality but also in including a full description of the emitter as well as base and collector. The simulation was applied to AlGaAs/GaAs and In(Al)GaP/GaAs devices and particular attention was paid to the effect of collector design and current density on device response. The results of the research have been freely shared with our UK industrial collaborators and, when appropriate, to the wider community. A major product of this and other concurrent device modelling projects has been the Software Library for Universal Random Particle Simulation (SLURPS). It provides a powerful tool for device modelling and can be applied to a wide range of new devices with the minimum of extra code development. The software has commercial potential but has already been made available to GMMT Caswell, DRA Malvern and the Computational Condensed Matter Physics Group at the University of East Anglia.

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