Thermally Activated Resonant Tunnelling in GaAs/AlGaAs Triple Barrier Tunnelling Structures

C P Allford[1], R E Legg[1], R A O'Donnell[1], P Dawson[2], M Missous[3], P D Buckle[1]

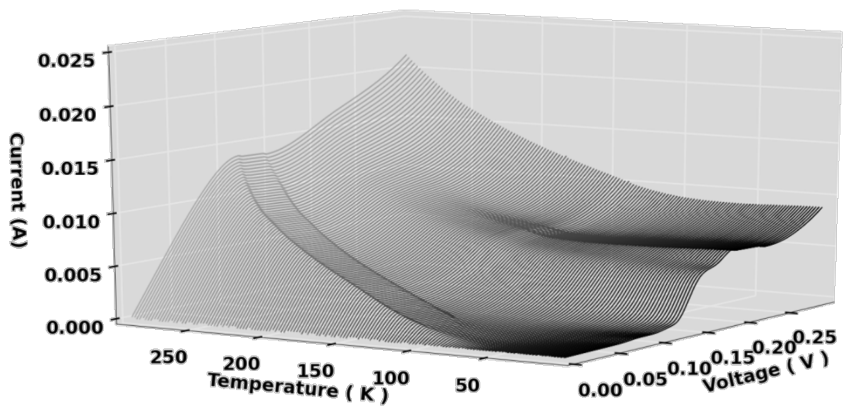
1. School of Physics and Astronomy, Cardiff University, Queen's Buildings, The Parade, Cardiff, CF24 3AA
2. The School of Physics and Astronomy, Alan Turing Building, The University of Manchester, Manchester, M13 9PL
3. School of Electrical and Electronic Engineering, Sackville Street Building, The University of Manchester, Manchester, M13 9PL

A thermally activated resonant tunnelling feature has been observed in the current-voltage characteristics (I(V)) of triple barrier resonant tunnelling structures (TBRTS) due to alignment of the n=1 confined states in the two quantum wells (QWs) within the active region. With rising sample temperature, the tunnelling current of the resonant feature increases in magnitude, showing a small negative differential resistance region which is discernable even at 293K. This behaviour is unique to multiple barrier devices and cannot be observed in conventional double barrier resonant tunnelling structures.

Symmetric TBRTS, of nominal well widths 67Å and asymmetric QW, with decreasing second well widths, nominally 64Å to 46Å, have been studied with temperature dependent resonant tunnelling behaviour observed in both symmetric and asymmetric designs.

Activation energies have been extracted from Arrhenius plots of the magnitude of the thermally activated peak current for each device design. This activation energy decreases as the second well width is decreased due to alignment occurring at increasingly greater bias and as such at energies closer to the Fermi level in the emitter region of the devices. Experimentally determined activation energies are in good agreement with theoretical values obtained by modelling the device I(V) characteristics, using a self-consistent Schrödinger-Poisson simulation over a large temperature range.

email: allfordcp1@cardiff.ac.uk



Forward bias I(V) characteristic of a symmetrical TBRTS. The temperature dependent resonant current peak can be seen emerging at ~60K and continues to increase in magnitude up to 293K.