Landauer expression for current

\[ I_i = \frac{2e}{h} \sum_j \int_{E_j}^{E_{j+1}} T_{ij}(E) \left[ f(\mu_j) - f(\mu_i) \right] dE \]

- Tight-binding Hamiltonian for both relaxation and conductivity calculations
- Used 4 orbitals (s, p) for describing C atoms and 9 orbitals (s, p, d) for describing Ni-C interactions

Transport in Y-junction Carbon Nanotubes

Rectification in Y-junction Nanotube has a Strong Dependence on the Structural Symmetry

Ballistic Rectification at Nanoscale


Ballistic Rectification at Nanoscale

(1) \( V_L = V_r = V_V = 0.00 \)

(2) \( V_L = V_r = V_r = V_V = 0.00 \)

(3) \( V_L = V_r = V_r = V_V = 0.00 \)
Ballistic Rectification at Nanoscale

<table>
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<th>V1</th>
<th>V3</th>
<th>OR</th>
<th>XOR</th>
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Bio-mimetic Dendritic Neuron: Carbon Nanotube

A 4-level dendritic neural tree: 14 branched carbon nanotube junctions

D. Srivastava et al., Comp. in Science and Engineering, IEEE, APS (2001)

Summary and Future

- Rectification and Switches with Nanotube Y-Junctions: Generalized a variety of logic gates and devices, and a complete understanding of ballistic rectification.

- Complex tree structures with made with carbon nanotubes: Simulate signal transmission and processing phenomenon in branched networks

D. Srivastava, M. Mitra, and K. (The authors' research article, Computing in Engineering and Science, late August 2001)