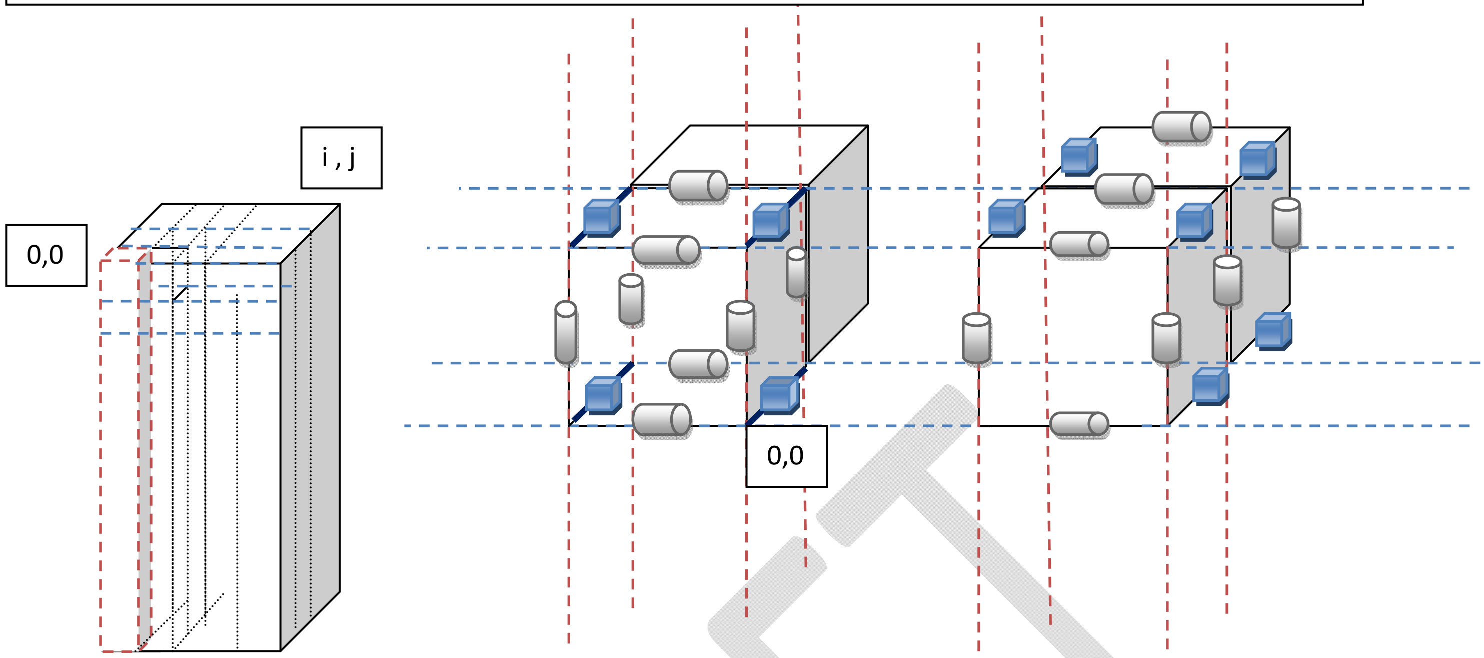
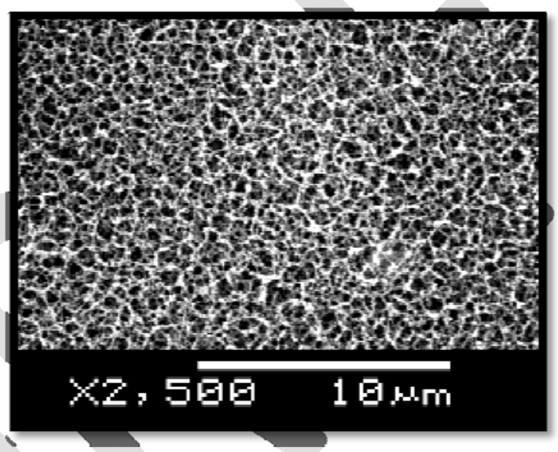
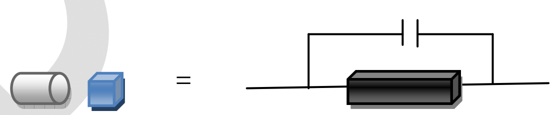
By Sid Senadheera – *Simulating Transmission of electrons by Quantum Tunneling*

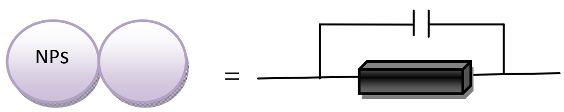




It can be proved that the above nanofiber texture can be approximated by an arbitrary matrix with *(i,j)* indices giving the number of junctions (or the number of overlaps between red and blue lines).



The cylinders and cubes are figurative representations of the above circuit, with a tunneling diode (or the Esaki diode) and a Capacitior. Or in other words NP aggregates making up the fibers can be represented :



$$(Matrix - 1; Gives\ transmission\ coefficient) \quad T_{ij} = \begin{bmatrix} T_{00} & \cdots & T_{0i} \\ \vdots & \ddots & \vdots \\ T_{j0} & \cdots & T_{ij} \end{bmatrix}$$

$$T_{ij} = \sum_{i=0}^{n=i\ x\ j} \{4T_{parallel\ to\ current} + 8T_{perpendicular\ to\ current}\}$$

Using the WKB approximation the transmission amplitude can be written $e^{-\int dx \sqrt{\frac{2m}{\hbar^2}(V(x)-E)}}$

Or in other words, this is the probability of an electron with Energy E tunneling through a barrier V(x) between the NPs.

$$T_{ij} = \sum_{i=0}^{n} \left\{ 4.\, e^{-\int dx \sqrt{\frac{2m}{\hbar^2}(V(x)-E)}}{}_{\substack{linear\ (blue) \\ transmission}} + 8\, e^{-\int dx \sqrt{\frac{2m}{\hbar^2}(V'(x)-E')}}{}_{\substack{for\ grey \\ cylinders}} \right\}$$

The forward potential (coming from the first term) and the potential and particle energy from the sides (cylinders) which is the second term have two different values. The second term is smaller than the first term. σ_{jk} is the matrix that gives the surface charge density. Transmission of a single electron through the potential can be written as :

$$T_{ij} = \{T_{il} \cdot \sigma_{lk}\} \cdot A_{kj}$$

<u>As an example:</u> Transmission current through a potential difference along a nanowire through an area A′=80 wires in cross-section can be written in abstract notation as:

$$\mathbb{T} = \{T_{10,8} \cdot \sigma_{8,10}\} \cdot A_{10,8}$$