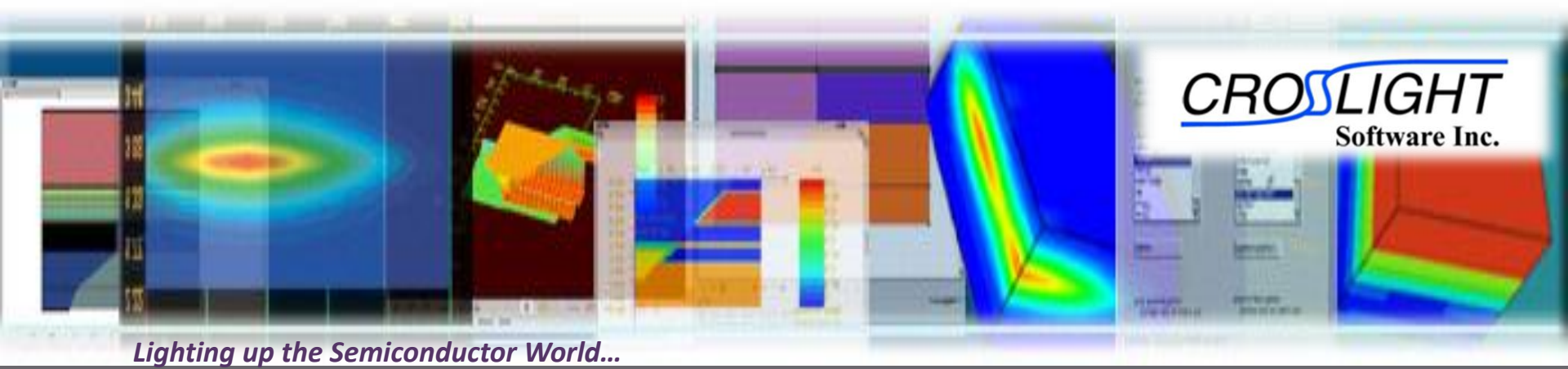
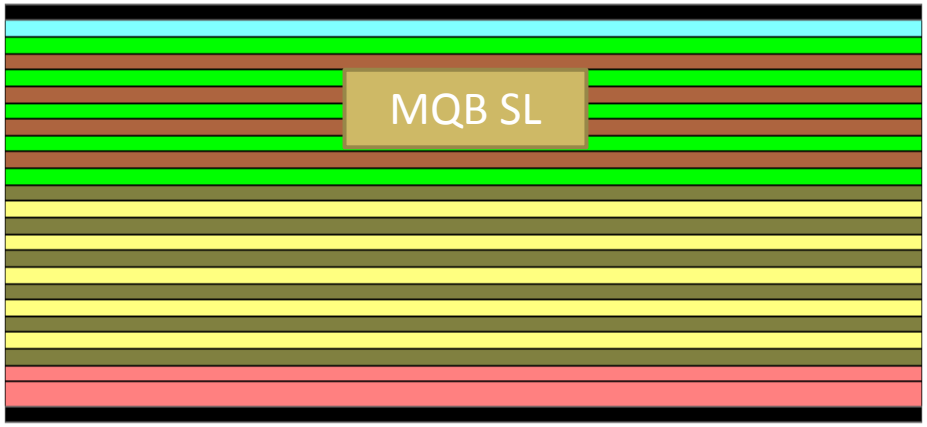


Lighting up the Semiconductor World…

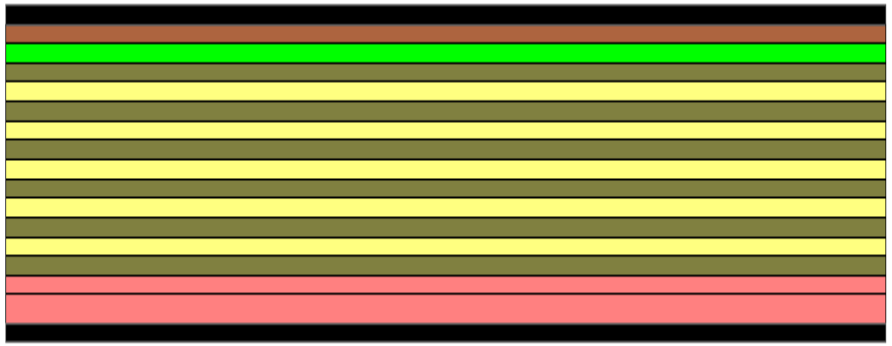
Comparison of LEDs with/without multiple quantum barriers (MQB)

Structure

With SL



Without SL



MQB tunneling

Tunneling current through MQB SL is calculated by propagation matrix method. This model cuts the barrier potential into piece-wise constant segments.

For segment *j*, the wavefunction is

$$\psi(z) = A_j \exp[\mathrm{i}k_j(z - z_j)] + B_j \exp[-\mathrm{i}k_j(z - z_j)]$$

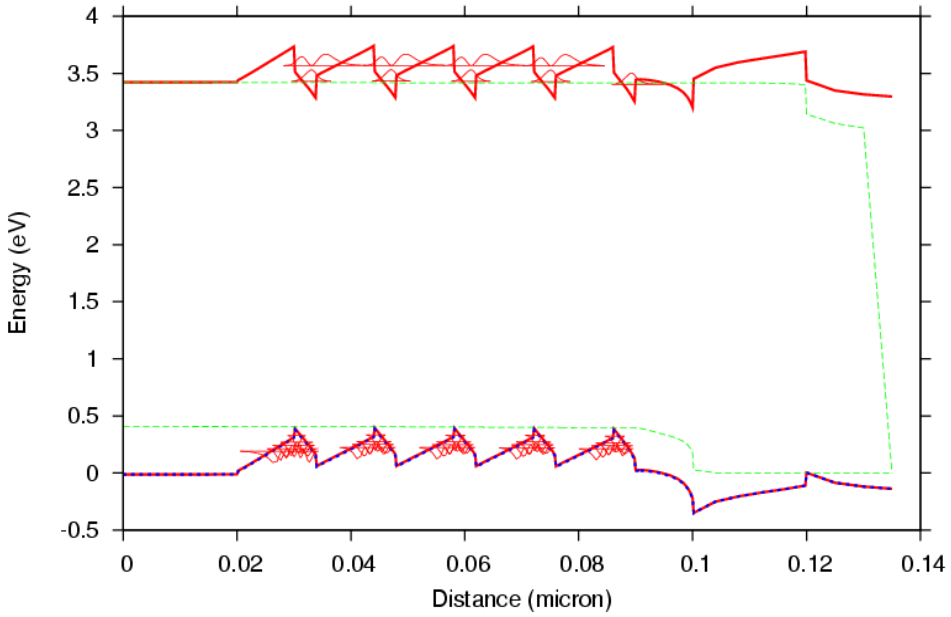
Boundary conditions relate segment *j* and *j+1*

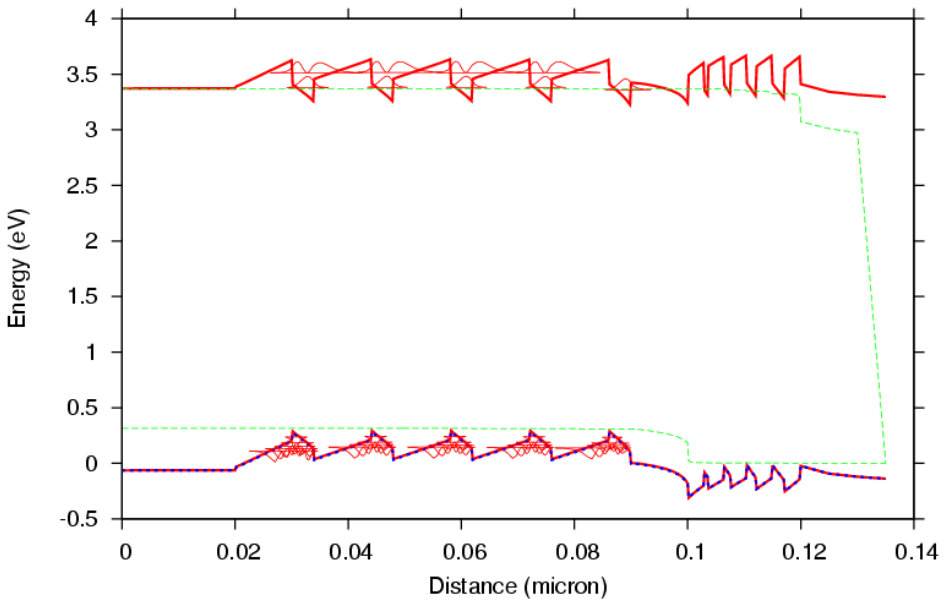
$$\begin{pmatrix} A_{j+1} \\ B_{j+1} \end{pmatrix} = T_{j,j+1} \begin{pmatrix} A_j \\ B_j \end{pmatrix}$$

Repeat for all segments, we get output at *N* with input at *0* segment

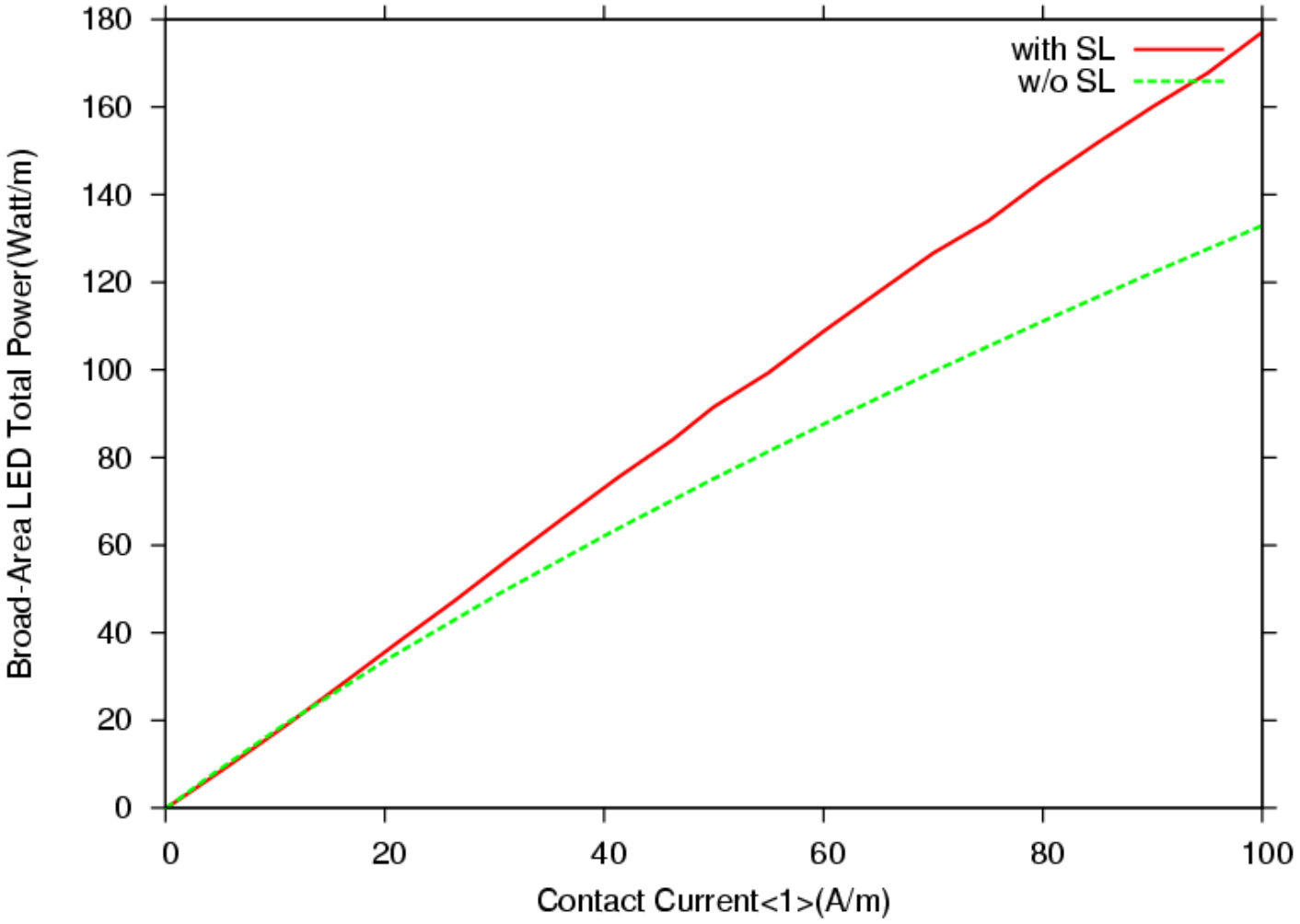
$$\begin{pmatrix} A_N \\ B_N \end{pmatrix} = T_{N-1,N} T_{N-2,N-1} \cdots T_{0,1} \begin{pmatrix} A_0 \\ B_0 \end{pmatrix}$$
$$= \begin{pmatrix} T_{11} & T_{12} \\ T_{21} & T_{22} \end{pmatrix} \begin{pmatrix} A_0 \\ B_0 \end{pmatrix}$$

Band diagram



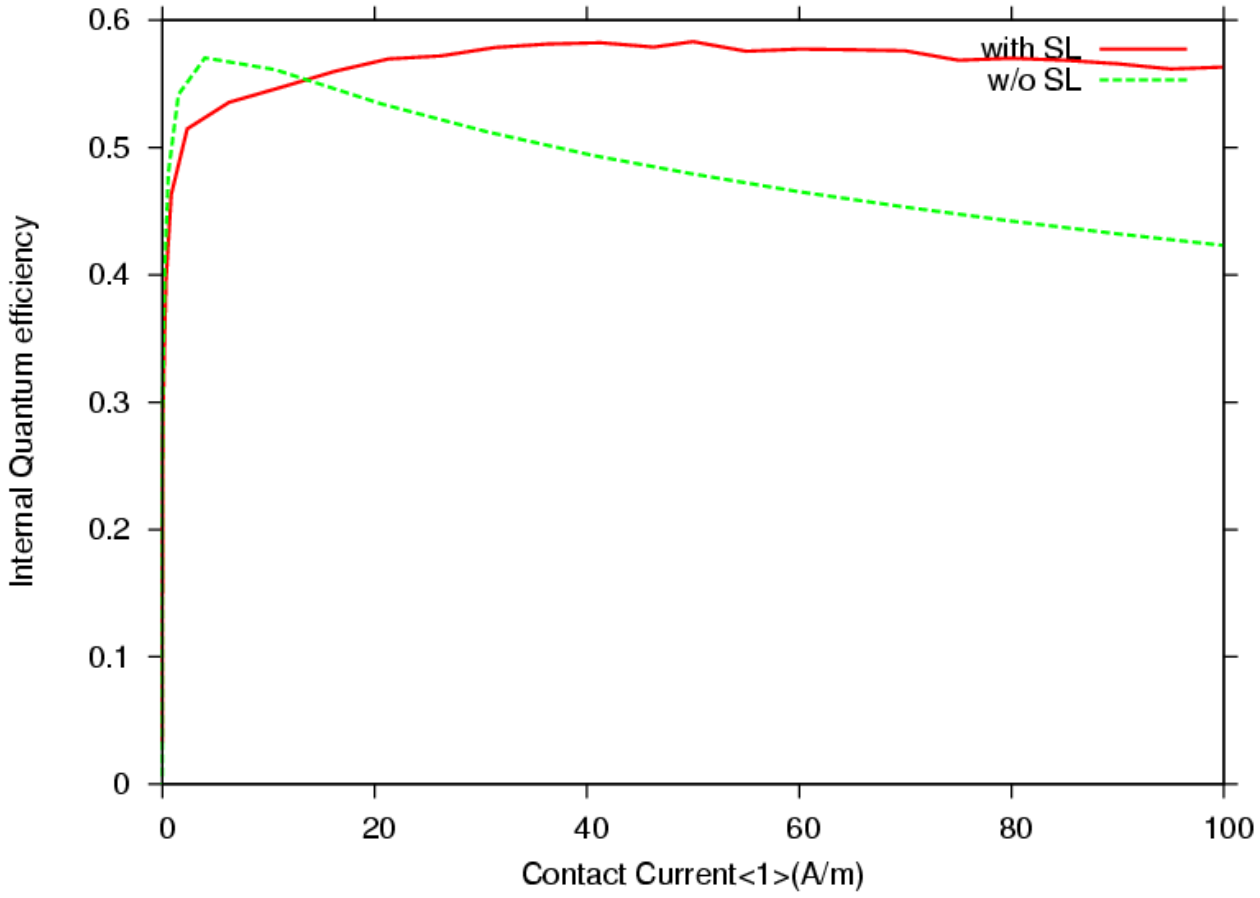


L-I



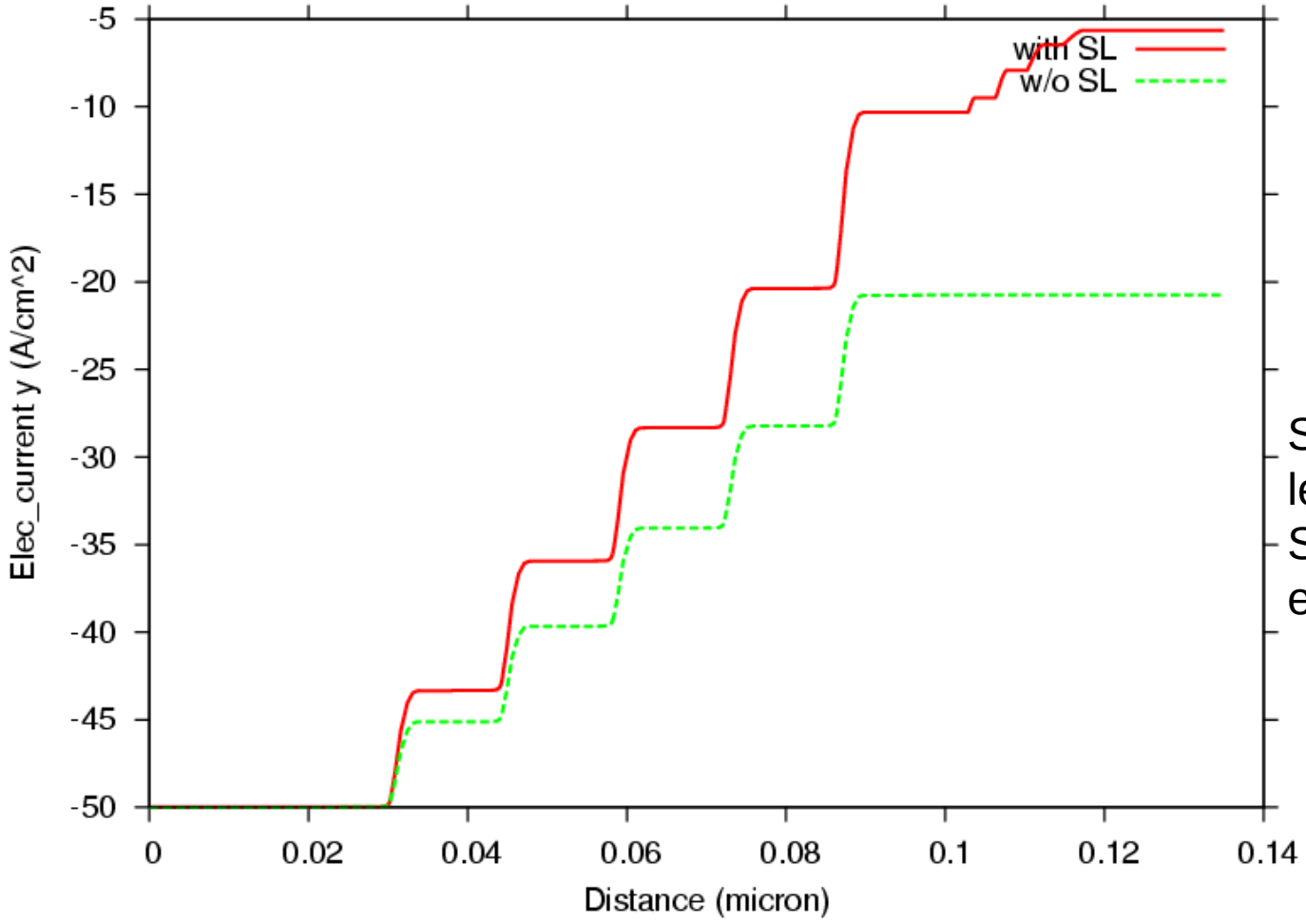
Higher power with SL

IQE



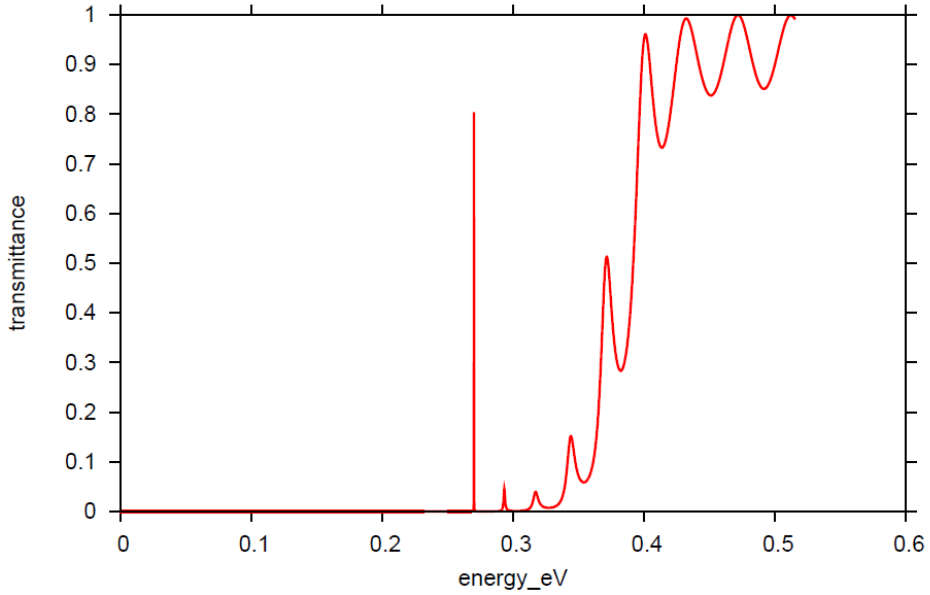
Smaller droop wish SL

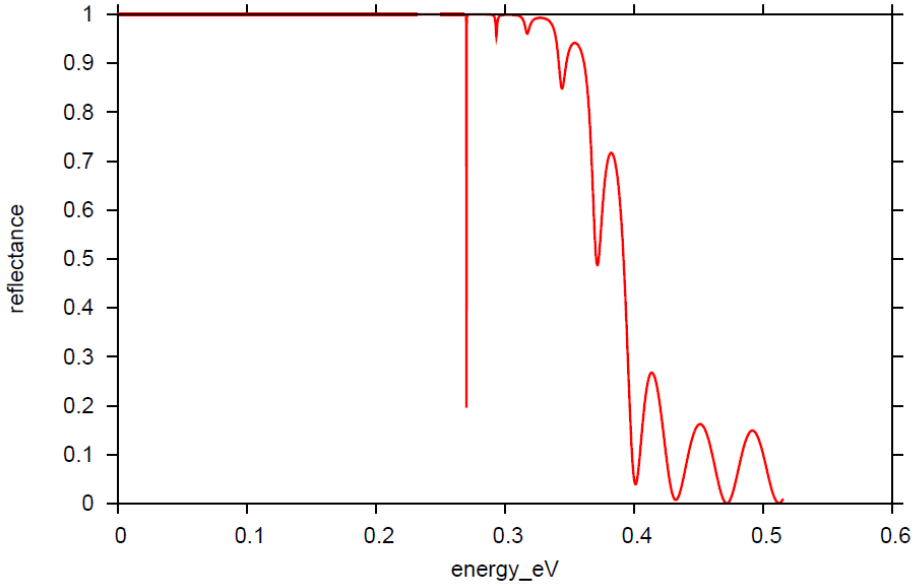
Electron leakage



Smaller electron leakage with SL.
SL is more effective in electron blocking

Tunneling Spectrum





Conclusion

- MQB blocks electron leakage more efficiently by effectively increasing the potential barrier of electron.

A Glimpse

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