# Slides on resonant tunneling

3rd lecture on transport in FFFN35

2018-11-20

# Transmission *T(E)* for double barrier

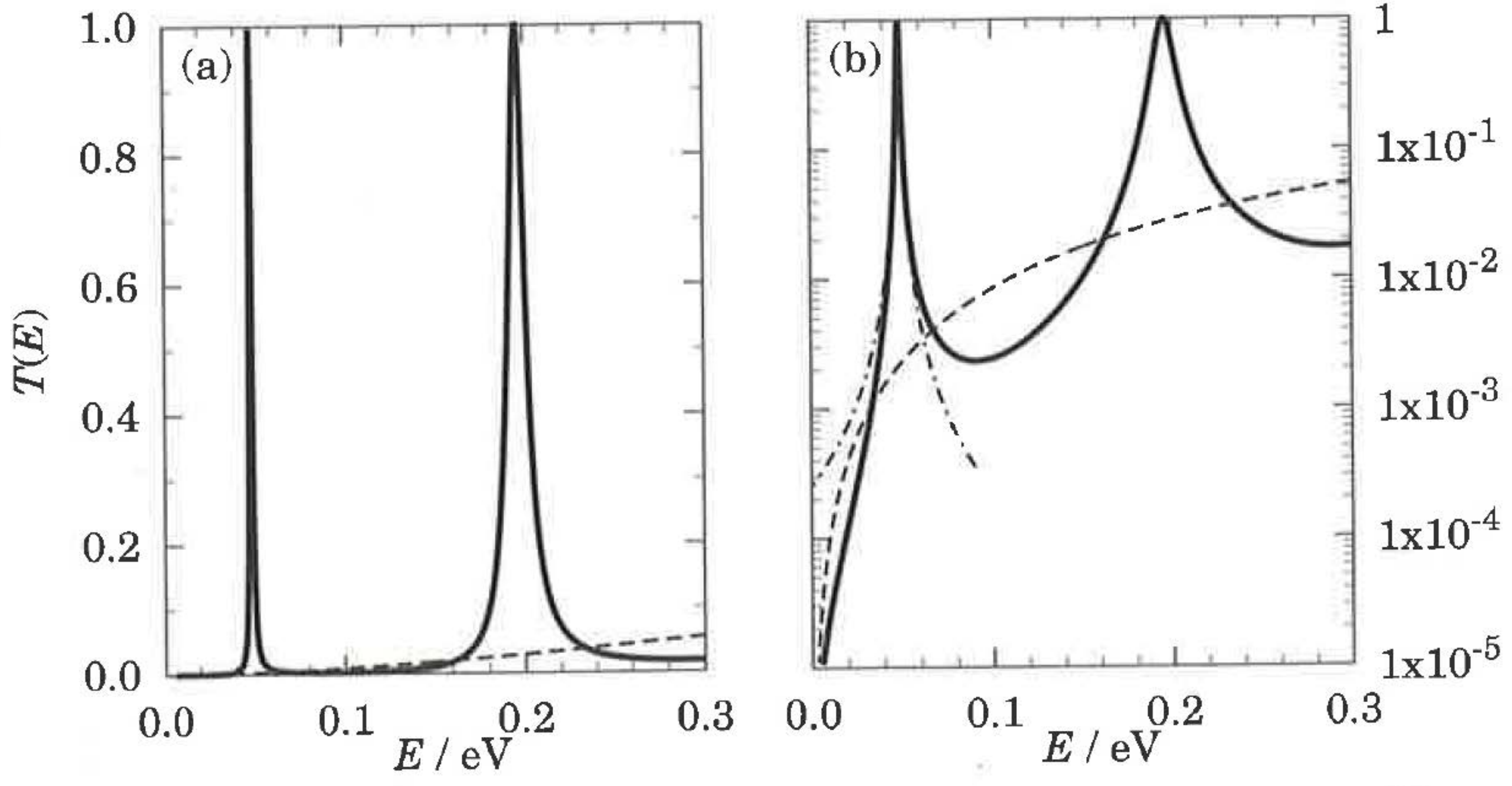
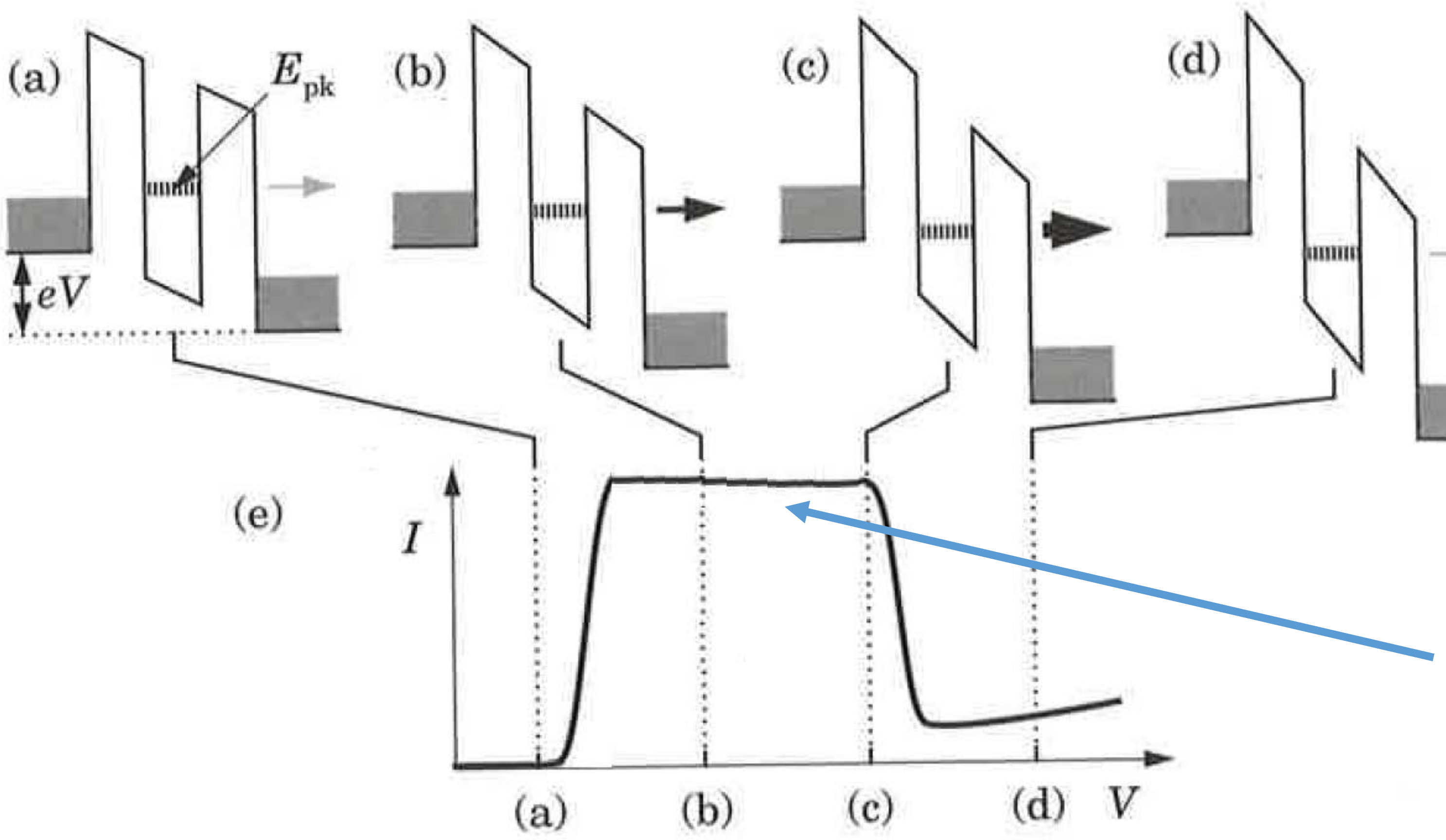



FIGURE 5.11.

# Resonant tunneling, 1D:

$$I = \frac{2e}{h} \int_{\mu_R}^{\mu_L} T(E)\, dE$$




-Constant current if resonant state is in the bias window.
-Otherwise low current.

# Resonant tunneling, 3D:

$$J = \frac{e}{h}\frac{m}{\pi\hbar^2}\int_{U_L}^{\infty}[\Theta(\mu_L - E) - \Theta(\mu_R - E)]\,T(E)\,dE$$

$$J = \frac{e}{h}\frac{m}{\pi\hbar^2}\int_{U_L}^{\infty}[\Theta(\mu_L - E_{pk}) - \Theta(\mu_R - E_{pk})]\,T(E)\,dE$$

$$J = \frac{e}{h}\frac{m}{\pi\hbar^2}\int_{U_L}^{\infty} eV\ T(E)\,dE$$

$T(E)$ large only at $E_{pk}$

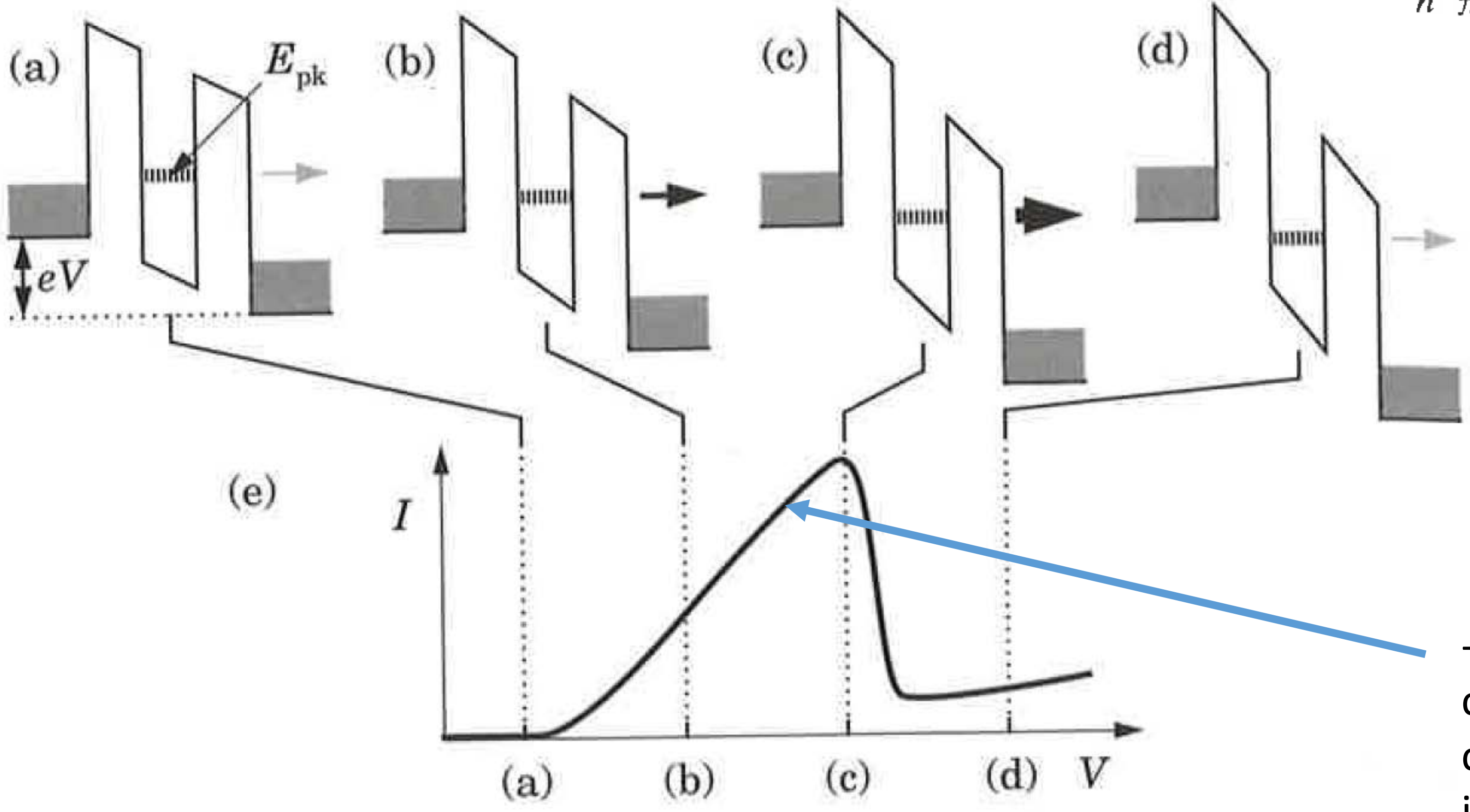



FIGURE 5.13.

-Linearly increasing current as more ways to choose $k_x$, $k_y$ and $k_z$ with increasing bias voltage $V$.

-Otherwise similar to 1D.

# Resonant tunneling diodes, measured data

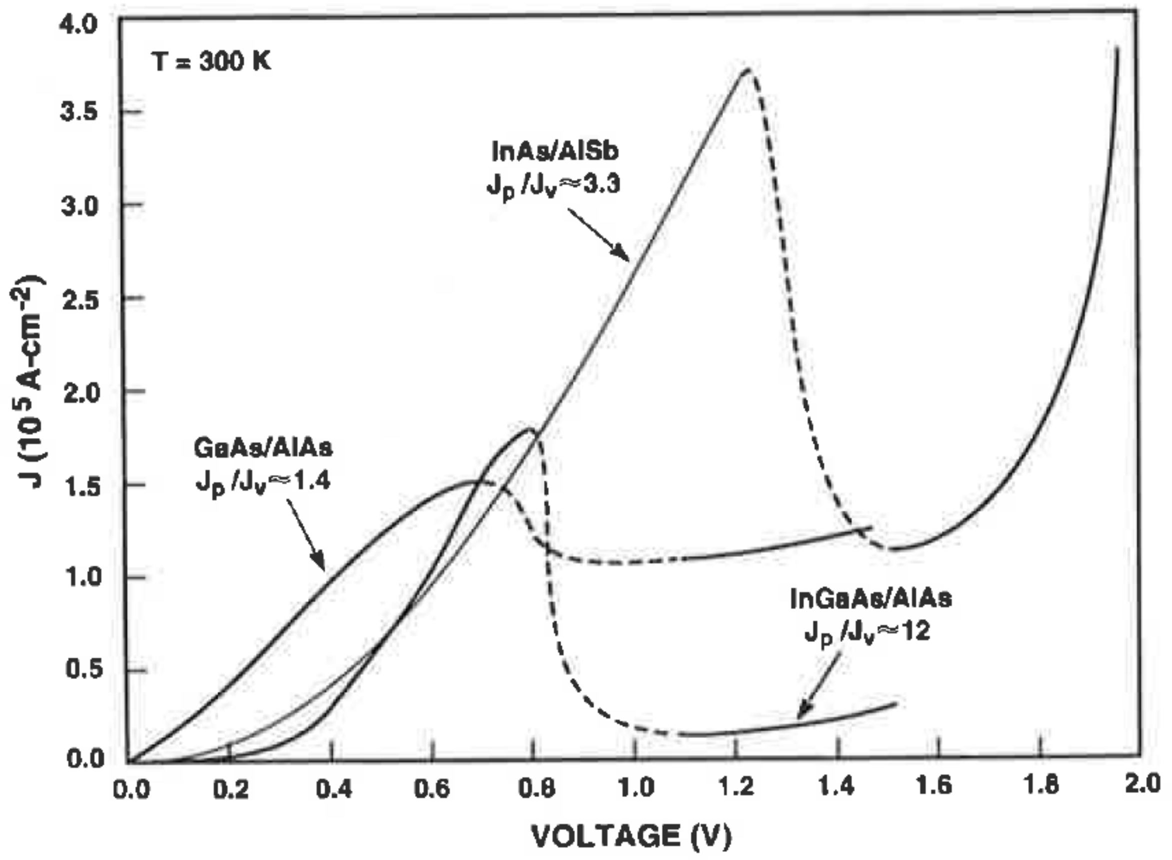



**FIGURE 5.15.** Characteristics of resonant-tunnelling diodes in three material systems measured at room temperature. [From Brown (1994).]