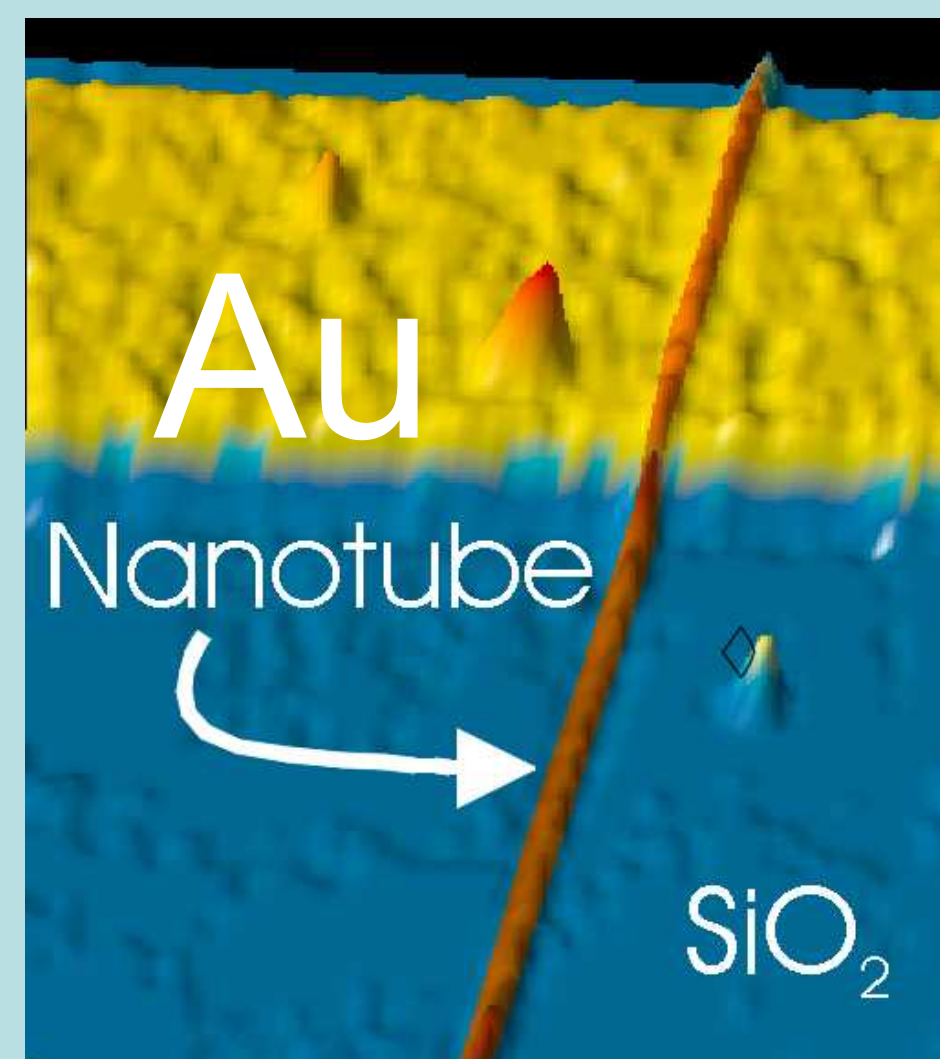


# Size Effects on Electrical Contacts to Carbon Nanotubes



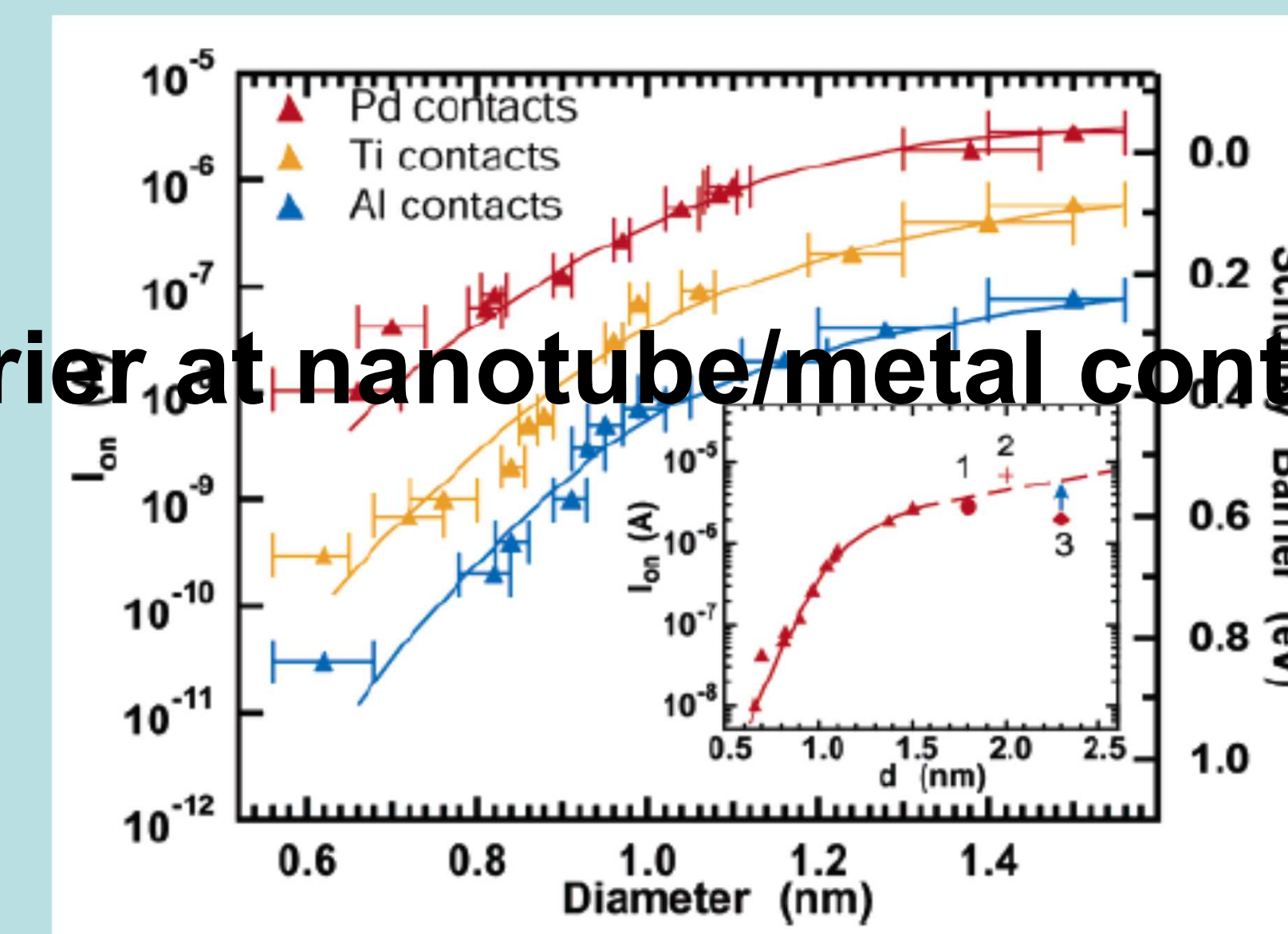
From R. Martel

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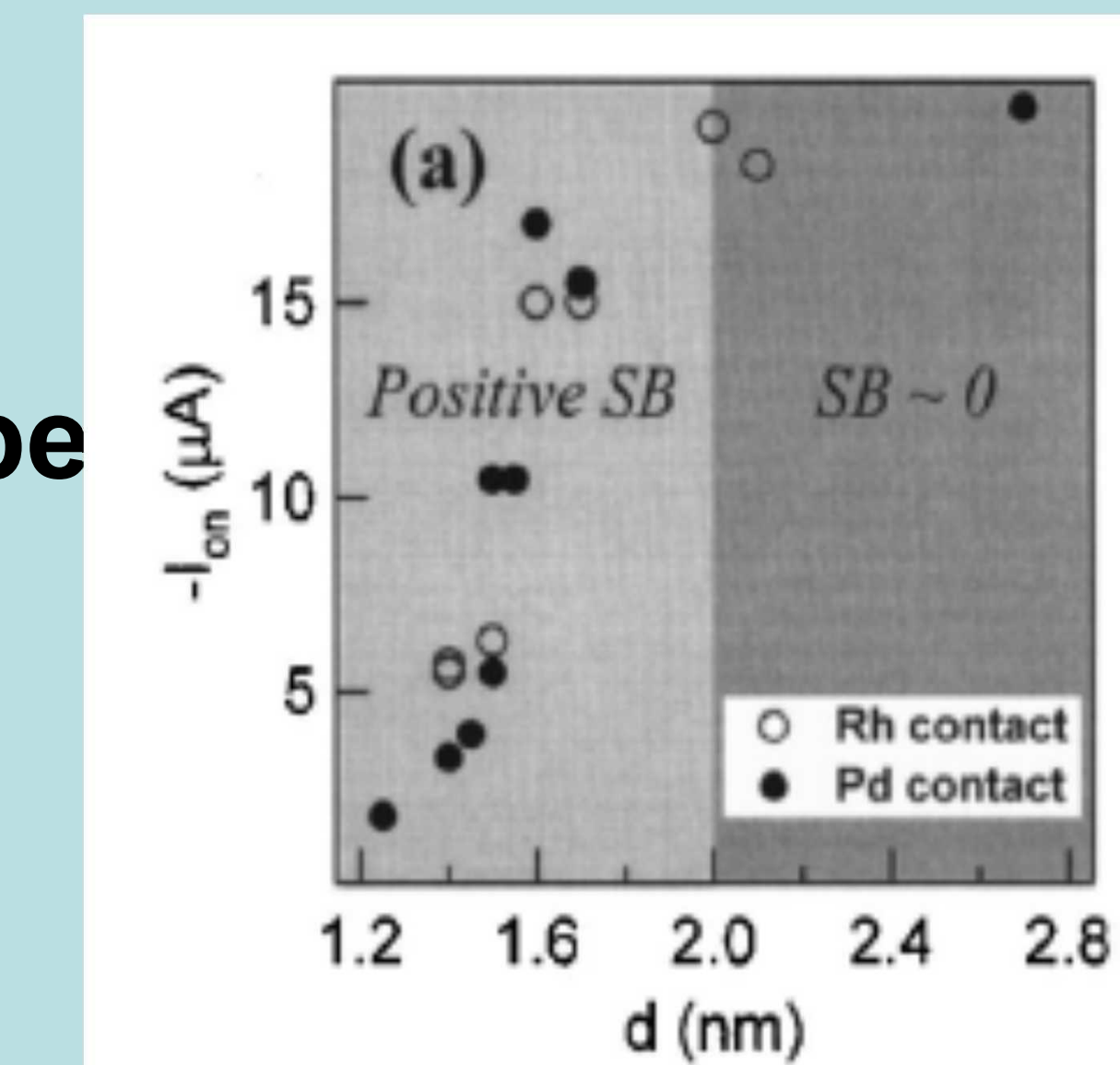
*Physical Review Letters* **97**, 026804 (2006).



**Issue:** Experiments indicate that the height of the Schottky barrier at nanotube/metal contacts depends on the nanotube diameter. What is the physical origin of this diameter dependence?

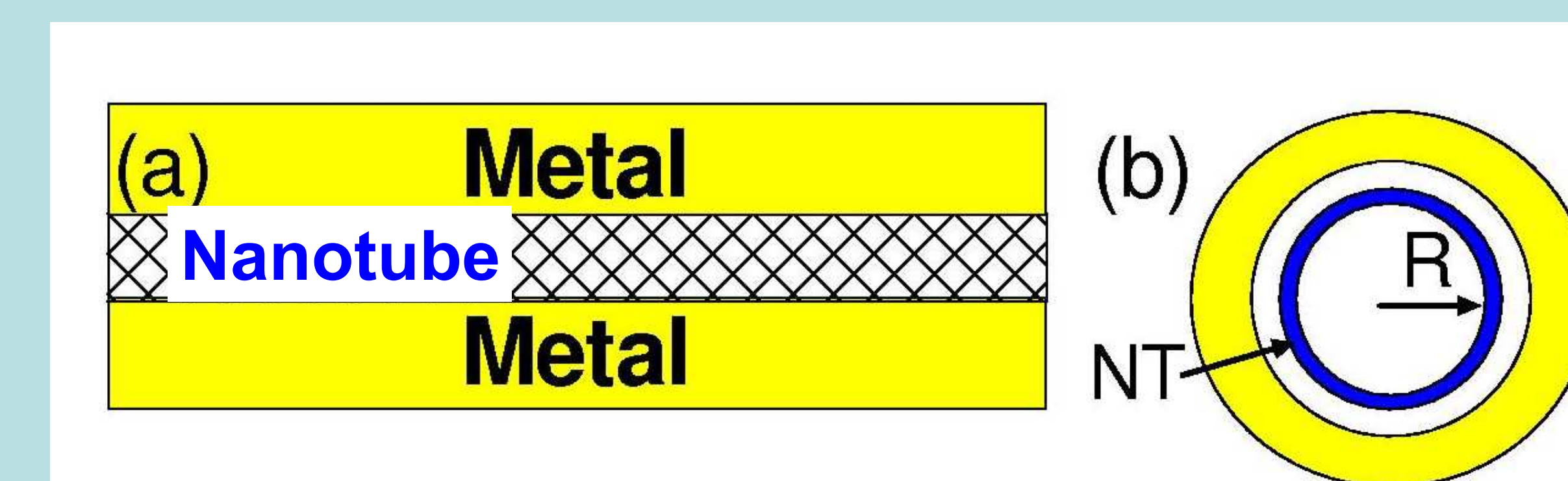
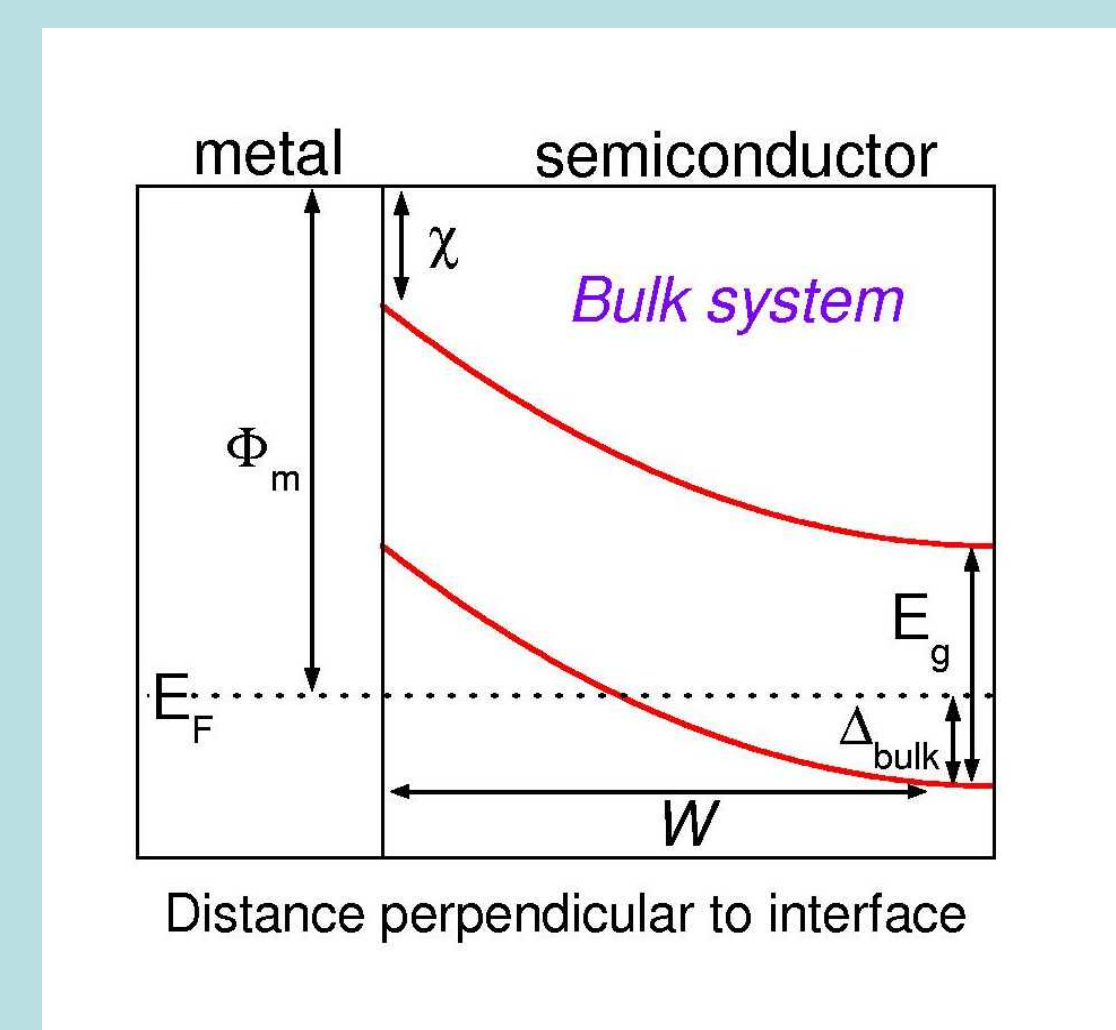


Chen et al, *NanoLetters* (2005).



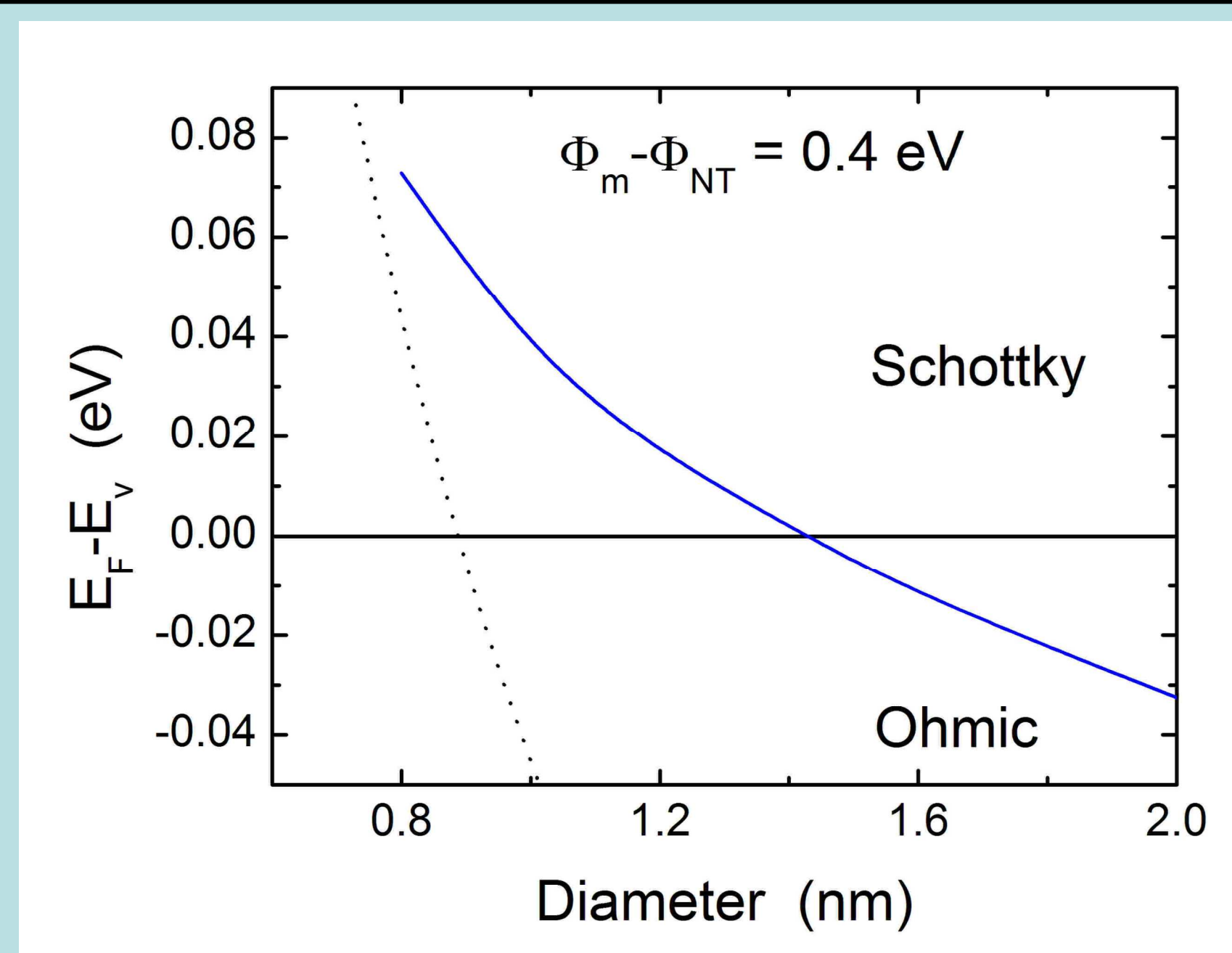
Kim et al, *Appl. Phys. Lett.* (2005).

At bulk metal/semiconductor contacts, charge transfer between the metal and the semiconductor is determined by the relative alignment of the Fermi level and the semiconductor band edges. For nanotubes, the bandgap and the effective work function of the nanotube are both dependent on the diameter.



**Key nanoscale physics:**  $R \ll W \rightarrow$  Weak charge transfer

We performed self-consistent calculations of Schottky barrier height at nanotube/metal contacts, and find that the barrier height decreases with diameter, with a transition to ohmic contacts around 1.5nm, in agreement with experiment.



Diameter dependence arises due to dependence of bandgap and capacitance on nanotube diameter.