Conductance of AFM deformed Carbon Nanotubes

Alexei Svizhenko\textsuperscript{1}, Amitesh Maiti\textsuperscript{2} & M. P. Anantram

\textsuperscript{1} NASA Ames Research Center, Moffett Field, California

\textsuperscript{2} Accelrys Inc., San Diego, California

3/13/2002
Tombler et al., Nature 405, 769 (2000)

Upon deformation

sp² to sp³

Stretching of bonds

Opens bandgap in most nanotubes

What is the conductance decrease due to?
Approach

1) AFM Deformation

2) Bending

Relaxed structure using molecular dynamics

Central 150 atoms were relaxed using DFT and the remaining 2000+ atoms were relaxed using a universal force field

Density of states and conductance were computed using four orbital tight-binding method with various parametrizations
Bond Length Distribution & Conductance

(12,0) Zigzag

Bending

AFM-tip deformation

AFM DEFORMATION

Conductance (S)

Conductance (S)

BENDING

Conductance (S)

$\theta^\circ$

Conductance (S)

$\theta^\circ$

Conductance (S)

$\theta^\circ$
AFM Deformed versus Stretched

- Uniformly stretched
- AFM-deformed

Conductance (S)

% of strain

Transmission

Energy (eV)

- ε=0%
- ε=10%
- ε=8.27%, Θ=25°
What happens to other chiralities?

- Metallic zigzag nanotubes develop largest bandgap with tensile strain.
- All other chiralities develop bandgap that varies with chirality.
- Experiments on a sample of metallic tubes will show varying decrease in conductance.
- Some semiconducting tubes will show an increase in conductance upon crushing with an AFM tip.