

# Déformation d'un solide

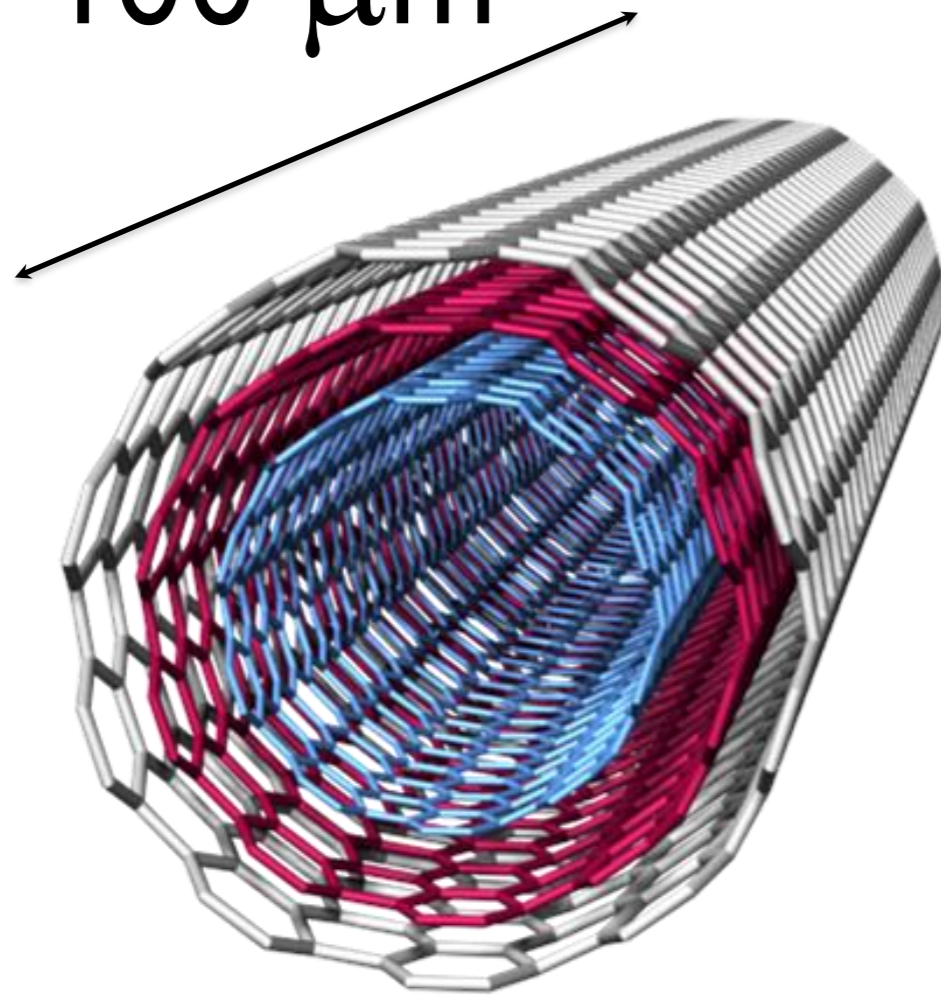
Mécanique, cours 18

László Forró

Prof. László Forró

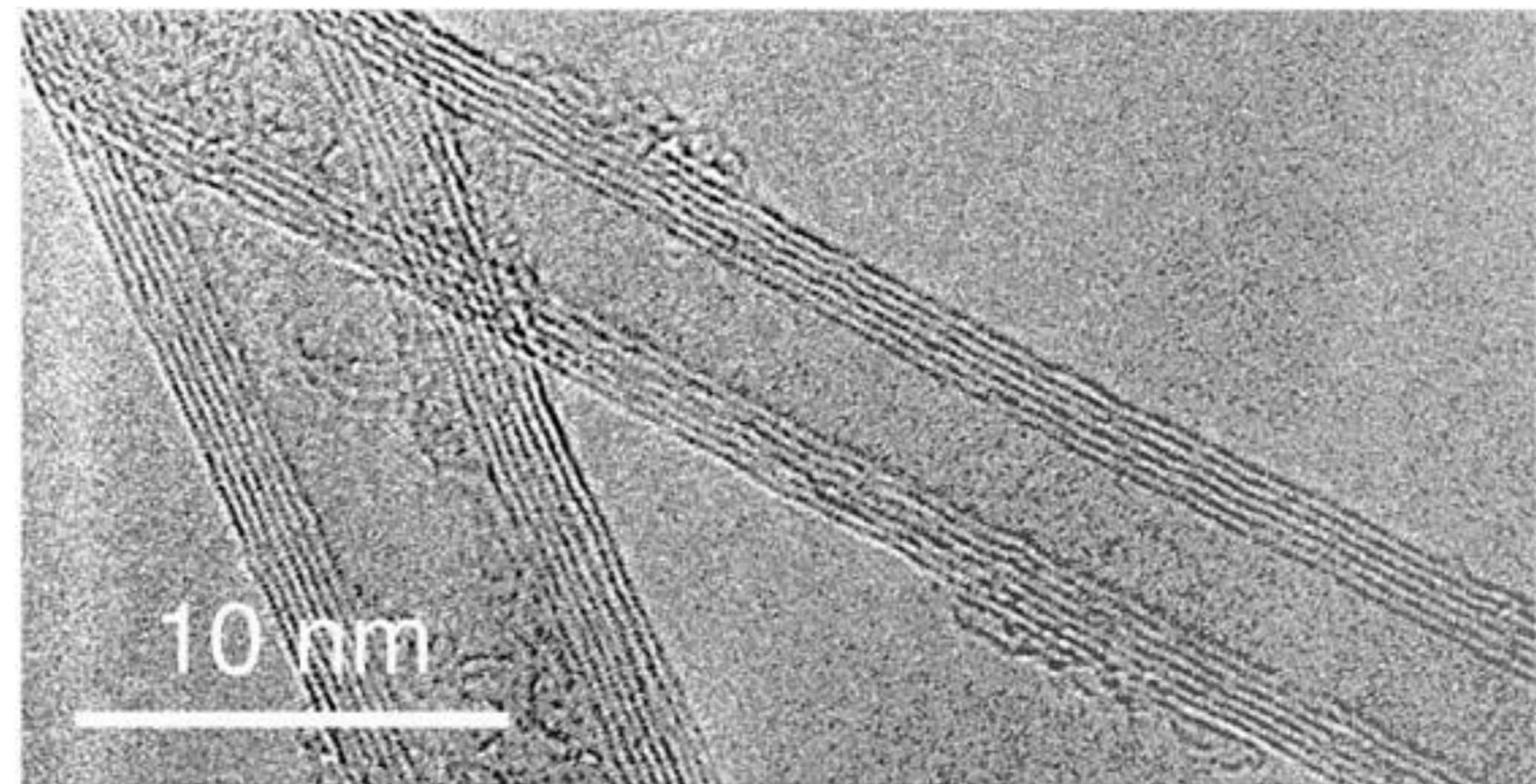
Laboratoire de Physique de la Matière  
Complexe - EPFL

1-100  $\mu\text{m}$

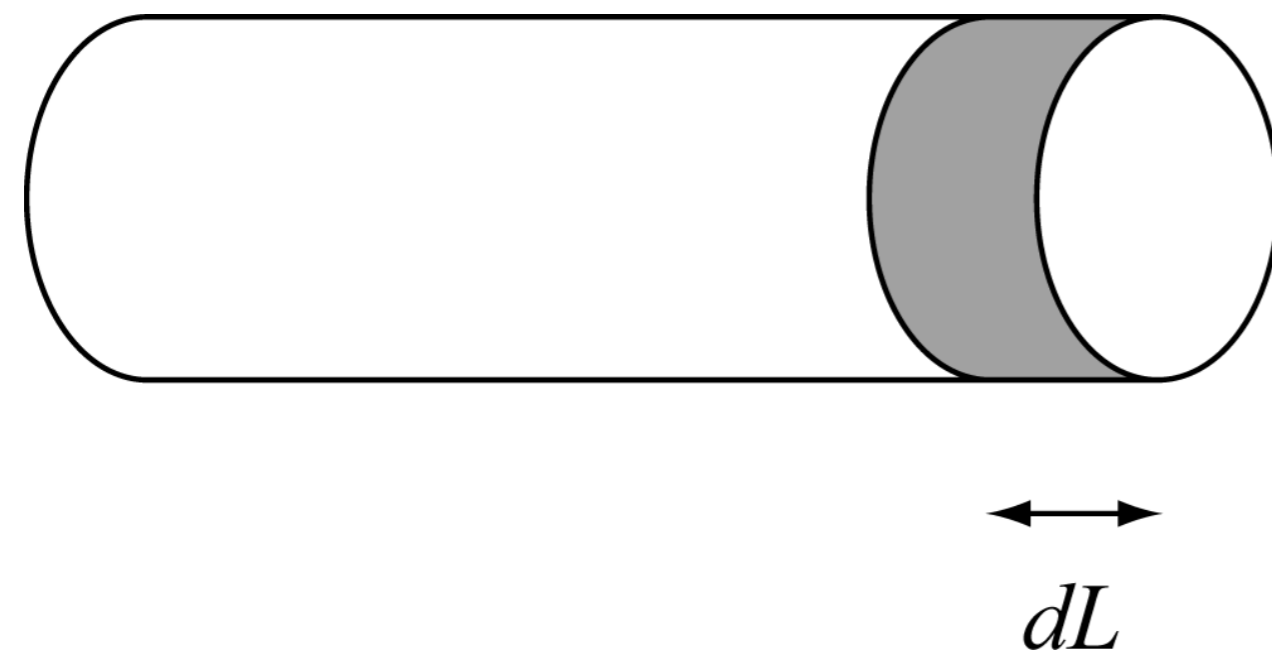
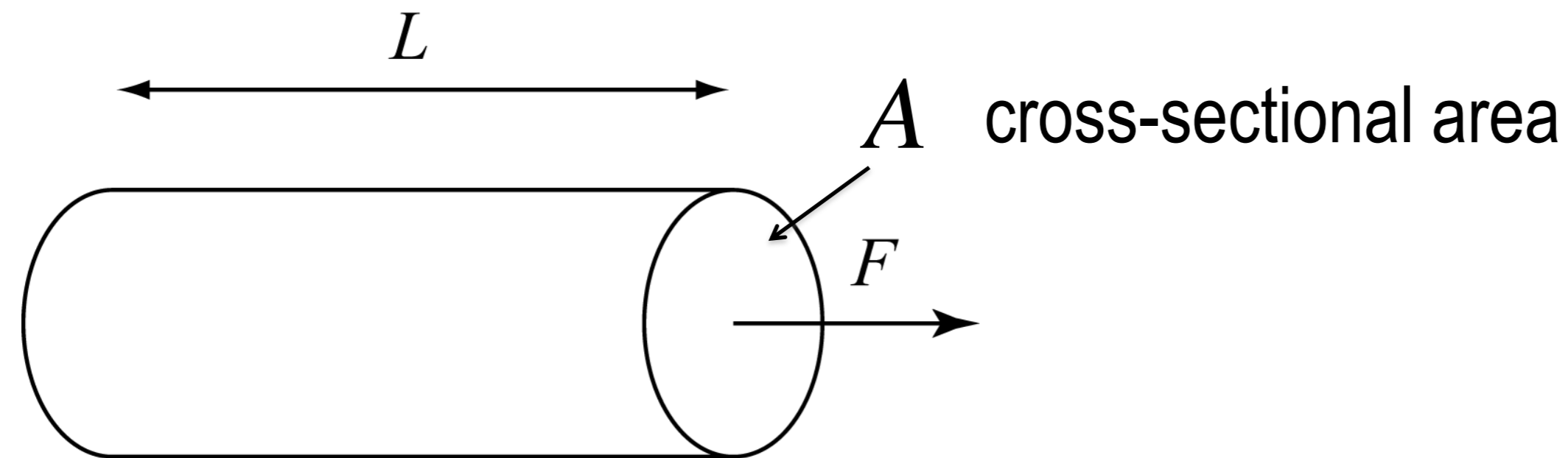


5-30 nm

Nanotubes de carbone



# Force en fonction de la déformation



contrainte  $\longrightarrow$  allongement  
spécifique

$$\sigma = \frac{F}{A}$$

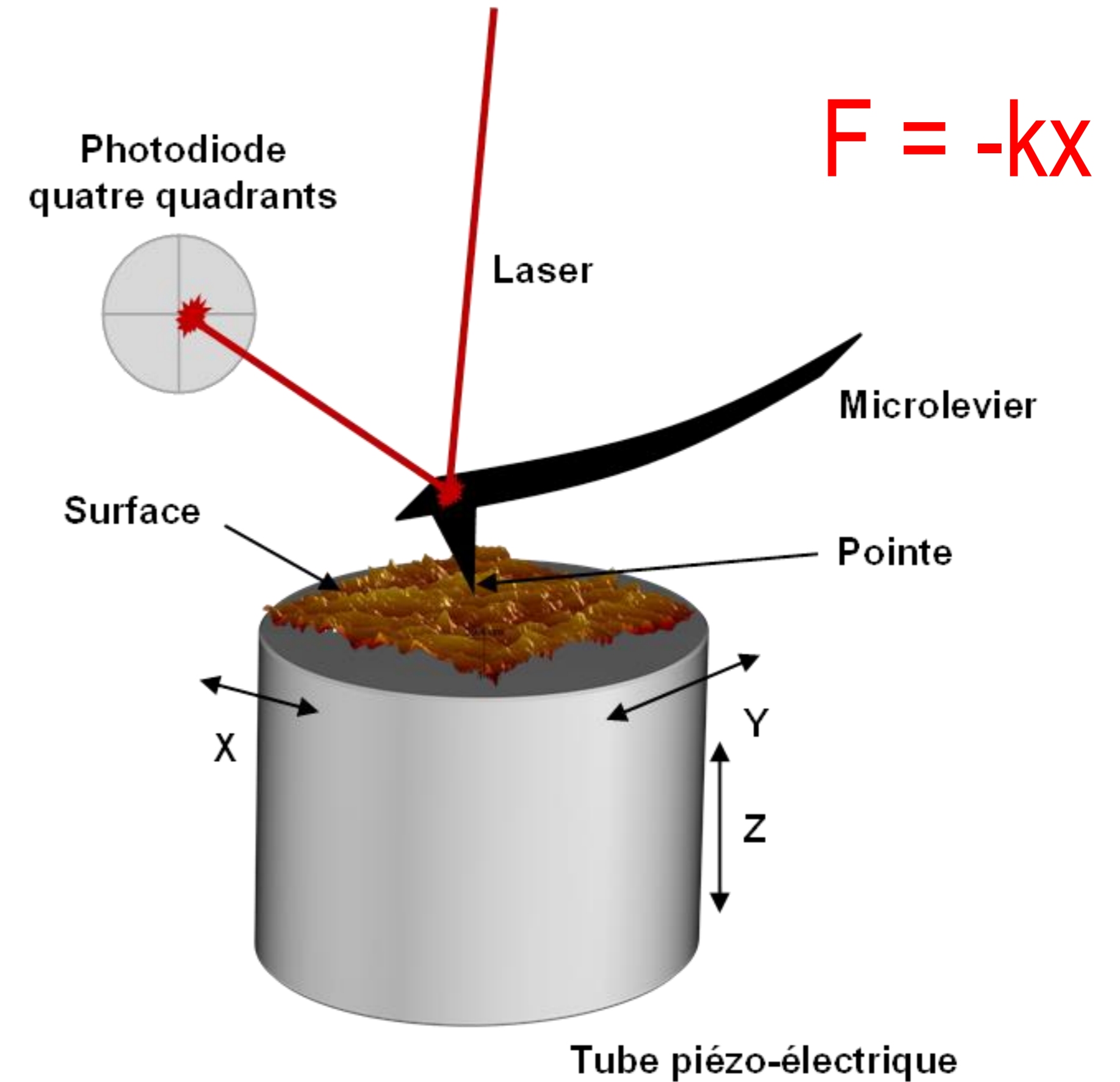
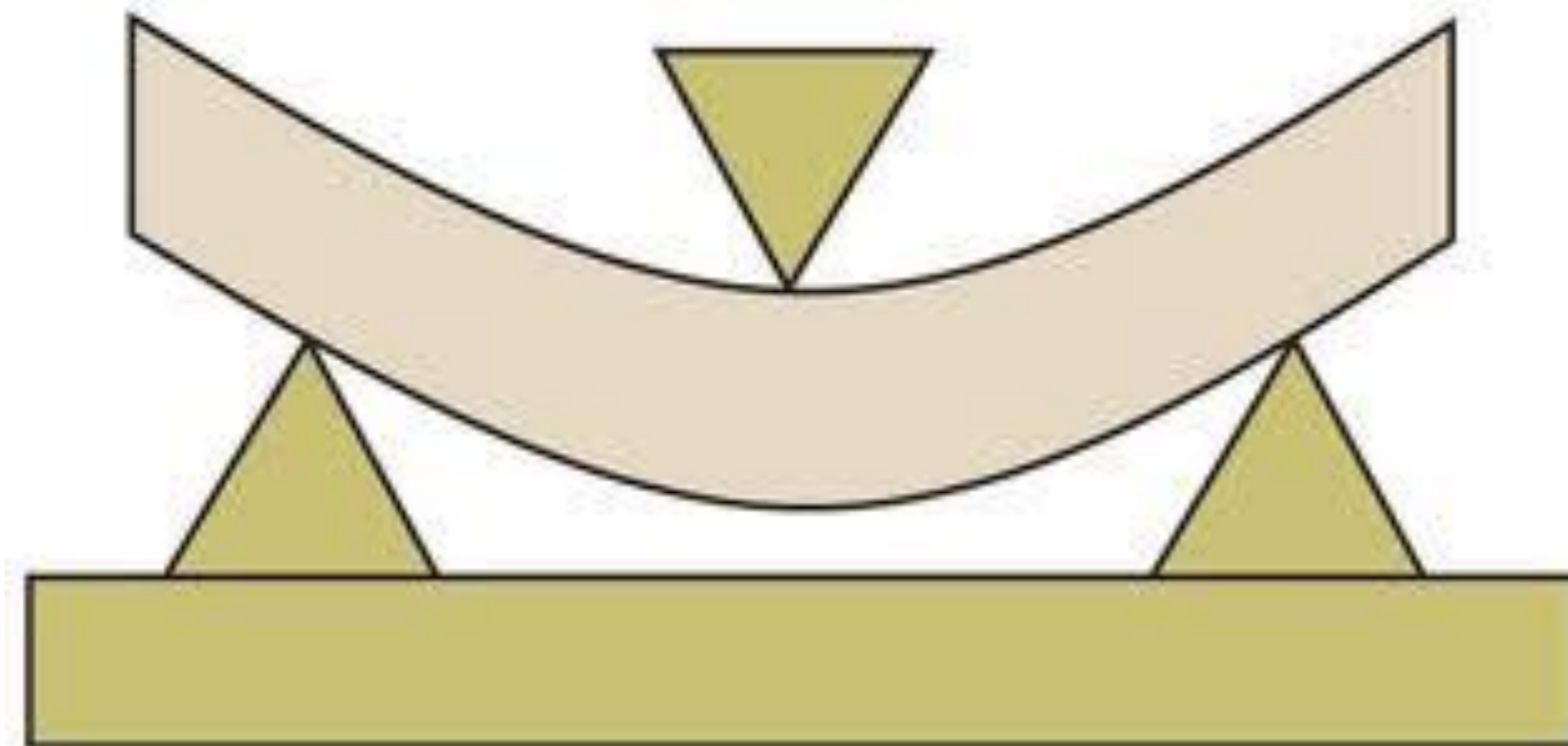
$$\varepsilon = \frac{dL}{L}$$

Loi de Hooke

$$\sigma = E\varepsilon$$

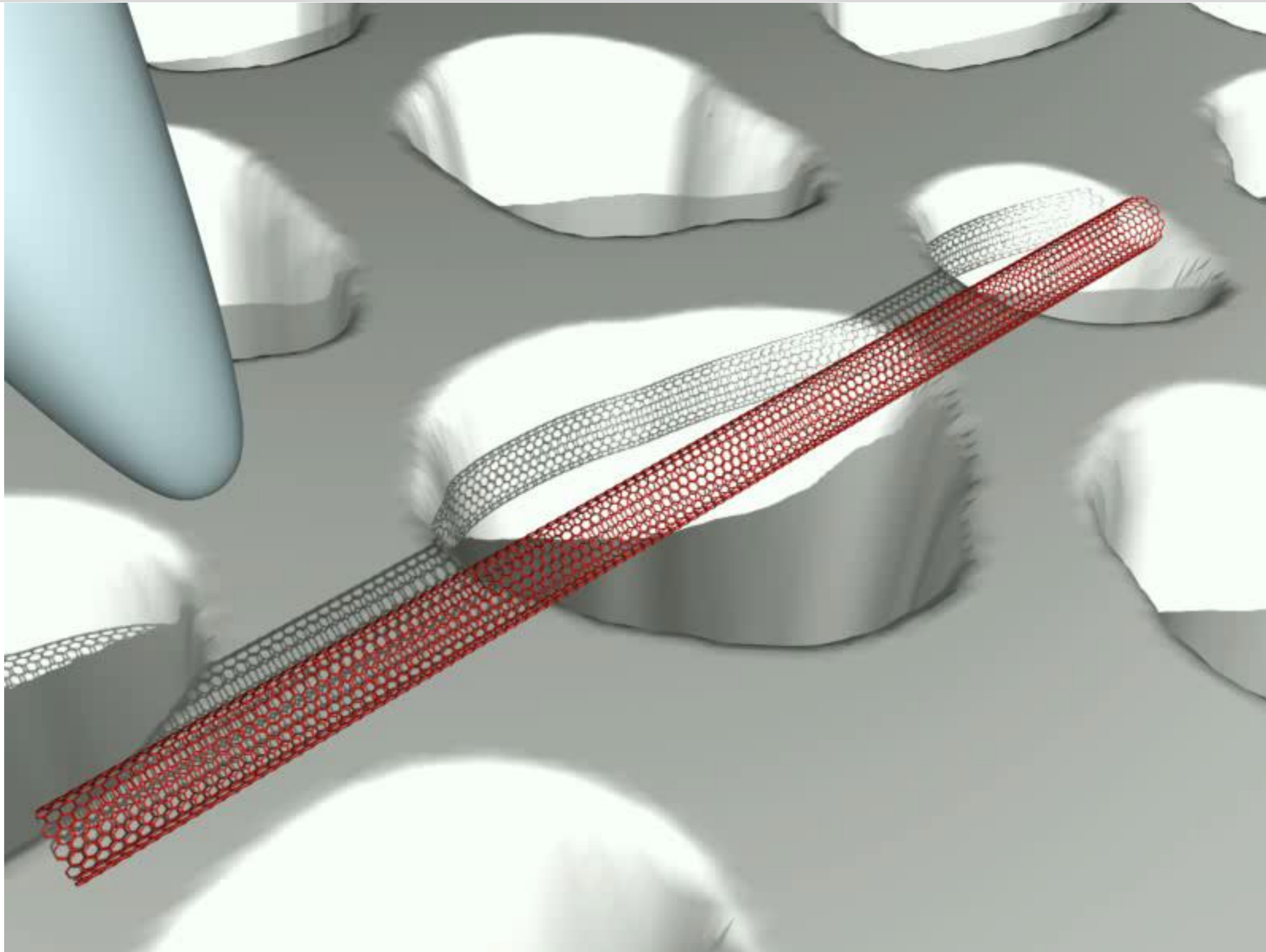
Module de Young

# Force pour déformer un nanotube

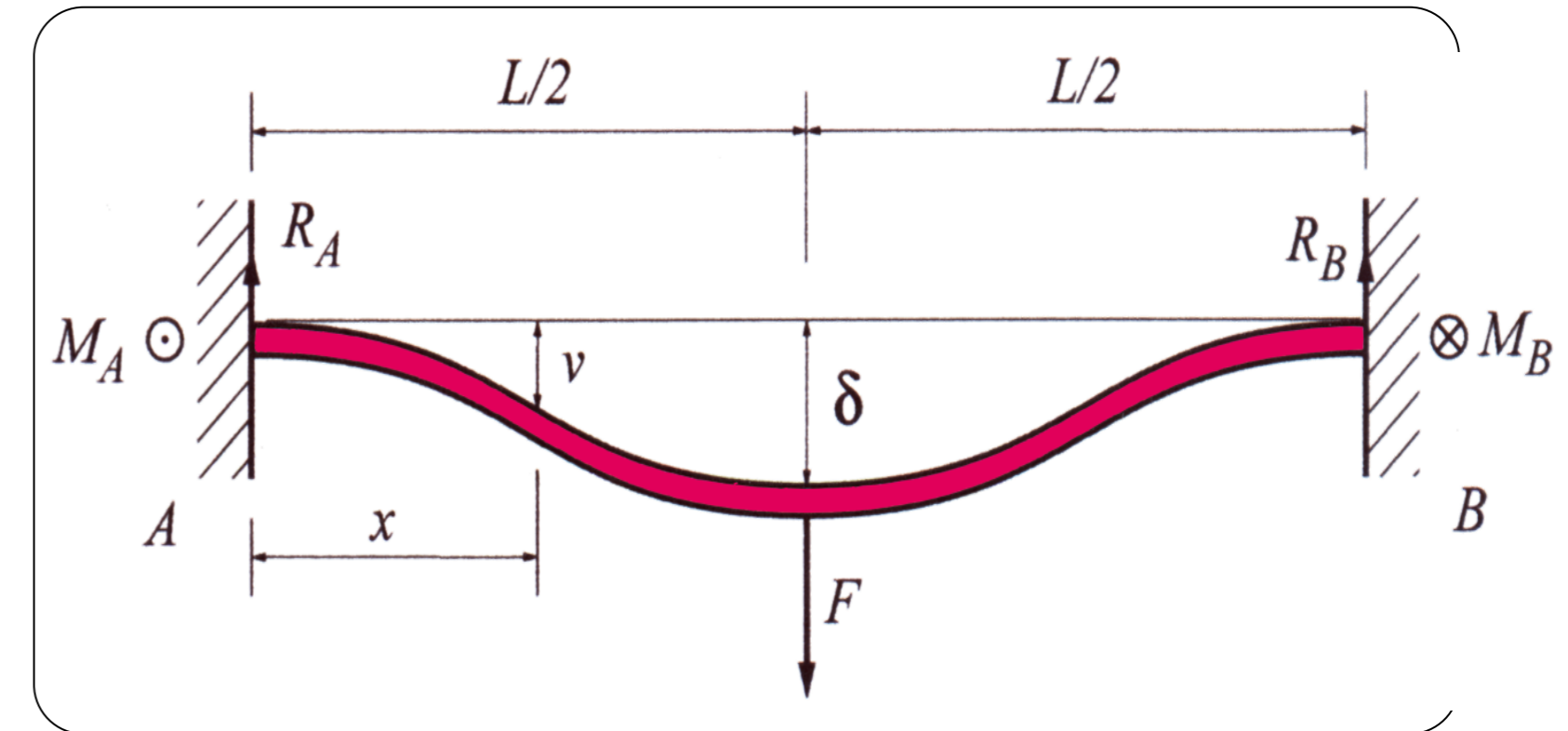
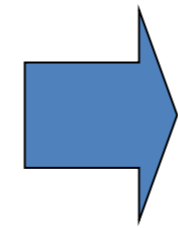
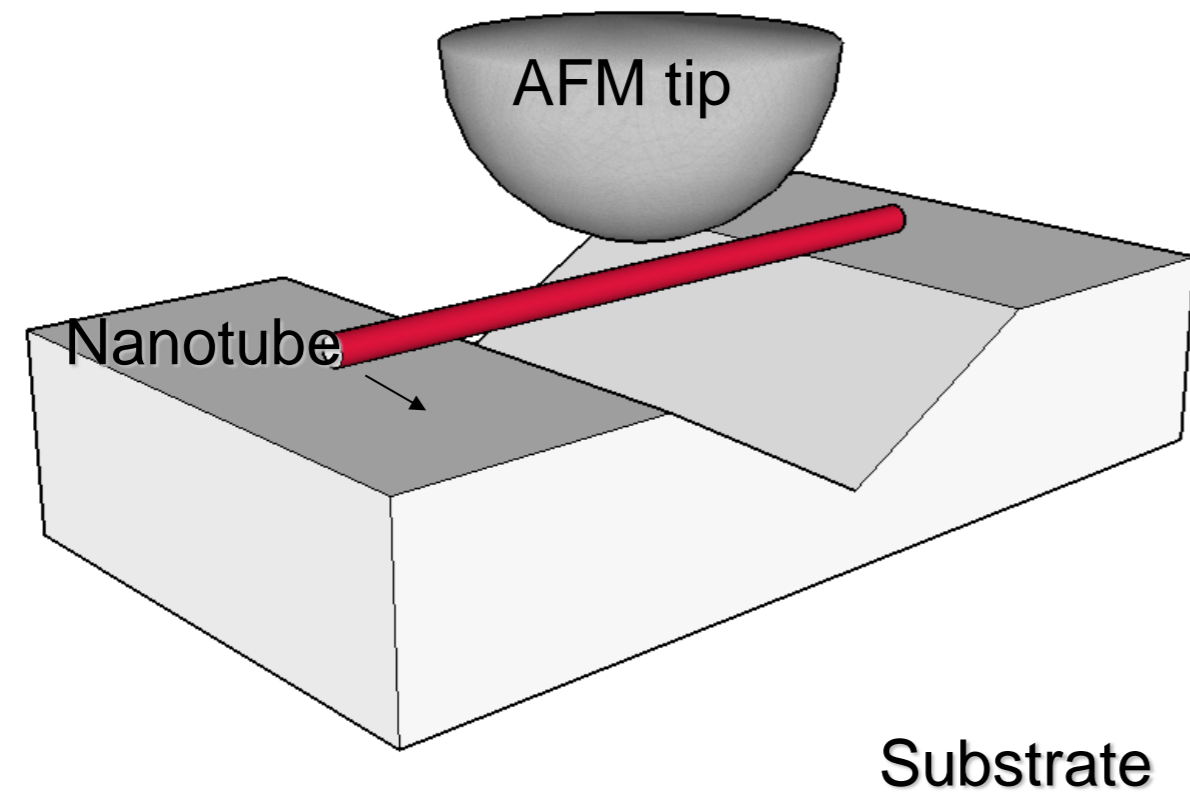


Microscope à Force Atomique

# La méthode de «fromage Suisse»

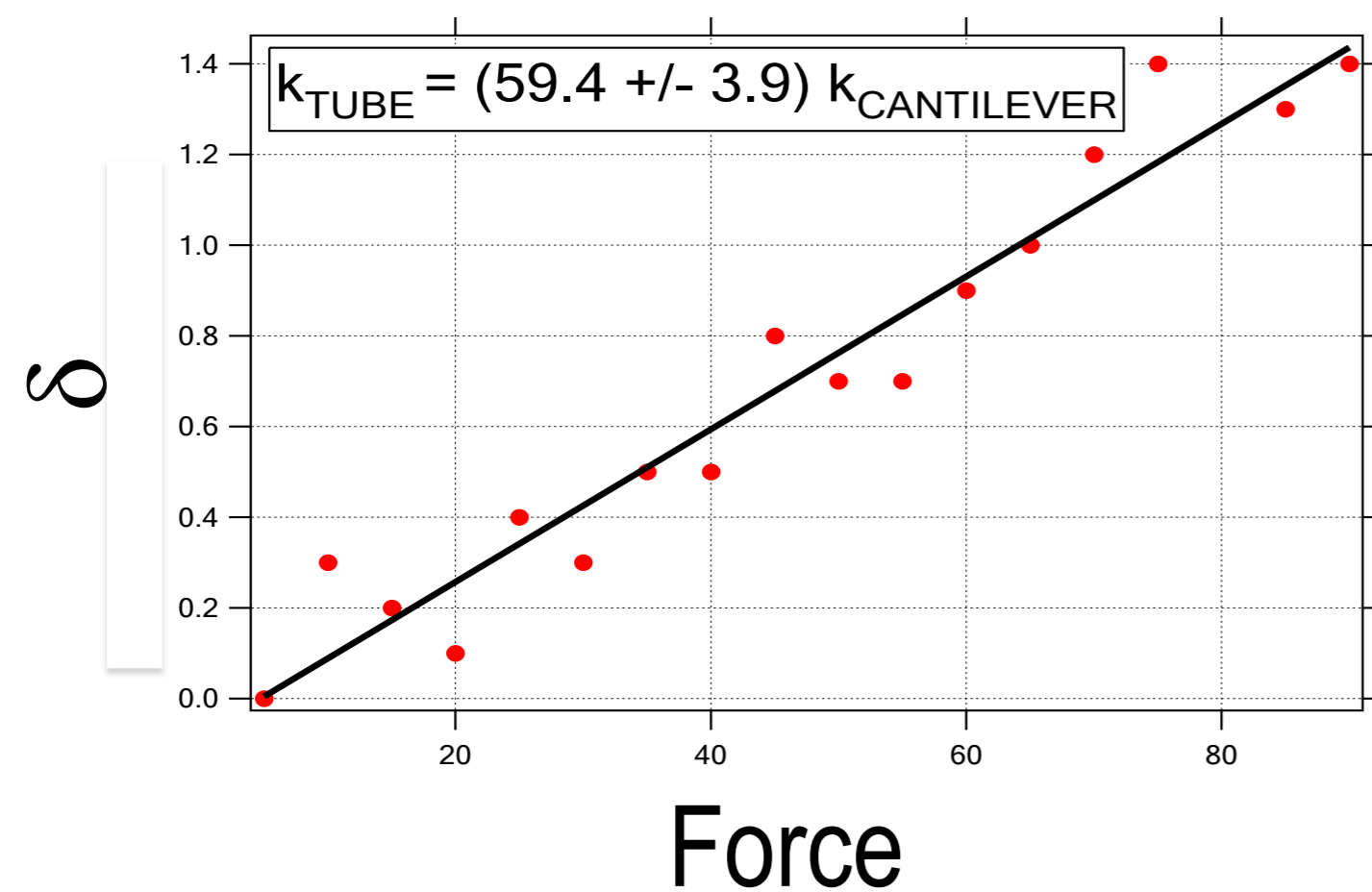


# Mesure force-déformation



S.P. Timoshenko and J.M. Gere, Mechanics of Materials

## Analysis AFM Images at Different Contact Force



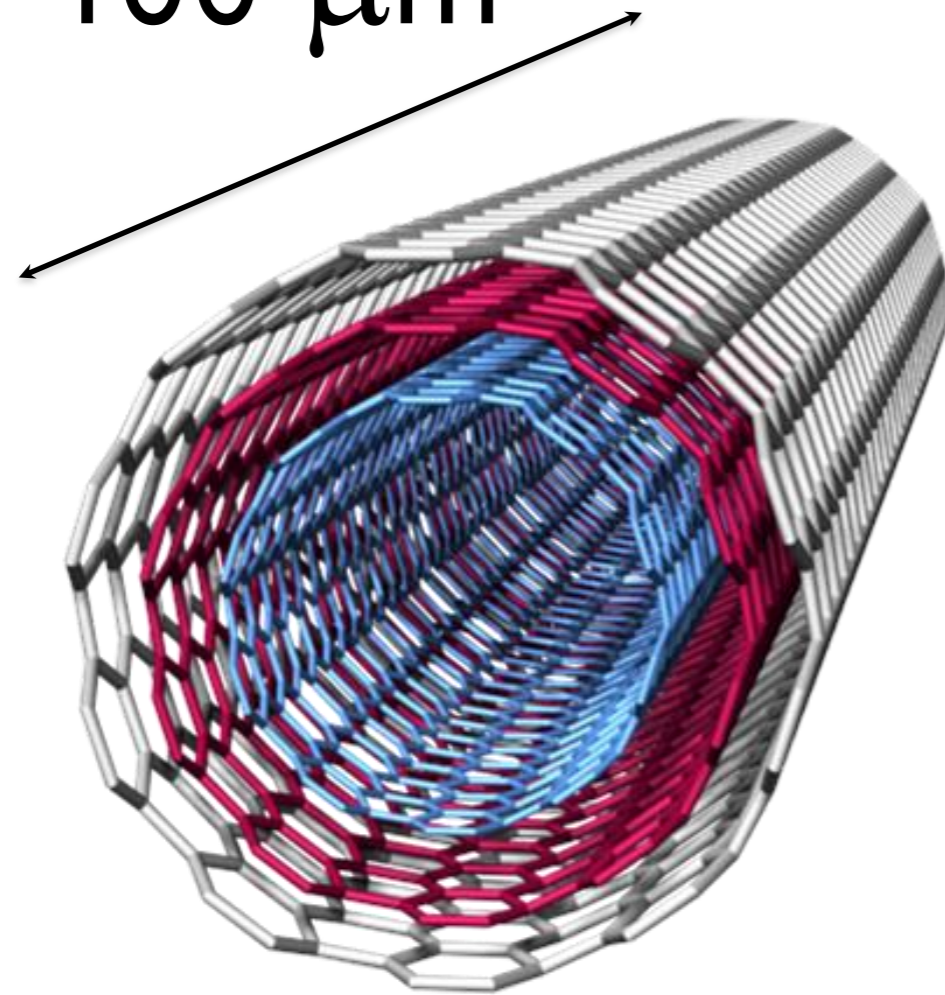
$$\frac{\partial F}{\partial \delta} = \left( \frac{3 \cdot \pi \cdot D^4}{L^3} \right) E$$

Shape Module de Young

D: nanotube outer diameter

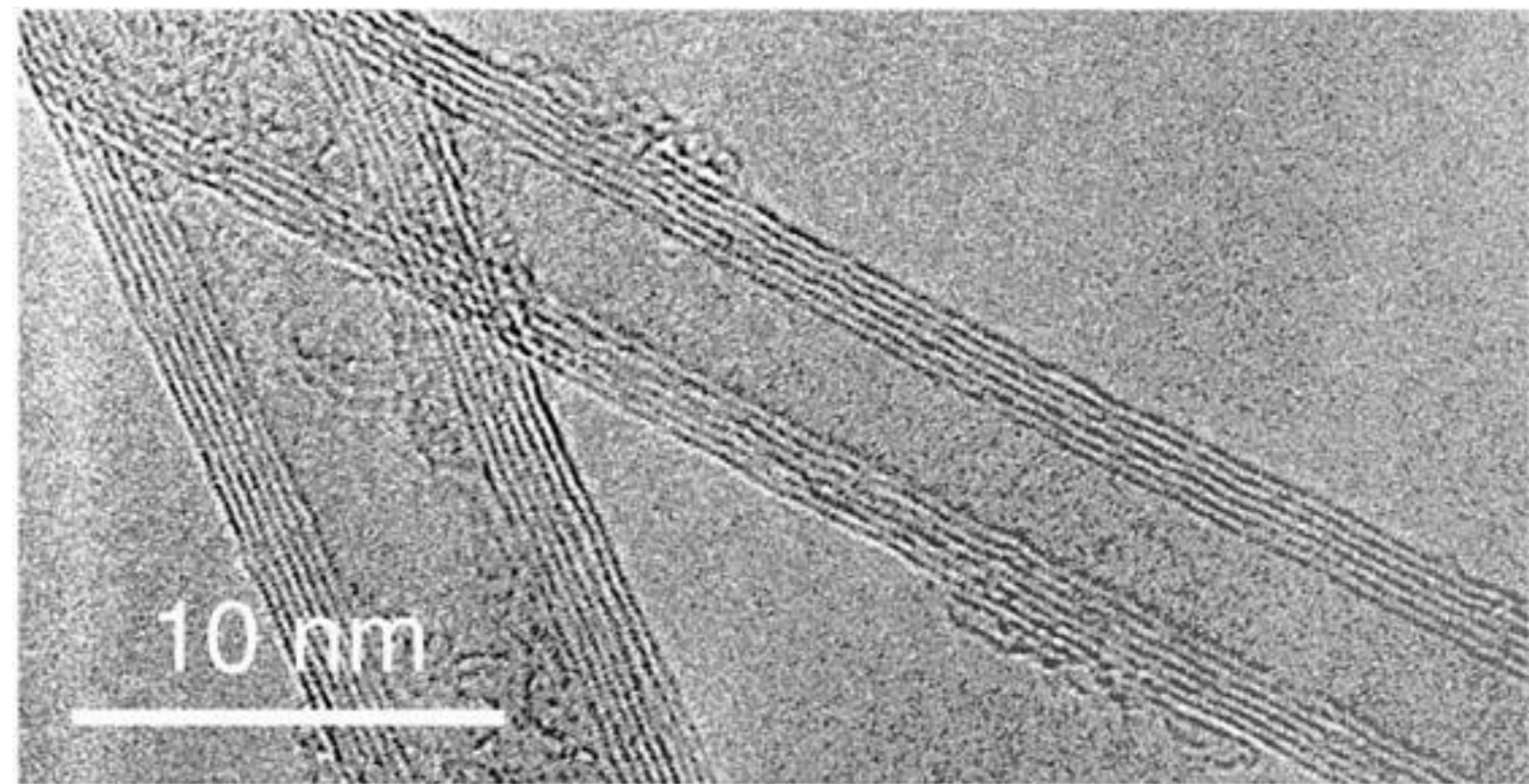
# Nanotube de carbone : matériau très résistant

1-100  $\mu\text{m}$



5-30 nm

Nanotubes de carbone



Module de Young = 1 TPa