

Lecture IX

PROBLEM 1

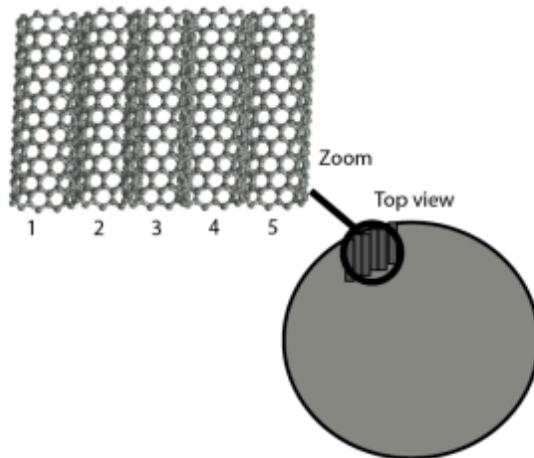
Estimate the increase in sensitivity, for hydrogen peroxide detection in cyclic voltammetry, after the functionalization of the working electrode with SWCNTs. Assume that the increase in sensitivity is only given by the increase in the electroactive area.

Consider electrode diameter of 4mm and a scan rate of 100mV/s. A solution of 1mg/ml of SWCNT in chlorophorm was prepared and then 10 μ l were drop cast on the electrode surface. Consider nanotubes as rigid bodies with diameter equal to 1.5nm and length 500nm.

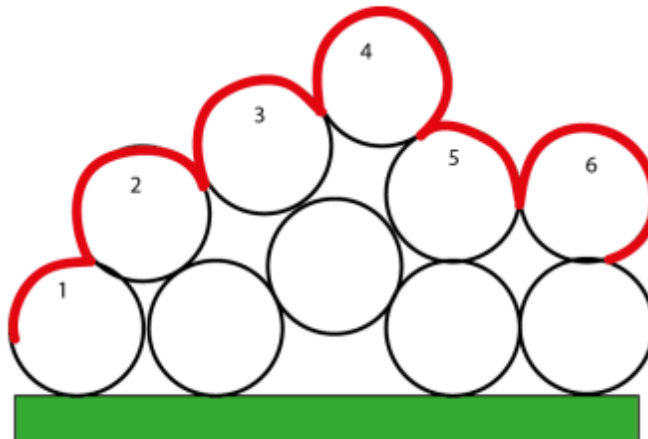
Main assumptions:

We consider carbon-nanotubes as rigid bodies, aligned on the surface of the electrode. We can approximate CNTs as a layer of small cylinders spread parallel on the electrode surface.

We can divide the electrode surface in small sections, each made by a bundle of CNTs:



We can calculate the area of each section, by assuming that the bundle of CNT has the following conformation



PROBLEM 2

By nanostructuring electrodes with carbon nanotubes we obtained an increase in sensitivity (obtained with cyclic voltammetry measurements) from $0.26 \text{ nA}/\mu\text{m mm}^2$ to $0.63 \text{ nA}/\mu\text{m mm}^2$. Estimate the increase in the electroactive area in this case, starting from Randles- Sevcik equation.