Announcements

Pre-lab Lecture
- Mod3 Concepts
- Intro to M13 Virus
- Intro to Solar Cells Materials
- Today in Lab (M3D1)
Announcements

• Introducing... Jackie, TA for Module 3
• Module 3 assessment
  – done as a team
  – novel research proposal
  – define a specific question and an approach to address it
  – downtime in lab during M3 to work on it
  – pre-proposal: written (due M3D4)
  – final proposal: oral or written (due M3D6)
Module 3 Foundations

• Biology can interface with nano- and microscale materials
  - Cells 1-10μm
  - Viruses 0.01-1 μm
  - Proteins 1-100 nm

• Nanoscale materials may have improved or even emergent properties
  - Benefits:
    - Electromagnetic
    - Optical, catalytic
    - Also high surface area : volume
  - Risks:

• Our nanomaterial is a phage!

1 μm
10 nm
M13 phage life cycle

Infection

Amplification

Morphogenesis

Image from Fall 2007 wiki. RF = replicating form
M13 as engineering substrate

Length of DNA (to be packaged) dictates size of phage... w/in limits

Surface proteins can be used for peptide display

Library design and screen via binding assay

Images from 20.109 wiki

+ longer & more varied peptides
Phage titer: plaque assay or spec.

By plating:
Phage slow *E. coli* growth upon infection

By spectroscopy:
• Nucleic acids (peak 260) and proteins (peak 280) can be ∼quantified at 269 nm absorbance
• Subtract background at A320

θFU (cf CFU)
SWNT-Au/TiO2 nanocrystal approach

• Begin today: react phage w/SWNTs or gold
• Vary ratio of phage:SWNT or phage:Au

• Next time react w/Ti(OCH(CH3)2)4
• Why bother? [w/ Ø?]
  - isolated SWNTs, nice paths
  - proximity to TiO2

• Eventually...
  – TEM observation
  – Solar cell assembly

Image: Matt Klug
Today in Lab (M3D1): Workflow

• Prepare phage by precipitation with PEG/NaCl
  – Incubations/spins *alone* are almost 2 h
  – At the end, phage are in the supernatant!!
  – Pellet is bacterium *Know where your * pellet is

• Obtain viral titer
  – take care with quartz cuvettes!

• React/dialyze phage w/SWNTs or gold
Today in Lab (M3D1): Samples

Part 3: reacting phage with SWNTs or Au

<table>
<thead>
<tr>
<th>Group</th>
<th>Material</th>
<th>Ratio (material:phage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT</td>
<td>SWNT</td>
<td>1:1 (SWNT:phage)</td>
</tr>
<tr>
<td>SY</td>
<td>SWNT</td>
<td>2.5:1 (SWNT:phage)</td>
</tr>
<tr>
<td>KK</td>
<td>SWNT</td>
<td>5:1 (SWNT:phage)</td>
</tr>
<tr>
<td>IS</td>
<td>Au</td>
<td>1:1 (Au:phage)</td>
</tr>
<tr>
<td>EA</td>
<td>Au</td>
<td>5:1 (Au:phage)</td>
</tr>
<tr>
<td>BMS</td>
<td>Au</td>
<td>10:1 (Au:phage)</td>
</tr>
</tbody>
</table>

1. Calculate volume of Gold needed (stock [Au] = 5x10^{13} nanoparticles/ml)
2. Mix in a glass scintillation vial
3. Store in fridge

1. Calculate volume of SWNTs needed (stock=20 ug/ml)
2. Mix in dialysis tubes (label clips of your tubes)
3. Dialyze against NaCl pH 5.3 then 10

Low pH = minimize electrostatic repulsion (phage/SWNT)
High pH = stabilize complex, ready for TiO_{2} (↑ nucleation)

Slide modified from N. Kuldell