Columbia-Cooper
iGEM 2012
Biological Production of Printed Circuit Boards
What are PCBs?
PCB Manufacturing Issues

Ferric Chloride

Process Accessibility

Environmental Impact
Acidithiobacillus ferrooxidans

Light as a Means of Spatial Control

http://partsregistry.org/Featured_Parts:Light_Sensor
The Grand Vision
Two Major Questions

Can *A. ferrooxidans* actually be altered to die when exposed to light?

Can this process be engineered to be that simple?
Liquid Media
**Liquid Media Etching**

### Average Copper Consumption Rates in Liquid Media:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Rate (mg Cu/hr)</th>
<th>Rate (g Cu/g<em>cells</em>hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacteria (up to Day 3)</strong></td>
<td>6.1</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>No bacteria</strong></td>
<td>1.4</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>Actual Bacteria Rate w/o oxidation from air</strong></td>
<td>4.7</td>
<td>0.38</td>
</tr>
</tbody>
</table>

![Graph showing copper mass remaining vs. day for different conditions]
Solid Media
Solid Media Etching

Total % Decrease of Copper in Solid Media vs. Day

- Data Points w/ Bacteria
- Data Points w/o Bacteria
- Interpolated curve w/ Bacteria
- Interpolated curve w/o Bacteria
Hybrid Media
Two Major Questions

Can this process be engineered to be that simple?

Can *A. ferrooxidans* actually be altered to die when exposed to light?
Our Idea
Kill Switch

Bba_K124017: Bacteriophage Lysis Cassette
YF1

Light Sensors

FphA

PhyB
Possible Promoters: GAL4-PhyB

Possible Promoters: YF1
Possible Promoters: FphA

Adapted from: Brandt S. The fungal phytochrome FphA from Aspergillus nidulans. Doctoral dissertation, Ruhr-University Bochum. 2008. pp68
Biobrick: BBa_K952000

pSB1C3-FphA

Phytochrome FphA Protein Domain
Biobrick: BBa_K952006

- pSB1C3
- Constitutive Promoter
- YF1-FixJ
- PfixK2
- Lysis Cassette

Blue light Induced Cell Lysis Composite Part
Biobrick: BBa_K952007

- pSB1C3
- LacI
- YF1-FixJ
- FixK
- Lysis Cassette

IPTG and Blue Light Inducible Cell Lysis Composite Part
Biobrick: BBa_K952003

pSB1C3
-YF1-FixJ
-FixK
-amilGFP

Blue light
Inducible
Chromophore
Composite Part
Chromoproteins

http://partsregistry.org/wiki/images/d/d9/Pellets_BYR.jpg
Outreach: Maker Faire NYC
How’s it going?
Future Directions

- Fusing FphA with other histidine kinase domains
- A. Ferrooxidans transformation protocol
- Modifying pJRD215
- Etching media
Acknowledgments
Questions?