

# HAPPY ENDING

## Highlights for our solution

- Plant-based printed substrate and hydrophobic coating for printed circuit board

## Questions to address

### Strength

- Use the abundant and cheap agricultural waste as a starting material
- Enzymes are freeze-dried so no device degradation even if the enzyme container breaks (safety)
- When the plant-based substrate disappears, the tiny metal parts left behind will allow an easier material separation in recycling process

### Weakness

- What if users just don't bother saying goodbye and just trash them? -> solution: give discount for new purchase if customer say goodbye and return the phone to Google for recycling
- Cutin coating effect depends on its thickness

### Next step

- Other enzymes can be added to the platform and degrade other materials in the future
- Replace other parts in PCB to be transient electronics -> why not now?  
Inferior electrical property

### How can we change the environment?

- Facilitate recycling process -> more rare metals recovered -> reduce the demand from metal mining
- We see them as a starting point to shift towards more transient electronics usage in the

### Product life cycle

- After saying goodbye
  - The PCB

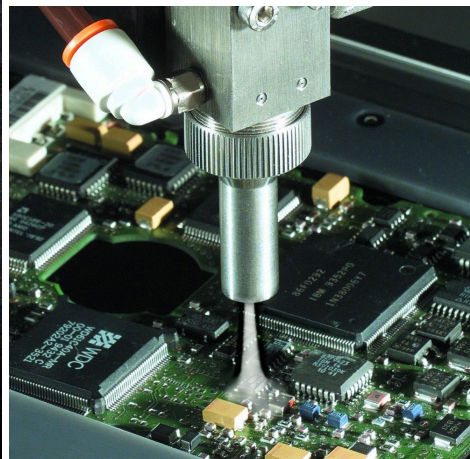
### Dual use/ethics

**Our focus is to improve further for plant base pcb to allow and extend lifecycle of electronic devices until we decide to throw it away or it couldn't repair -> people usually keep unused or broken devices and it become trash.**

## **Responsive coating material for transient electronics**

Team: CAUGCUCACCGUAAU (HAPPY)

Member: Henry Tan, Thanakrit Wongsatit, Prompt Suatim



- Idea  
So cool if everything in the electronic device can dissolve in water. But it's too absurd if your phone breaks down into pieces after accidentally drop it in a toilet bowl
- Ideal coating/encapsulating material properties

- Can be produced by the organism naturally or by metabolic engineering approaches\*
- Liquid resistant, hydrophobic -> water will not disintegrate the coating\*
- Biodegradable\*
- Coating is independent from coating material thickness -> so we can just coat it in thin layer
- Disintegrated by some stimulus e.g. electricity
  - Tap 10 times with sound to trigger the goodbye mode
  - Temperature is not appropriate as some electronic device might overheat
  - In case that the material cannot be directly disintegrated by the trigger, encapsulated enzyme might be utilized
- \* = at least the solution should satisfy these conditions
- What if?
  -

## Materials

What if product materials were grown instead of manufactured, what if they were derived from waste, repairable, repurposable, responsive, and truly sustainable?

What if they could provide benefits to the user or their surroundings? What new materials could be utilized for consumer electronics of the future—from phones and speakers to laptops and more? Invent and apply the materials of the future.

- Next steps
  - Decide about the material so we can explore its life cycle -
  - Study trigger mechanism
- What are we excited about?
  - Plant-based PCB exist -> substrate made from cellulose.

IEEE TRANSACTIONS ON ELECTRON DEVICES

1

## Plant-Based Completely Biodegradable Printed Circuit Boards

Vijay Kumar Guna, Geethapriya Murugesan, Bhuvaneswari Hulikal Basavarajaiah, Manikandan Ilangoan, Sharon Olivera, Venkatesh Krishna, and Narendra Reddy

- Biofilm for implants -> pcb coating
- Questions
  - What are current coating materials for PCBs, Electronic parts for Google products - ?
  - Since the coating is applicable to any transient electronic parts other than PCB, would there be any other electronic device that is more attractive than the PCBs.
  - What is the current development of PCB, Electronic part, Battery in Google?
  - What is the current recycle campaign for google products?
  - According to the "Reflection" part in score rubrics. Does it cover the feedback from the experts we know that are not involved in this team?

#### 4. Reflection

Has the team recognized all the voices—experts and otherwise—necessary to inform the project? Has the team recognized strengths and weaknesses of its vision? Has it suggested ways to address them? What might next steps be to progress toward the next iteration of the idea?