Introduction:

So far, we have been able to achieve a 0.7V result from prototypes created with alginate materials as substrates, laser cutting a well and using a silver conductive paint for drawing a bottom electrode onto which our nanowire solution is dropped and evaporated using a hotplate. Typically, a 10ul pipette is used in a 0.5 cm^2 "cell" at 50% humidity.

The Air-gen produced 0.5V of electricity at 50% humidity.

We do not know the current concentration of our nanowire solution.
The goals are:

- Test various substrates not previously tested and measure voltage
- Test voltage at various humidity levels
- Test alternative ways to add a top electrode
- Test soldering techniques to add wires connecting the electrodes
- Test connecting "cells" in series - test what this does as far as voltage

Materials and Methods for Electric Skin:

- humidity gauge (50% humidity is ideal),
- 9V battery (to test electrodes/circuits' conductivity on their own),
- 10ul pipette tips,
- 0.5 -10ul pipette,
- ruler (to measure and draw 0.5cm X 0.5cm square for drop casting),
- A sharp pencil (to draw a square),
- scissor (to cut tape into shape and strip top electrode wires if needed),
- scotch tape (to make wells and hold down top electrode),
- 50ml distilled water solution with an unknown concentration of nanowires
- silver conductive paint (conductive silver and water pen for drawing circuits),
- Substrates: glass, alginate biomaterials, Kapton (polyimide tape),
- Soldering iron and solder for making connections with electrodes
- alligator clamps (to connect the multimeter to the electrode without using hands),
- multimeter (to measure voltage),
- white paper (to work over for contrast in color and to draw a 0.5cm X 0.5cm square as a reference)
- nitrile glove (to prevent fingerprints and oils from getting on nanowires)


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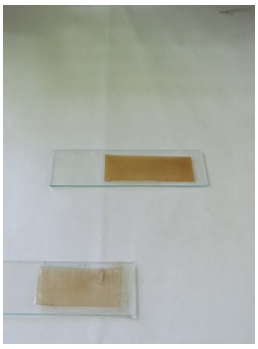
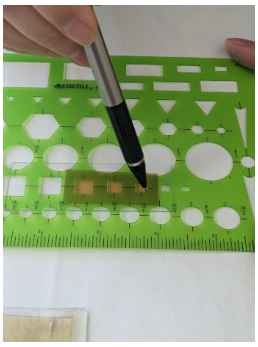
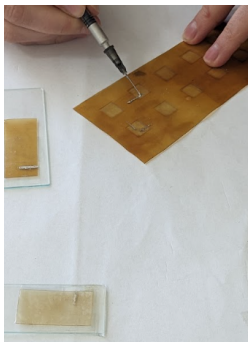
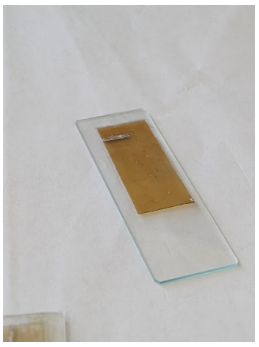



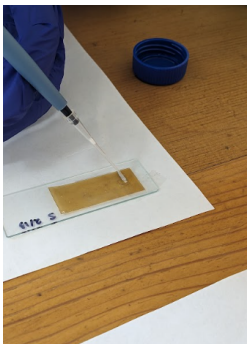

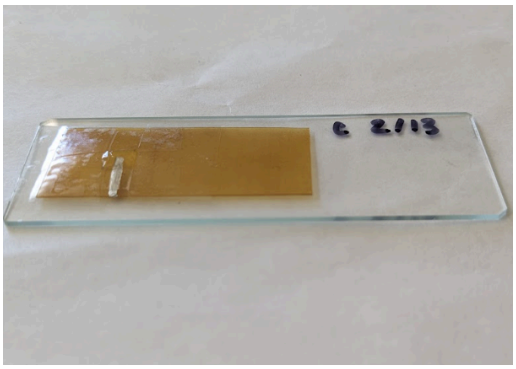

Notes for making the device:

- Softly swirl the solution to more evenly disperse the nanowires, without shaking to avoid potential agglomeration.

Single cells using a variety of substrates:

As per previous devices prototyped by Sequoia, we followed a similar protocol.

Device specifications:

- Silver conductive paint
- Glass slide for documenting and stabilizing the substrate (work surface)
- Substrates tested: paper, alginate, Kapton/polyimide, glass, silicone tape
- E.coli filtered nanowires in a 50ml solution (no concentration available)
- 0.5cm X 0.5cm X thickness not measured as we do not have exact devices to do this
- Pipette was used to add layers in drops of 10ul *drop casting
- Each layer was dried using a laboratory hot plate; the slides were placed on top of a glass petri dish to try not to be placed directly onto the hot plate, which may degrade the nanowires.
- Nanowires are dispersed evenly to all four corners of the “well”
- The top electrode partially covers nanowires

Results:
This produced a higher voltage of 0.028V. The humidity was at 50%.

- Low-functioning device

Discussion:
The measured voltage of 0.028V indicates the device is working, but it is not operating optimally at the desired 0.5 V. The device was no longer short-circuiting and the nanowires were fully exposed to the air. More nanowires could have been added to see if their thickness was the problem, but it seemed wiser to try a second variation of the device design first before wasting the limited supply of nanowires on hand. Besides the nanowire thickness being a potential problem, other factors could still be causing issues. The nanowires used are still older than the ones used in the original device. There was corrosion on the bottom copper electrode where the nanowires were dropped. The liquid nanowires could have slipped between the crack of the

copper electrode and glass that was being sealed by the tape. This seal could have been broken, allowing the nanowires to move outside of the 0.5cm X 0.5cm square. This would dramatically change the thickness of the nanowires. The bottom copper electrode is made by using a piece of copper adhesive tape. It is thin, but not thin enough to keep a proper seal between the tape and glass.

Possible design issues:

- Nanowire film is too thin
- Nanowires are too old
- Corrosion of the copper electrode
- Nanowires could have slipped between the cracks of the bottom electrode tape and glass.