How to make Electroluminescent (EL) Paint!!

by LitMedia on September 1, 2015

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Intro: How to make Electroluminescent (EL) Paint!!

I first came across EL Paint when researching how to make my own EL panels. Lighting is something I really love and the applications for this type of lighting are endless!

This is my first Instructable, it's also very long - so apologies for that!

This project is also VERY EXPENSIVE to get going. Fair warning! ;)

****** I must warn everyone of the following before you begin******

- Ensure you read ALL safety directions and the MSDS (Material Safety Data Sheet) for each chemical prior to using it,

- This project deals with high voltage AC, it is very easy to electrocute yourself if you do not seal the circuits prior to applying power!

- Ensure you use all PPE (personal protective equipment) when handling the paints and chemicals! and,

- Store all chemicals in a safe place, away from children.

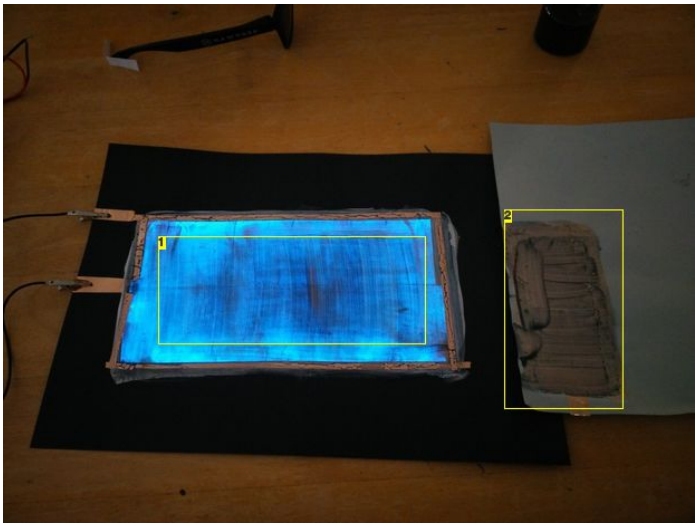
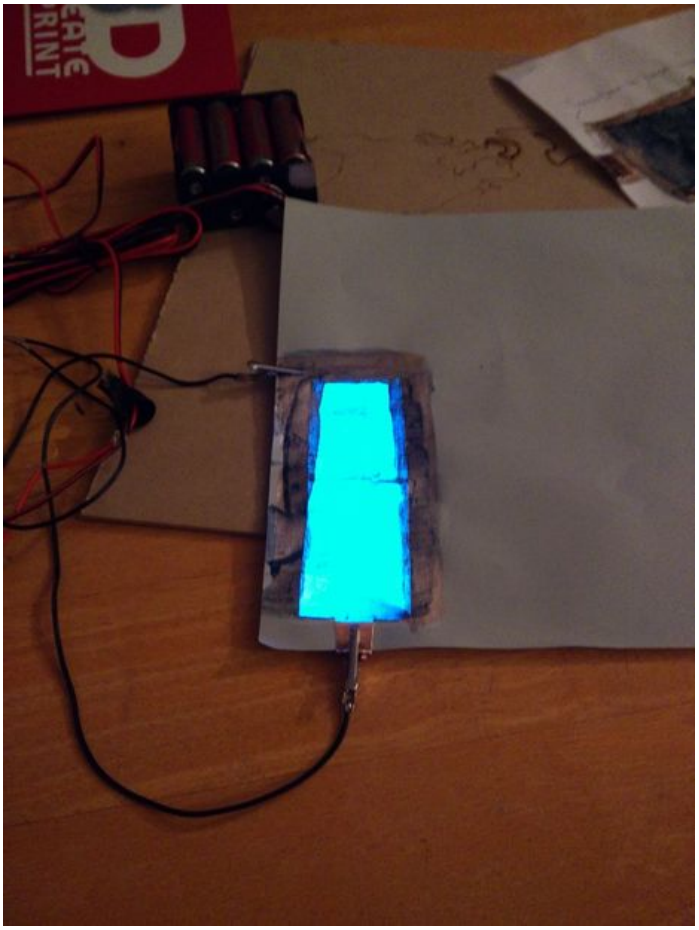


Image Notes
1. This one is still drying :)
2. This is the First iteration. Worked like a dream.



Step 1: What you need to start!

Firstly, you will need the following PPE:

1. Nitrile Gloves - They can be expensive, but are resistant to fair amount of chemicals. (The only exception is that paint thinners will eat them away while you wear them)

2. Particulate Mask - You need these (or equivalent) - the powders in this project can be super fine ~10nm or smaller.

3. Eye protection

4. Emergency eye wash

Please use this equipment!

This is the (non-exhaustive) list of basic equipment you will need: Prices are in $AUD

1. Heat Gun ~$60

2. Multimeter ~10

3. Rotary Tool with stirring attachment (or something that can stir small amounts of paint) - I used a rotary tool modified with a milk frothing attachment. ~$100

4. Paint Brushes x 5 - small to medium size. One for each type of additive plus spares. ~$20

5. DC to AC Inverter - This is what drives your paint! These are cheap and come in many varieties. I suggest using the battery powered versions while you get started -

It's cheaper! ~$5

6. UV Blacklight- To see where you apply the phosphor layer. ~$15

7. Glass Jars - These are to store the paint in once you've mixed the additives. Any glass jar with an airtight lid will work. ~$10

This is a list of the paint and additives you will need: -All ingredients can be substituted to suit your locations and suppliers. Except where is states "cannot be substituted" - this means that type of ingredient must be used.

1. Any clear coat polyurethane paint. Such as clear wood varnish or any single stage automotive acrylic clear coat. Water based polyurethane wood varnish is cheapest and easiest to work with when starting out. All of your additives will be used with this paint. ~$50

2. Electroluminescent Phosphor - **CANNOT BE SUBSTITUTED** This is the supplier I purchased it from. It costs ~$300/KG (for the **non-encapsulated phosphor,** which is the cheapest). If you purchase elsewhere, make sure it isn't photo luminescent. You want the **electroluminescent powder**. The other stuff is glow-in-the-dark powder and won't work! ;)

3. Barium TitanateCANNOT BE SUBSTITUTED - This is the Dielectric additive. ~$80 You can purchase it from any supplier, but it has to be Barium Titanate (BaTiO3).

4. Antimony Tin Oxide (ATO)- This is the electrically conductive additive. Can be substituted with the following materials:

a. Copper Paste - Cheaper and highly conductive, but not transparent enough for the top coat - use as base layer. ~$70

b. PEDOT:PSS - Very expensive. Electrically conductive, easy to use and transparent. ~$700/KG

c. Silver Nano-Wires - Very Expensive. Electrically conductive, easy to use and transparent. ~$990/KG

d. Double sided Copper Tape - Excellent for the base layer, cannot be used for the top layer, or you won't see any light!

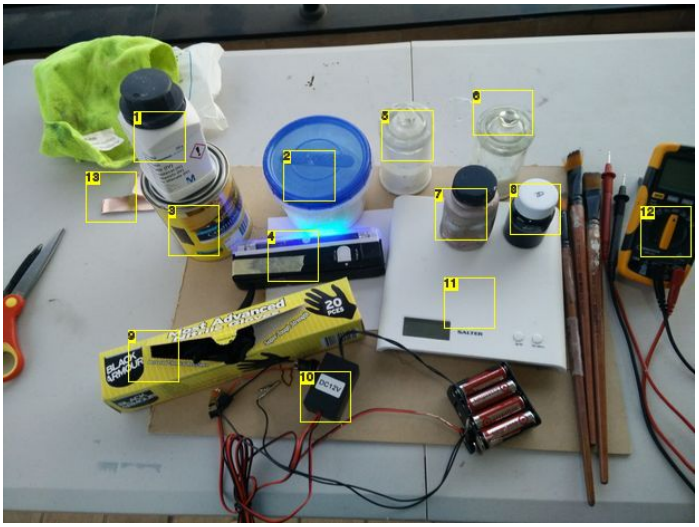


Image Notes
1. Barium Titanate
2. Electroluminescent Phosphor
3. Clear, Water based Varnish
4. UV Blacklight
5. Barium Titanate in varnish
6. EL Phosphor in varnish
7. Copper Paint
8. PEDOT:PSS
9. Nitrile Gloves
10. Inverter
11. Scales
12. Multimeter
13. Double sided copper tape

Image Notes
1. Heat Gun
2. Rotary Tool
3. Milk Frother attachment

Step 2: Getting Started

This instructable will only show you how to make you first EL Lamp on paper with a paint brush. Air brushing/Spray painting and applying this to various substrates such as cars, textiles and wood etc. are more complicated and will not be covered.

The 'functional' EL paint is made up from 5 separate layers of paint with different additives dispersed within. The layers work together to produce light via electroluminescence. (This is a really basic description ;)

The layers are comprised of the following (from base to top coat):

1. Electrically conductive back plane layer

2. Dielectric layer

3. Phosphor layer (Electroluminescent)

4. Electrically conductive clear coat layer

5. Bus Bar

Using this basic construction, this system can be applied to anything from a car to your bedroom walls!

All-in-all, the EL Paint comprises of a number of layers to achieve luminescence. The following directions outline the components and manufacture of each layer for a simple, single layer and single sided EL paint application.

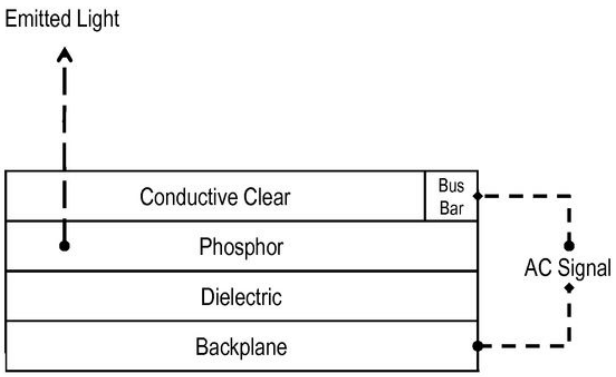
All steps from here are written using the following electrically conductive products:

PEDOT:PSS

Copper Paste

Copper Tape

This is what I decided to work with.



Step 3: Base Conductive Layer

The base conductive layer is applied to the desired substrate - in this case, paper. I use the copper tape or paint as my base layer because they are cheaper than the PEDOT:PSS.

1. Apply a thin, conformal coating of your electrically conductive paint or a layer of your copper tape, as shown in the picture, to the paper. *note: thickness should be no more than 1mm - (if the copper paint is not conformal, it will 'arc' electricity between the ridges in the paint and short circuit your lamp) - Also, if you use copper tape, make sure you smooth it out or it will create ridges in the final product.

2. This base layer should normally form the rough outline of your EL lit field (the area that lights up). You will need to extend a 'tail' out from the square you just painted - this is where the inverter will connect to the base layer.

The following step is only applicable if you chose to use paint as your base layer, not copper tape.

3. Use your heat gun to gently dry the base layer and allow to cool.

** Ensure you don't over heat the paint or cracks will form and it will break the continuity of your lamp, resulting in partial illumination**

4. Test the resistance of the base layer using your multimeter. You need to achieve a resistance of >1ohm over the entire area. The lamp may still work if the resistance is greater, however the light will not be even across the entire area because as the voltage and current drop, so does the light.

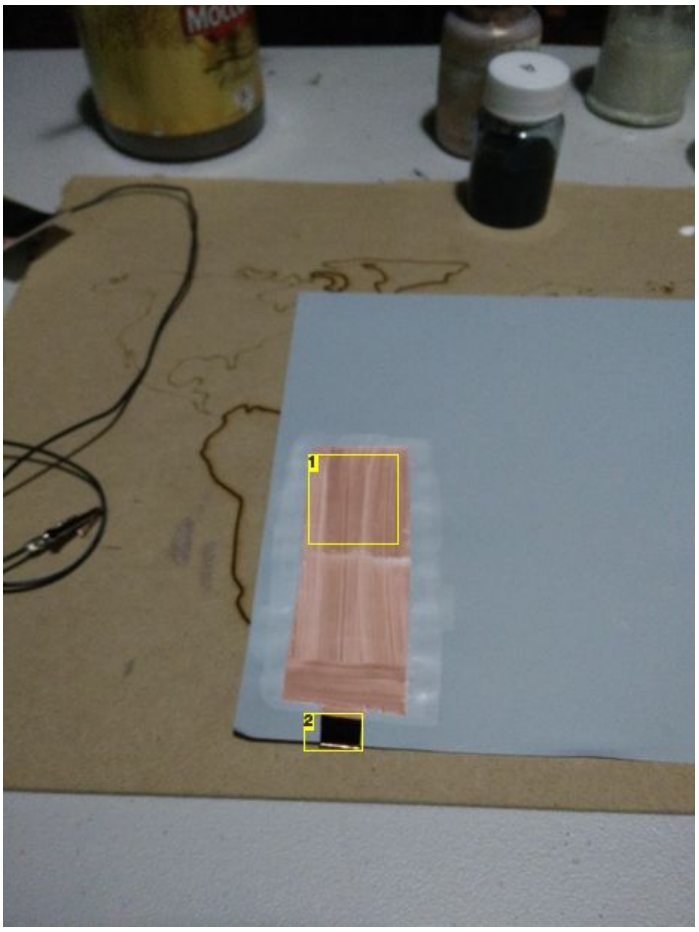


Image Notes
1. The copper tape is the base conductive layer
2. 'Tail' for connecting electrode

Step 4: Apply the insulator

Now we need to insulate the base layer from the phosphor layer and top electrode.

BaTiO3 to Varnish ratio is 19.1g of BaTio3 : 80.9g of Varnish

1. Check the base layer is dry...(if you used the paint)

2. Apply a **thin** coat of the Dielectric paint over the base layer.

3. Ensure that the Dielectric paint extends out, over the edges of the base layer. This ensures it is fully insulated.

4. Do not paint over the 'tail', this needs to have the inverter connected to it.

5. Use your heat gun to gently dry this layer and allow to cool.

** Ensure you don't over heat the paint or cracks will form and it will short circuit the base layer to the phosphor and top electrode layers**

6. Connect your multimeter to the 'tail' and then to the insulated area of the lamp. You should not get a reading - because we insulated it ;)

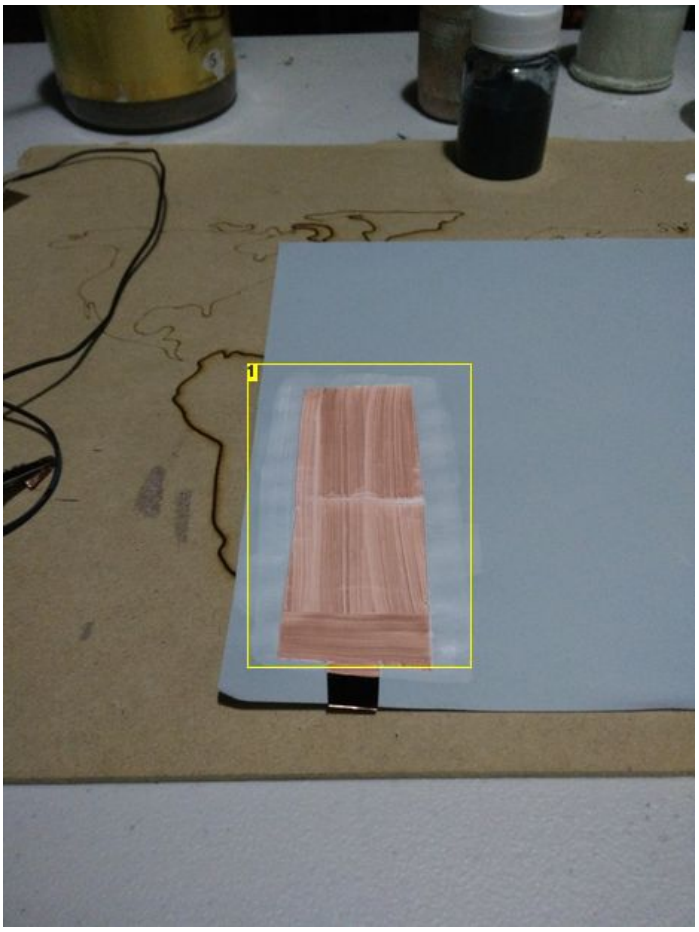


Image Notes
1. You can see the rough outline of the Dielectric layer over the copper tape.
Notice the 'Tail' is not covered.

Step 5: Apply the Phosphor!

This is the fun part ;)

EL Phosphor to Varnish Ratio is 30g of Phosphor : 70g Varnish

1. Prior to applying the layer, you need to re-disperse the EL Phosphor into the varnish. It would have settled quite quickly to the bottom of your container. Use the rotary tool and the UV light to mix and check the dispersion as you go.

2. Check the Dielectric layer is dry....

3. Once suitable dispersed, brush the EL layer onto the Dielectric Layer.

4. Use the UV light to check you achieve an even dispersion across the lit field.

5. Use your heat gun to gently dry this layer and allow to cool.
** Ensure you don't over heat the paint or cracks will form and it will short circuit the base layer to the phosphor and top electrode layers**

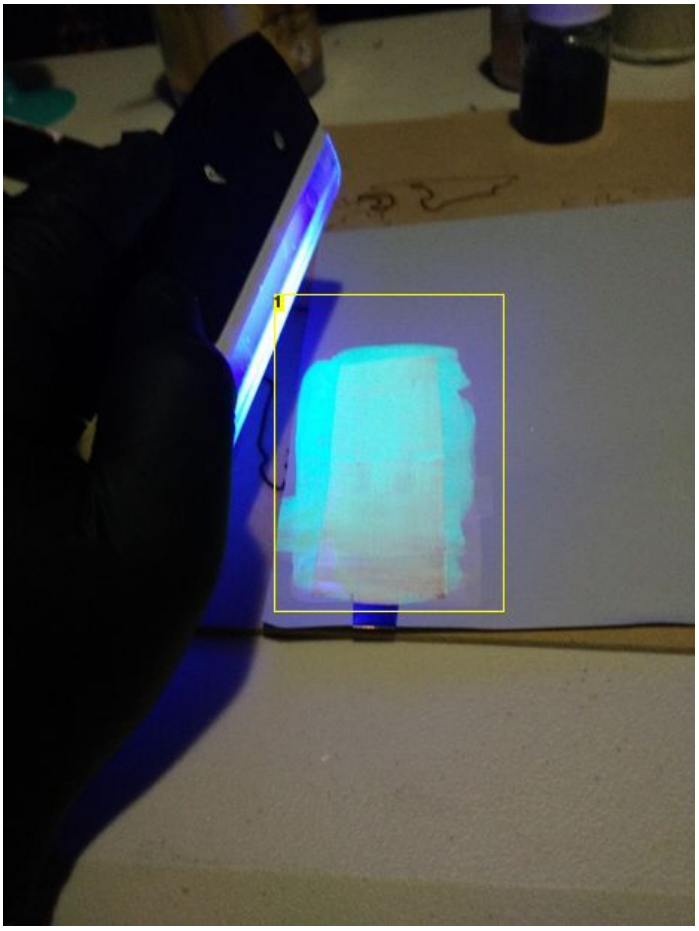


Image Notes
1. Check that the phosphor is conformal and you haven't left any blank areas with your UV light.

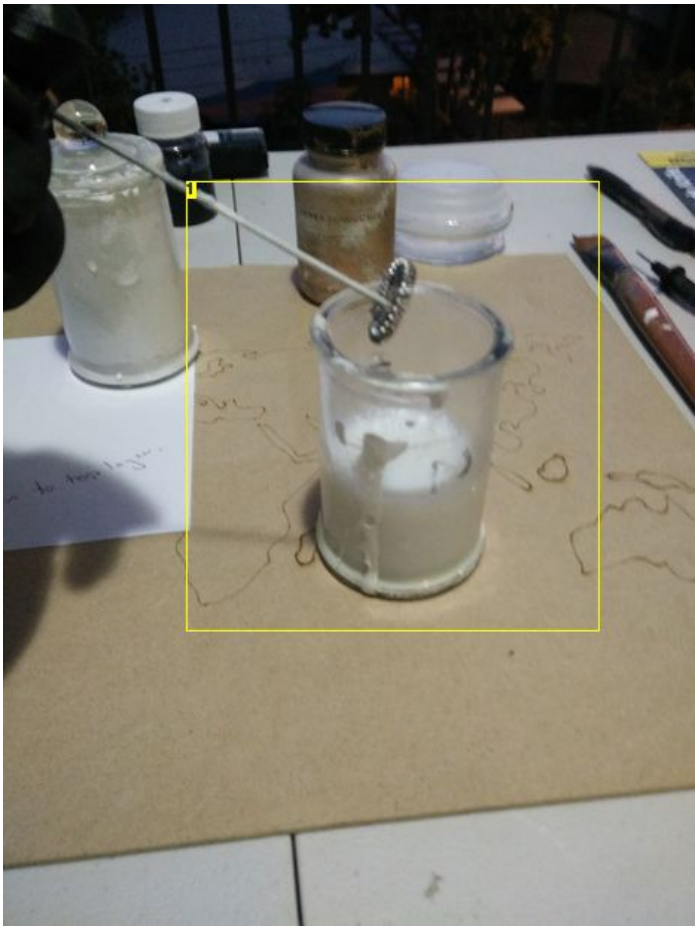


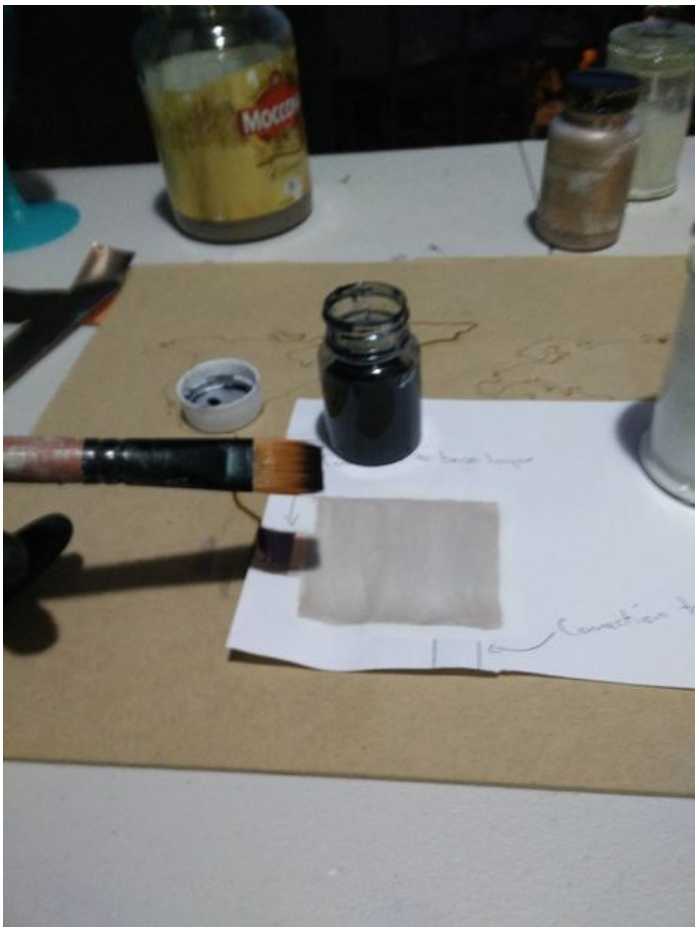
Image Notes
1. Ensure you mix your EL Phosphor fully prior to painting. Check the dispersion with your UV light as you do it.

Step 6: Apply the top electrode layer

Now we apply the top electrode layer. I used the PEDOT:PSS for this as it's transparent and conductive.

1. Ensure the EL layer is dry...

2. Apply the top electrode. Ensure you don't paint over the exposed base electrode layer!! or you will short circuit the panel.
3. Wait until this layer is completely dry before moving onto the next part. I suggest not using the heat gun for PEDOT:PSS. Let it air dry.



Step 7: Apply the bus bar

I applied the bus bar around the edge of the lit field of the lamp. Ensure it doesn't connect with the 'tail' of the base layer or it will short circuit.

The bus bar ensures an even application of electricity around the whole of the lamp.

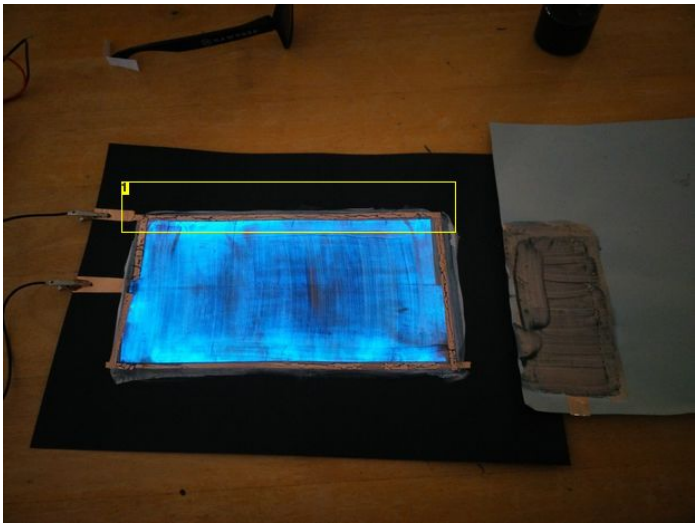
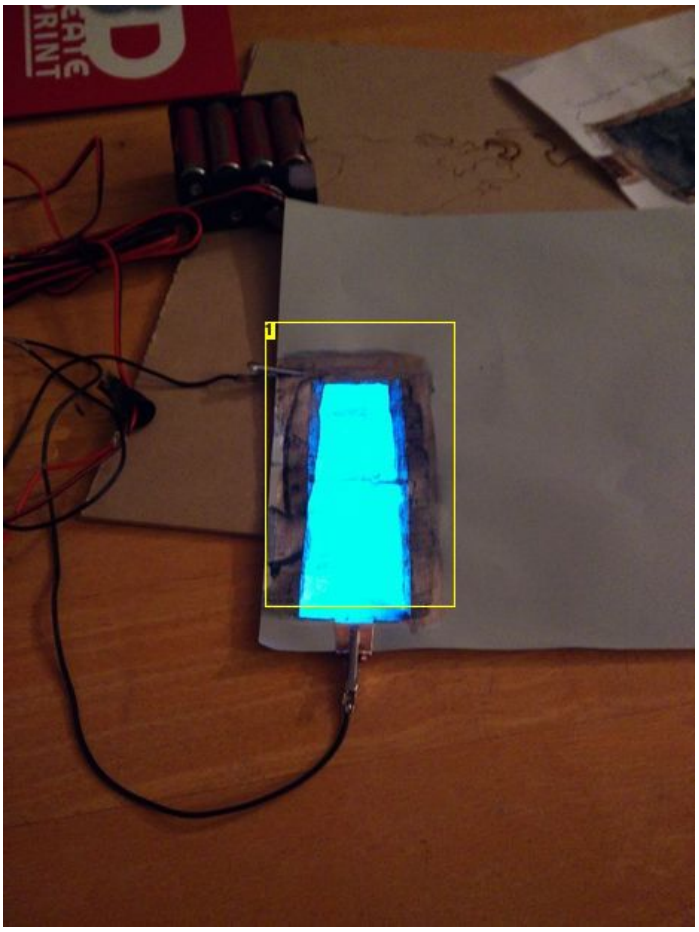


Image Notes
1. This bus bar is made from the copper tape.



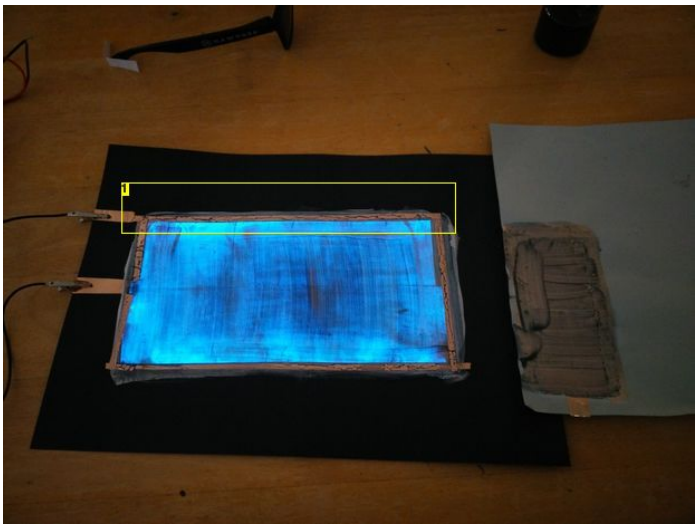


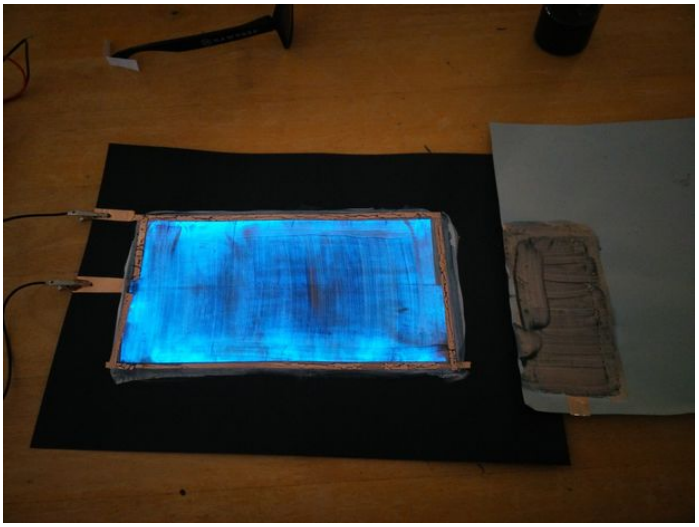
Image Notes
1. The bus bar is the copper paint layer around the edge.

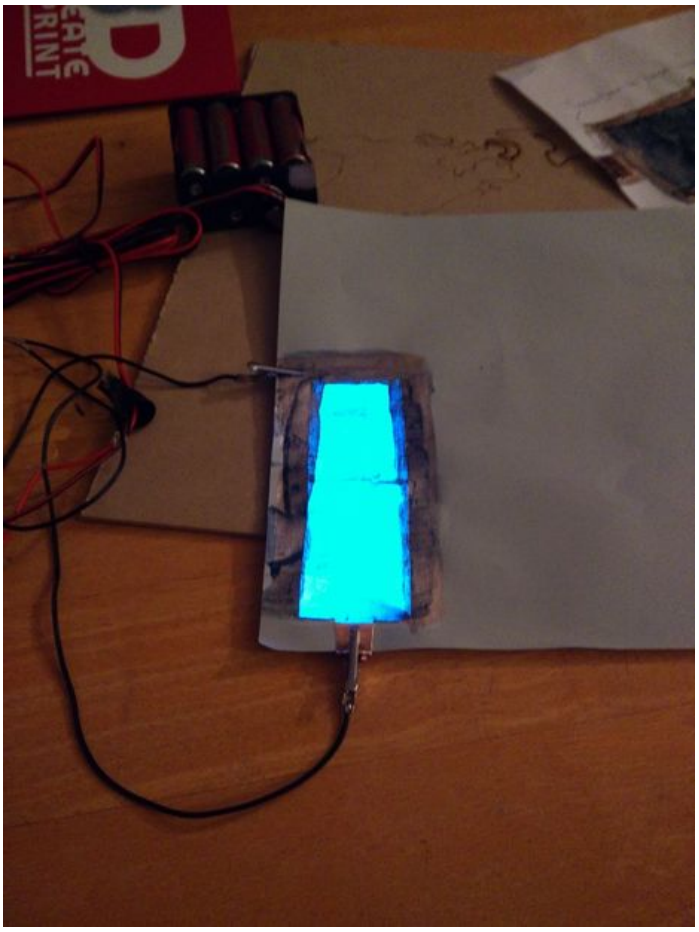
Step 8: Light it Up!!

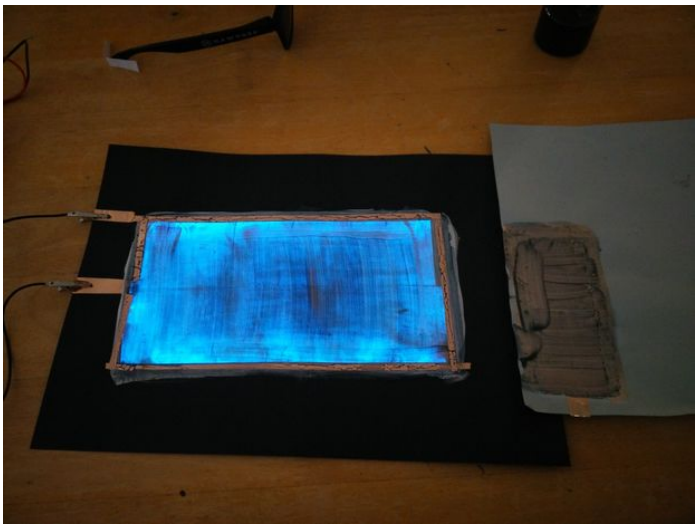
Let the paint dry completely for a while then apply power to your two exposed electrodes.

As I previously said, don't apply power too early or you will cause parts of the lamp to overheat, short circuit and form breaks (internal cracking) in the paint. This breaks the continuity of the lamp and will result in only a small portion of the lamp illuminating.

Please Vote for me in the first time author competition!







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