

Knowledge Product: EL Spray Painting Guide

This guide shows how a designer can spray paint EL inks on curved surfaces. The process is explained step by step. At first, it is explained what we can make. Secondly it is shown what materials you need. Thereafter, guidelines of making a design are shown. Lastly, the most important part of this knowledge product are the guidelines of painting the lamps yourself.

What can we make?

This paragraph shortly explains what an EL Lamp is and what we as designers can do with it

EL Structure & working principle

An electroluminescent lamp is a multilayer structure. A light emitting materials (phosphor layer) and a dielectric layer are sandwiched between two electrodes. One of the electrodes is transparent.

When an AC power supply is connected to the two electrodes (150 volts, 400 Hz) a changing electric field is created. This causes the phosphor layer to emit light.

Schematic drawing lamp

Application of EL

Design

Electroluminescent lamps have many advantages compared to other light sources. The technology creates opportunities for designers. Some of these advantages are listed below.

1. You can light up a surface instead of a fixed spot
2. Printing on different substrates is possible and even flexible lamps can be created
3. The designer is free in creating different shapes and patterns (in 2D and 3D, see figure ...)

Voorbeeld patroon en voorbeeld 3D

4. The lamps are very thin and lightweight
6. The light is non-directional
7. By choosing another type of phosphor paint, you can make other colours (like blue, red, orange etc.).
7. Lastly, the surface does not become hot. People can touch the lamp which creates freedom in interaction design

What do we need?

For spray painting the lamps you need several materials and tools.

Materials

At first you have to buy the paints, which are quite rare. These were bought from Litcoat in the United States. In figure ... you can see the paints. You usually buy a package which includes all four paints: the 1st conductor paint, a dielectric paint, a light emitting paint and the transparent conductor paint

Picture LITCOAT

You also need a primer paint, which you can just buy in a DIY store

Picture primer

Thirdly, you need is vinyl sticker sheets and flexible masking tape

Vinyl +Masking tape

For the power supply you need, an EL inverter, copper tape and wires.

Picture inverter+wires+ copper tape

A curved substrate of your choice. It should be smooth and impermeable for inks.

Tools

The tools you need are a compressor (with a pressure regulator), a paint brush, an oven (better not the same one as you use for your food) and a cutting plotter.

Picture compressor, paint brush, oven, cutting plotter

Practical Stuff

Be sure that you wear a mask and gloves during painting. You need a lot of paper towels and a pipette and spatulas can be handy.

Picture mask & gloves

Creating the design

1. Create an illustrator file of your design

Picture Illustrator drawing

2. Check whether your design meets the following requirements

- a) The bottom conductive layer does not touch the top conductive layer, when the dielectric layer is placed in between
 - b) The phosphor layer does not touch the bottom conductive layer
 - c) The contour of the dielectric layer has an offset of at least 2 mm with respect to the phosphor layer and the conductive layers.
 - d) The bottom conductive layer is not completely covered with the dielectric layer to enable connection with the wires to the inverter

Picture illustrator drawing, all layers on top of each other

3. The choice of your substrate. Make sure that you choose a smooth, non-porous material as your substrate. Suitable substrates which do not require a lot of pre-processing are: Aluminium, Glass, Perspex and Pet.

If you want to use another substrate like 3d printed PLA, you have to make sure that the material surface becomes smooth and impermeable for the paint. This requires sanding and varnishing.

All substrates need to be primed before painting the conductive layer

Picture of the materials I printed on

4. Plot your design. Make sure that you use a flexible (vinyl) sticker sheet. If you don't have a flexible sticker, make sure that you split the sticker parts so that it can be placed over the curved substrate

Picture of the plotting process

Painting Preparation

1. Choose a ventilated room, suitable for spray painting
2. Make sure that your work spot is clean and cover the table to protect it from the paint
3. Connect the compressor and the airbrush and adjust the pressure to 2 Bar
4. Wear gloves and a painting mask when handling the paint

Painting Process

5. Apply primer & leave to dry

Picture Priming

6. Place the sticker of the first layer over the surface, this requires precise work

Picture of the sticker on surface

7. Open areas can be covered with flexible masking tape. Be sure that everything that you do not want to spray is masked

Picture of masking tape

8. Choose the right needle for your airbrush

Picture Airbrush and needles

9. Mix the conductor ink (Litcoat 1), by stirring or shaking the bottle

Shaking the bottle

10. Thin the conductor ink → this is an iterative process, Start with a few droplets of water (you can use a Pipette)

Picture ink and pipette

11. Spray the ink on a test strip. First only water comes out of the brush. If no paint comes out, add . Be careful with how much water you add. Thinning with water means that you have to spray more layers of the conductive ink to cover the whole surface.
12. Spray at a distance of approximately 20 cm.

Picture spray on test strip

13. Make your substrate dirt and dust free

Picture, remove dust

14. Spray the 1st layer. Depending on how much you thinned the inks, you spray 2 or three thin layers.

Spraying (misschien filmpje)

15. Place the painted part in the oven to speed up the drying process. The temperature depends on what kind of substrate you have. You have to choose a safe temperature to prevent that your substrate deforms (e.g. 50 degrees for PLA). Let it dry in the oven for minimally 30 minutes

Oven

16. In the meantime you have to clean the paint brush thoroughly. You can clean the brush with acetone, by putting acetone in the paint glass and spraying it through the brush. Make sure that no conductive ink is left in the brush, because this particles can later cause a short circuit.

Clean the brush

17. Then you repeat step two till twelve for the next layer of paint.
 - a. The next layer is the dielectric layer. It is very important that this layer covers the whole conductive surface, apart from the connection point.

Picture litcoat 2 in bottle

- b. For the phosphor layer, it is advised to use the largest opening of the airbrush and to pay extra attention to mixing the paint. The paint consists of larger particles than the other paints.

Picture litcoat 3

- c. The top conductive layer is very aqueous. For this paint you need a small opening of the airbrush and you need to spray from a larger distance.

Picture litcoat 4

18. When all layers are finished, you can connect the lamp to the power supply. First add to pieces of copper tape to the connection points. This is to prevent that the wires scratch in the conductive layers. Then place the wires with another piece of copper tape on top of it
Picture how to make a connection
19. Switch on the power supply and check if it works!

Kijken of ik er nog 1 aan krijg → als er nog tijd is

Getting familiar with the method: an EL Lamp on a 2D surface

If you never used the paints, make a test lamp on a 2D surface. This is advised to get acquainted with the materials and the way you handle the paint. It hardly ever occurs that your first sample works. So you better not start with a highly complex (large) design on a strongly curved surface.

1. The first design can be for example a square on a PET sheet. (see picture ...)

Picture sample on PET sheet

2. The template can be made from masking tape

Picture with masking tape

3. Exactly follow the painting steps as explained above.
4. When the sample does not work, the trouble shooting guide (Claus, 2016) can be used. This guide was made for screen printing EL lamps, but can also be used for the spray painting method to find the cause of malfunction of the lamp.

There is only one additional factor that influences the functioning of your lamp. Because you have to thin the inks to be able to spray paint them with a paint brush, it can occur that the layer you printed is not covering the whole surface. When this is the case for the phosphor layer, you will see spots instead of a surface that lights up (picture..) When this is the case for one of the conductive layer, you can see that just a part of the surface (or nothing) lights up. When this occurs for your dielectric layer, your sample will not work