# Electroluminescent Materials

GWENT GROUP

ADVANCED MATERIAL SYSTEMS

Part of:-

SunChemical®

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Color & Comfort

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# Electroluminescent Materials Overview.

## Product Range.

GEM's products are based on a unique curing process that results in the low temperature formation of a thermosetting polymer that combines good adhesion to ITO and flexible substrates with excellent chemical, environmental and abrasion resistance. As a result of the improved environmental protection conferred by the inks the working life of most lamps can be improved.

| **Phosphor Inks** | **Product Code Number** |
|---|---|
| Blue/Green Phosphor Ink | **C2061027P13** |
| Green Phosphor Ink | **C2070209P5** |
| Blue Phosphor Ink | **C2061027P15** |
| Orange Phosphor Ink | **C2070126P4** |
| White Phosphor Ink | **C2070126P5** |
| Blue/Green & Blue Phosphor Ink | **C2080211P2** |
| **Insulation/Dielectric Inks** | |
| White Dielectric Ink | **D2070209P6** |
| Pink Dielectric Ink | **D2090130P5** |
| **Conductor Inks** | |
| Carbon Conductor Ink | **C2050503P1** |
| Silver Conductor Ink | **C2131014D3** |
| **Binder Vehicle for Phosphors** | |
| Polymeric Binder | **R2070613P2** |
| **ITO Film** | **F2071018D1** |

# Introduction

Demand for innovative lighting technology has been met with the development of electroluminescent materials. Although luminescent have always been associated with the natural world, recent technological advancements have enabled luminescent materials to become readily available for commercial use.

Why Gwent Electronic Materials?

- Gwent Electronic Materials (GEM) is a major supplier in electrochemical industry. One of our development projects has lead to the creation of an electroluminescent materials range. These materials have been specifically designed to have a variety of applications.

- GEM's background in "polymer thick film inks" means that we have a firm base of organic binder technology and powder dispersion techniques on which to base our formulations.

- GEM supply inks which are required to make electroluminescent lamps by screen printing. These inks are designed to be used without adjustment; if you require specific properties in an EL ink we can tailor inks to your requirements.

GEM also offers a full screen printing service, the combination of our company's extensive experience of screen printing and our electroluminescent range enable us to produce an outstanding finished product.

Gem prides itself on high standards and quality we have obtained:-

# Key features

- Thin, flexible and lightweight.
- Print intricate designs.
- Screen printable.
- Highly resistant to aging and atmospheric effects.
- Perform well under humid conditions.
- Exceptionally low heat generation.
- Resistant to impact and vibration.
- Low power consumption.
- Long life.

# Applications

- ***Electronic equipment***
  Watches
  Toy and games
  Mobiles
  Palm computers
  Remote controls.

- ***Advertisement***
  Safety and animated signs
  Unique lighting.
  Lighting for interior and exterior purposes
  Emergency illumination'
  Backlights.

- ***Architecture and Decorative purposes.***

- ***Customisation of clothes and accessories.***

# Our Electroluminescent Display Materials

**Compatible with**

- ITO sputtered coated polyester film
- Transparent coated flexible substrates.

**Our unique heat curable inks**

- Cross-link at low temperature (130°C) to form coherent coatings.
- Excellent chemical and water resistance.
- Exceptional adhesion.
- Flexibility

**Have high conductivity bus bars, tracking and connections**

Our Silver inks with ITO, PET insulator and dielectric compatibility. Our products exhibit

- Excellent hardness
- Flexibility for display applications.
- Cross-linking inks, which can be used to attach terminals.

**Rear electrodes and for lower cost applications**

- GEM's Carbon ink is suitable for the rear electrode on the surface of the dielectric layer.
- This ensures that possible humidity and migration effects are avoided, this can occur with silver conductors in poorly encapsulated systems in harsh environments.

**To Protect from**

- Humidity and physical effects (by encapsulating it with flexible insulator)

Using the same stable organic system as the insulating material, the dielectric contains dispersed Barium Titanate to form the high dielectric constant layer.
We supply a **complete system** of top of the range Phosphor inks with high brilliance and long life, to push the technology to new limits. The combined use of the latest phosphor technology with our innovative resin technology enhances our system of Electroluminescent Materials.

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# Building Sequence

A polyester film with an indium tin oxide (ITO) spluttered coating or a screen printed translucent ink with good conductivity on a clear base substrate.

The printing of an electroluminescent lamp on polyester consists of:

1. The front **Bus bar**, this is usually a silver ink which needs to be printed and cured. If the design is based using an ITO spluttered polyester the bus bar needs to be printed on the ITO side.

2. **Phosphor** is the next layer which is printed. Depending on the chemistry of the phosphor a range of colours can be emitted. It is vital for this layer to be dispersed evenly across the electrode.

3. **Dielectric** insulator, barium titanate dielectric insulating layer, the thickness of this layer depends on insulating requirements.

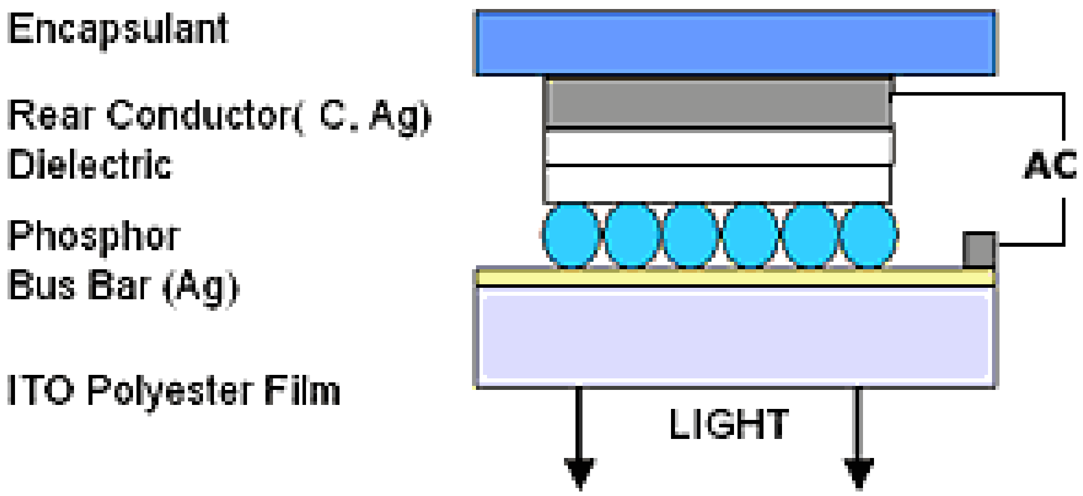
4. **Rear electrode** needs to be printed to match the inner edge of the bus bar, this can be either a silver or a carbon ink.

This sequence can be reduced to four stages, with a careful design we are able to combine printing of the front bus bar and the rear electrode (steps 1 and 4).

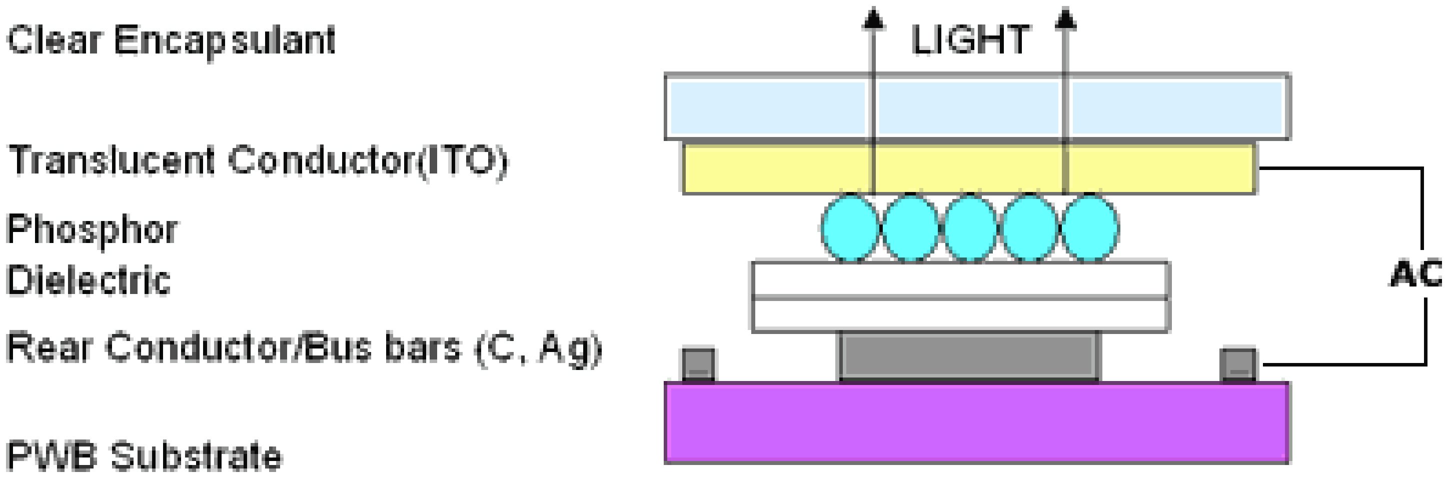
# Typical Constructions

Involves one of the methods outlined below:-

**STANDARD BUILD**

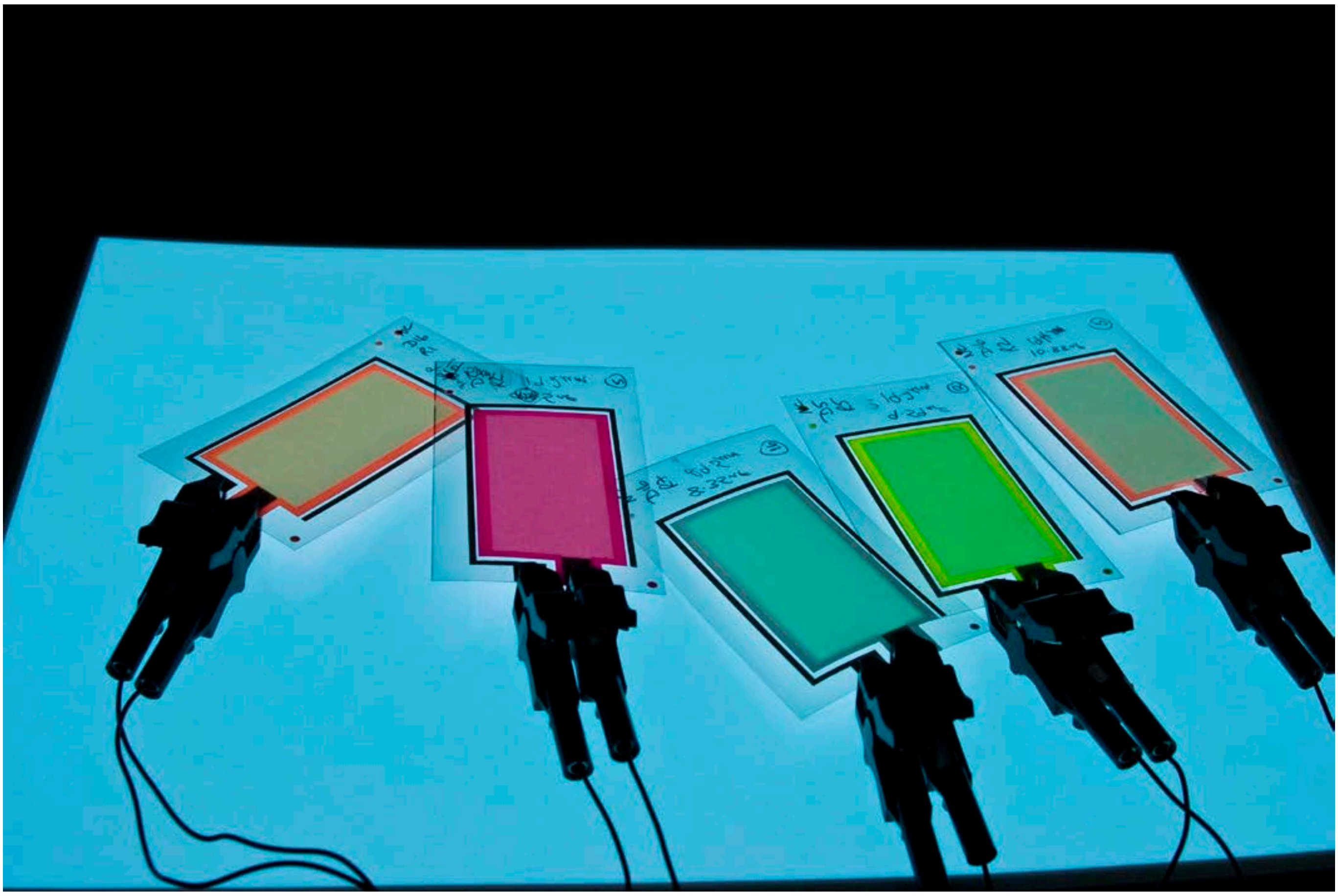



**REVERSE BUILD**



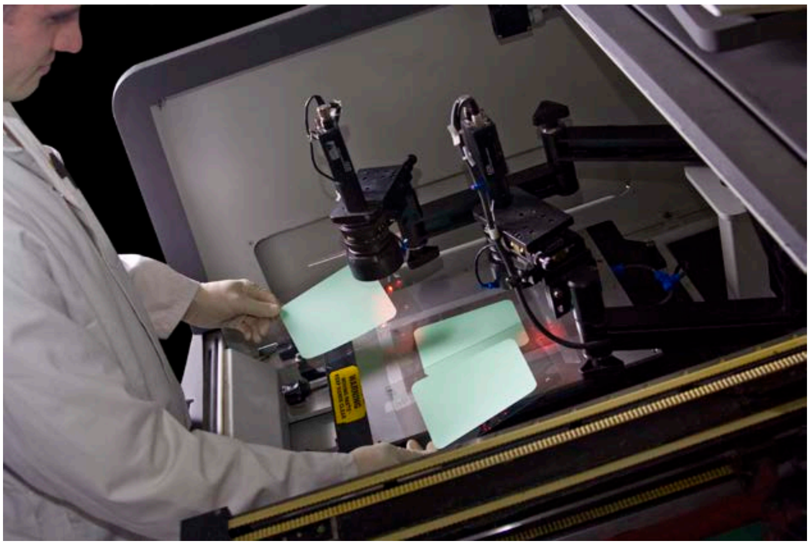
Electroluminescent Inks can be screen printed onto plastic sheets to form illuminated panels. These thin, lightweight panels can be cut and formed into various shapes to give truly flexible illumination. The panels are vibration and impact resistant, generate minimal heat in operation and have low power consumption.

The EL lamps which are formed from these panels are used in a variety of applications including backlighting in portable consumer electronics, telecommunications equipment, instrument panel illumination, information and advertising.



# Electroluminescent Lamps

The EL lamp is a parallel-plate 'lossy capacitor' an active electroluminescent phosphor is embedded in dielectric. Application of an AC voltage to both plates generates a changing field within the active layer, this causes the phosphor to emit light. The EL lamp is constructed from various layers of screen printed Polymer Thick Film ink compositions.



**(Above: EL Lamp using Phosphor Blue C2061027P15)**

- An EL lamp requires 60-250V AC, and frequency range from 50-1000Hz. Brightness of the lamp can be increased by a higher voltage and frequency, however both these will shorten the life of the lamp.

**Typical Operating Voltage**

- 100-120V AC RMS, recommended for most applications.
- 60--250V AC RMS, (minimum – maximum).

Within the operating range, brightness obtained has a close proportional link to the square of the RMS voltage. For example to achieve an approximate quadrupling of the brightness of an EL lamp, you will need to double the RMS voltage.

**Typical Operating Frequency**

- 400-800 Hz, used for most applications.
- 50-5000Hz (minimum – maximum).
- Sine wave is preferred, due to the fact that square wave profiles usually contain harmonics which can shorten the life of the lamp.
- Increasing of frequency will increase the brightness of the lamp and also change the colour to some degree.

If your requirements are outside this range, please contact us for advice as in some applications lamps can operate at higher frequencies.

**DC/AC Inverters**

Luminosity of the EL lamp will decrease with time. DC/AC inverters are most commonly used and have internal rectifiers. When in continuous use the inverter compensates for the loss of luminosity and increase the life of the lamp. Levels of luminosity can be altered via voltage and frequency.

**Useful Life**

The useful life is the time in which it takes the lamp to decline to an unacceptable function level for the specific application it was designed for.

The useful life is not the half life of the lamp. The half life is the time taken for the lamp to decrease to half of its original brightness. Usually the useful life is more than this.

EL lamps decrease in luminosity with time as do all Zinc Sulphide Phosphors. This decrease only occurs during periods of time when the lamp is in use, when in appropriate storage conditions this decrease in luminosity does not occur.

The Useful life of an EL lamp is dependent on the ambient lighting conditions, the finished product, minimum brightness for application, power available

The useful life of EL lamps ranges from a few thousand to 50,000 hours

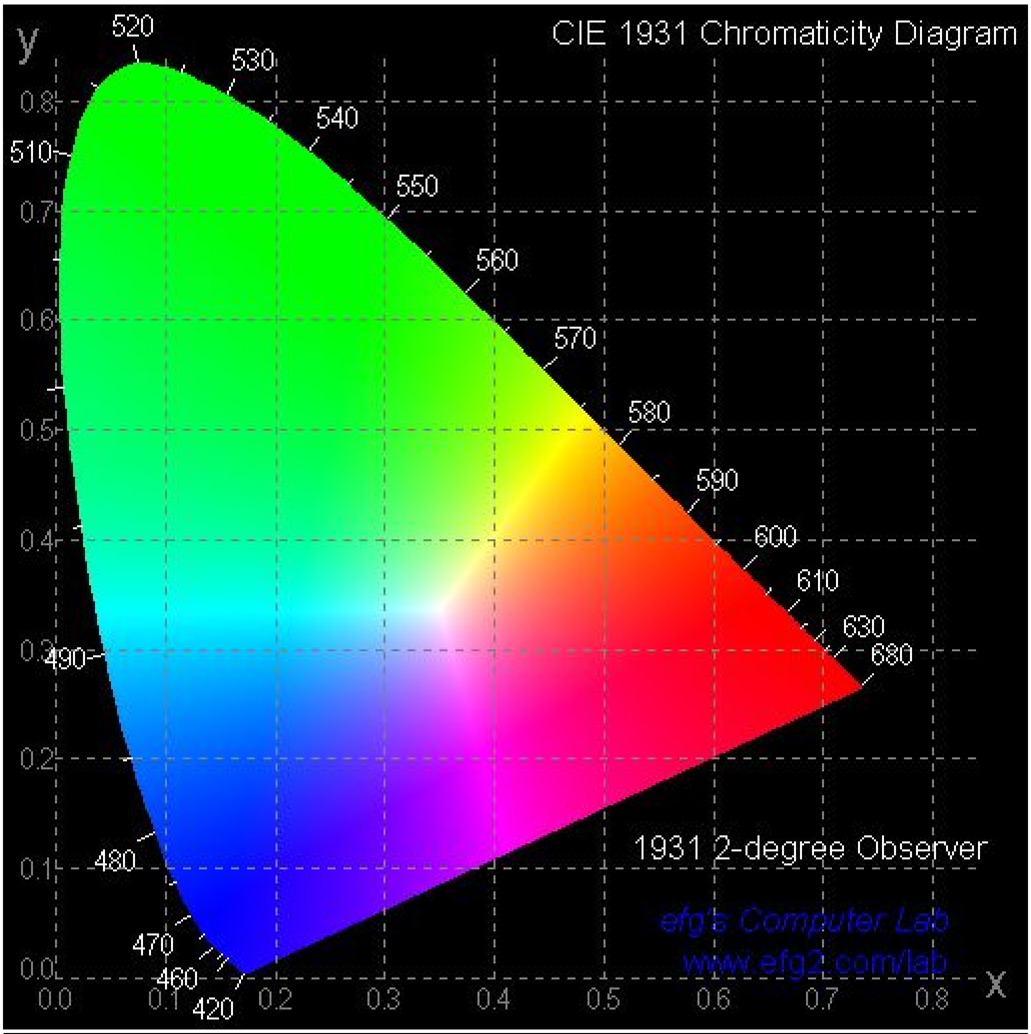
Different colours of EL Lamps will have different decay patterns. Higher levels of brightness produce a steeper decay curve, than those with an initial level of lower brightness.

Turning on and off an EL lamp has no adverse effects.

Load responsive responses, can increase the usefulness of an EL lamp. Changes caused by aging of EL lamps cause the inverter's output of voltage and frequency to rise thus increasing the lamps brightness.

# Colour

Our ink colours are defined based on the CIE colour system. The CIE colour system provides a base for standard observers of the colour. As demonstrated by the graph we have the ability to produce a multitude of colours.



# Design Notes

The thickness of each design layer is crucial to the performance of EL lamps. Therefore, thickness must be maintained with extreme precision.
When the EL lamp is designed for out door use supplementary protection against UV and moisture are essential.
Once the final product had been made a protective lamination or a protective screen-printed layer should be used.

**For larger areas**;

To provide increased illumination a silver bus bar should be printed around the perimeter.
The rear electrode, if you wish to use carbon it produces a resistance which is too high, therefore an overprint of a silver grid must be used.

# Processing

**Storage**

GEM's electroluminescent inks may be stores in a stable environment at 20°C for 3 months to increase the life of the inks store at 5°C for up to 6 months, store with the lids tightly sealed. Storage above or below these temperatures is not recommended, as irreparable damage to the inks may occur. Jar rolling of the Phosphor ink is recommended at 2-5rpm due to settling during storage. For the Carbon, Silver and Dielectric inks, rolling of the jars is not advised due to the possible changes in rheology.

**Handling**

GEM's inks should be mixed before use. For best results stir at a slow pace for 1-2 minutes this will ensure complete homogeneity. Please note if the Phosphor inks are stirred vigorous it is likely that the micro-encapsulation will be damaged. Thinning of inks is not usually required as inks are designed for screen printing.

**Printing**

The container and ink should be within the boundaries of the optimum temperature before printing commences. GEM's inks should be printed between 20 - 30 °C for optimum results.

# Screen Printing Parameters

| Product | Polyester Mesh | Thickness (μm) Dried | Coverage ($cm^2$/g ink) |
|---|---|---|---|
| Phosphor Inks | 156 | 35 | 160 |
| Silver Ink C2131014D3 | 156 | 10 | 300 |
| Dielectric Ink D2070209P6 One layer | 156 | 13.0 | One layer 230 |
| Dielectric Ink D2070209P6 Two layers | 156 | 20.0 | Two layers 152 |

**Drying**

Inks are designed to dry in an oven or on a belt dryer.

**Test Strips**

It is suggested that test strips are used during the construction process of EL lamps. This will enable monitoring and enable the checking of consistency. Furthermore this may aid the identification of faults.

# Lamp Luminescence Data using Standard Build

## Measured at 100V 400Hz

| Phosphor Ink | Colour | Lux | x co-ordinates | y co-ordinates |
|---|---|---|---|---|
| C2070126P5 | White | 85.87 | 0.3746 | 0.4661 |
| C2070126P4 | Orange | 45.97 | 0.5224 | 0.4304 |
| C2070209P5 | Green | 187.17 | 0.1710 | 0.4705 |
| C2061027P13 | Blue/Green | 168.97 | 0.1610 | 0.3743 |
| C2061027P15 | Blue | 121.65 | 0.1515 | 0.2063 |
| *C2080211P2 | White/Pink | 153.60 | 0.2264 | 0.3987 |

## Measured at 137V 800Hz

| Phosphor Ink | Colour | Lux | x co-ordinates | y co-ordinates |
|---|---|---|---|---|
| C2070126P5 | White | 240.08 | 0.3177 | 0.3373 |
| C2070126P4 | Orange | 147.55 | 0.5460 | 0.4509 |
| C2070209P5 | Green | 490.74 | 0.1771 | 0.3700 |
| C2061027P13 | Blue/Green | 417.08 | 0.1574 | 0.2758 |
| C2061027P15 | Blue | 317.76 | 0.1543 | 0.1678 |
| *C2080211P2 | White/Pink | 391.71 | 0.2142 | 0.3013 |

***White/Pink lamp is made by using Phosphor ink C2080211P2 and following standard build but using a single layer of D2070209P6 white Dielectric and a single layer of D2090130P5 Pink Dielectric.**

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