

Mittels Siebdruck hergestellte Elektrolumineszenz-Panels



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Introduction

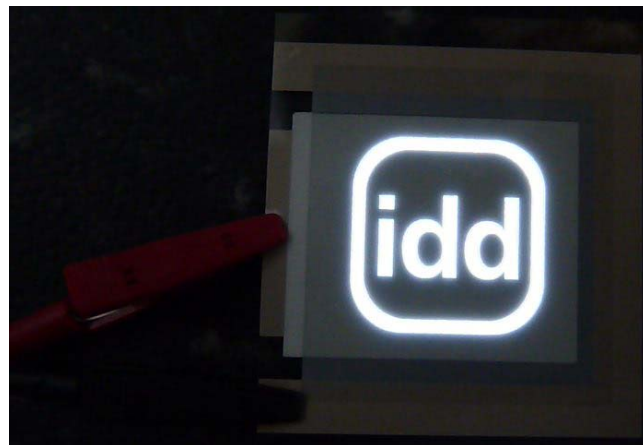
- Electroluminescence known for a long time
- Main research by Destriau in 1960s
- Today: commercially available printing paste systems
- Current application of electroluminescent devices:
 - Automotive and aviation (cockpit background illumination)
 - Background illumination of mobile phones or LCDs
 - Lighting panels
 - Lighting wire
 - Advertising



Source: Schreiner VarioLight

Functional Principle

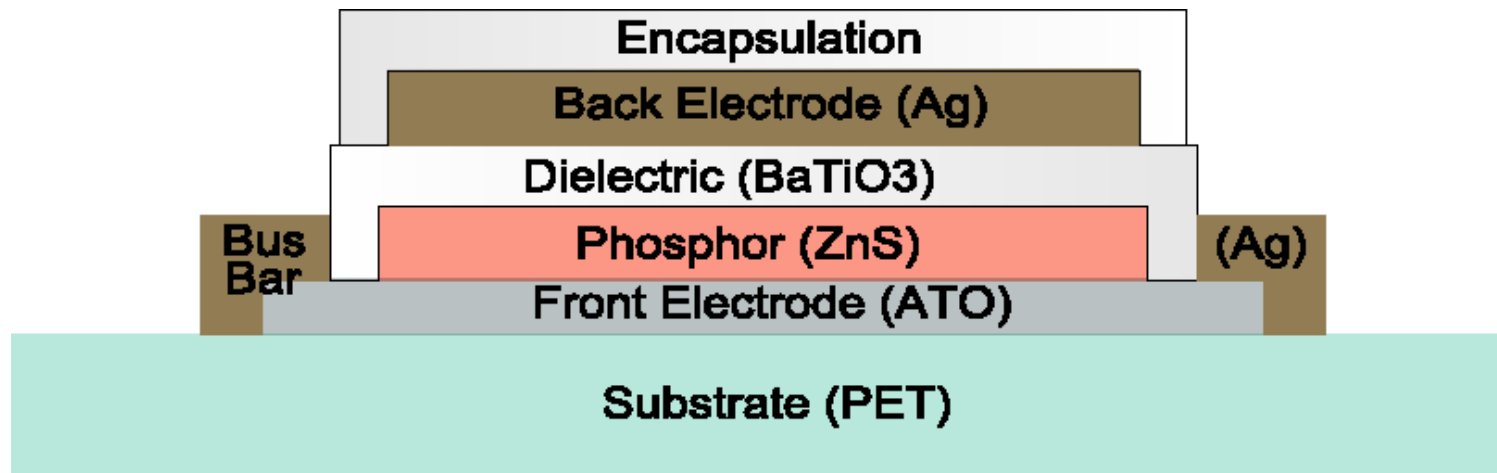
- Light emitting capacitor
- Application of AC voltage
 - Phosphor particles are excited and exhibit light
- Common driving parameters
 - Voltage: 130 V AC
 - Frequency: 700 Hz





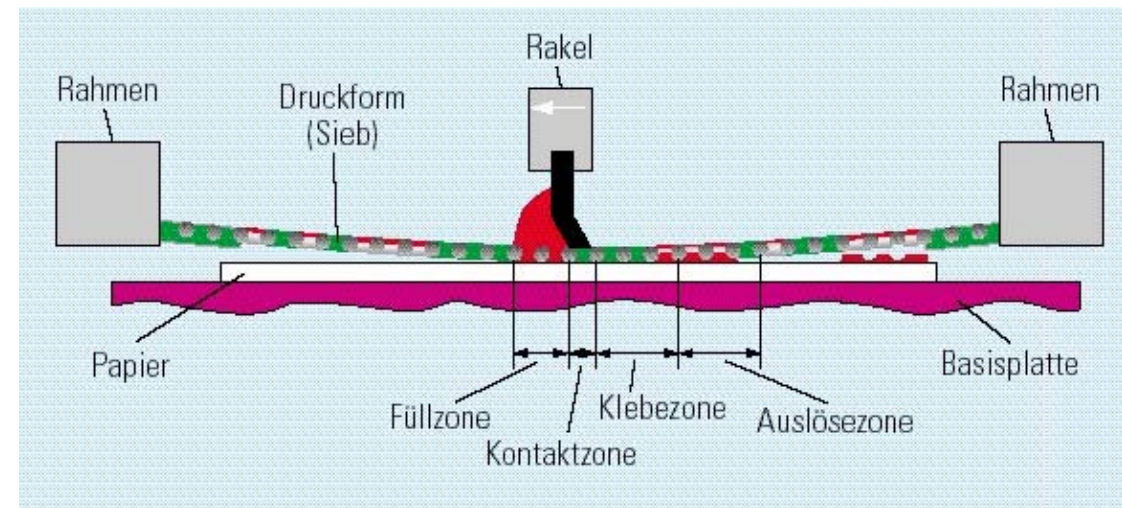
Structure of Layers

- Substrate - PET film or paper
- Transparent Electrode - ATO (Antimon Tin Oxide)
- Phosphor - ZnS (Zink Sulfide) doped with Copper, Manganese or rare earths
- Dielectric - BaTiO_3 (Barium Titanate)
- Back Electrode - Silver
- Encapsulation - Varnish



Fabrication

- Materials: DuPont LuxPrint-Series
- Process: Screen printing
 - Machine: Werner Kamann GmbH
 - Squeegee: Shore hardness 75°, 85° (Ag) resp.
 - Blade angle: 70°
 - Printing speed: 0,25 m/s
- Drying: 130 °C, 15 min



Source: Kipphan, H.: Handbuch der Printmedien. Heidelberg: Springer Verlag 2000

Benefits vs. Drawbacks

Benefits

- Slim structure
- Dazzle-free illumination
- Easy fabrication with standard technologies (e. g. screen printing)
- No significant heat production
- Robuste
- Flexible



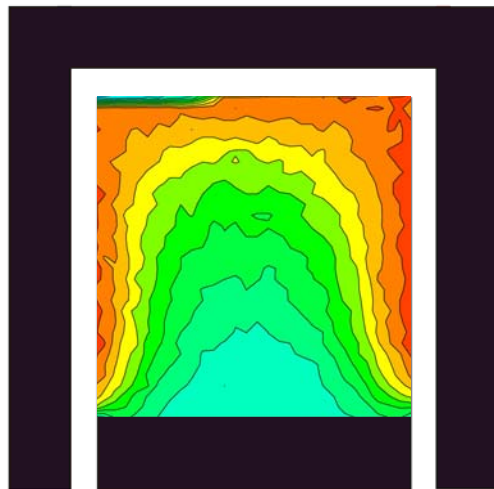
Drawbacks

- High operation voltage required (of order of 100 V)
- Non-optimized panel design → inhomogeneous brightness distribution
- Clearly audible noise (high pitch)

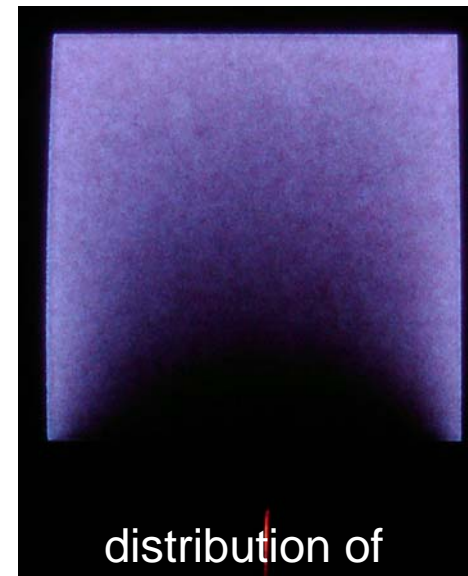
Source: <http://www.ecolightfx.com/portfolio/images/Backlit%20EL%20Panel.gif>

Electrical Model I

- Irregular distribution of voltage over area of EL-panel caused by:
 - Difference of conductivity between front and back electrode
 - Panel design (u-shaped contact bar surrounding front electrode)
- Result: darkening towards the center of an EL-panel by application of higher frequencies



uneven distribution of voltage
(scheme)



distribution of
brightness

Electrical Model II – Ways to Improve the Performance

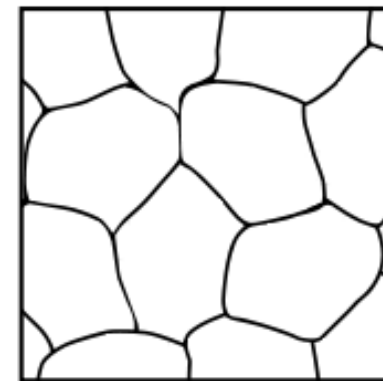
- Reduction of operation frequency

Drawbacks:

- Noises in audible ranges
- Higher voltage necessary

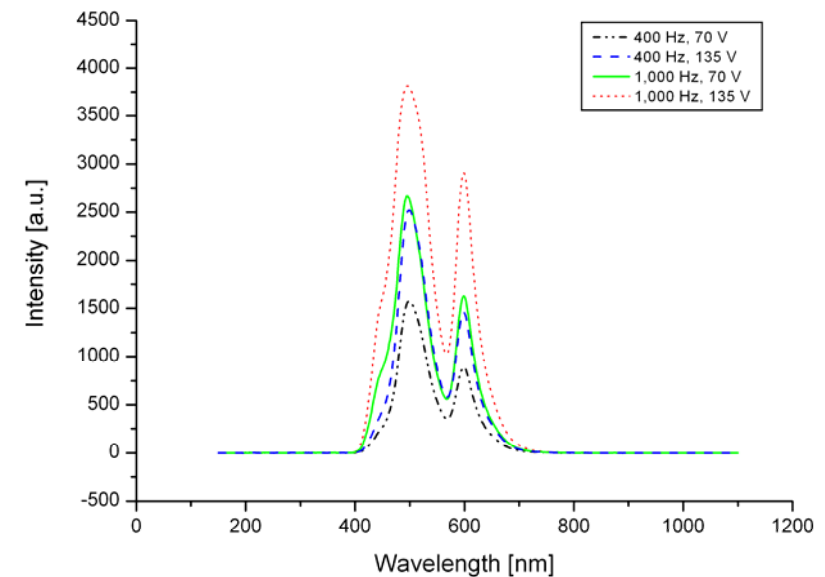
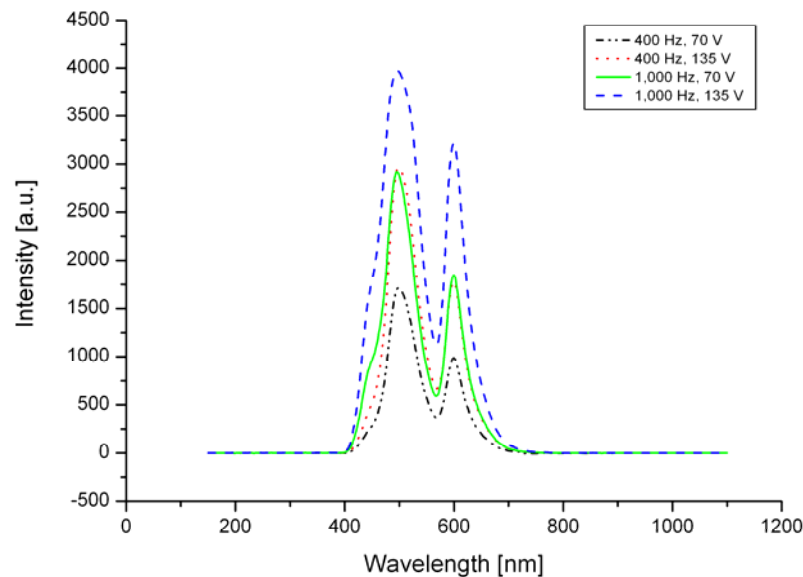
- Increase of sheet conductivity of the transparent electrode

- Other materials as e. g. ITO (vapor deposited on to substrate) or PEDOT:PSS (research in progress)
- Highly conductive support structure
 - Honeycomb or irregular grid
 - Very thin lines



Electrical Properties of the EL Device

- Reduction of driving voltage by increase of frequency
- No loss of brightness (intensity)
- Only applicable for:
 - Small panels
 - Panels with highly conductive transparent electrode



Thank You for Your Attention



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An Investigation of the screen printing process for electroluminescent panels and the influence of printing and operation parameters on the performance of the panels
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