Electroluminescent light sources
**Electroluminescent light sources**

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<th>History</th>
<th>1936</th>
<th>Electroluminescence discovered by G. Destriau</th>
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<td>1950</td>
<td>First scientific research (ITO)</td>
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<tr>
<td>early 1960’s</td>
<td>Scientific focus on TF-EL</td>
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<td>1967</td>
<td>Enhanced efficiency due to 2 insulating layers</td>
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<td>1980’s</td>
<td>Application in monochromatic displays</td>
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<td>Today</td>
<td>Research on EL TV technology</td>
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**Tunneling**

Phenomenon illustrated by the „particle-in-the-box“ model

- Particle in the box does not obey Heisenberg’s Uncertainty principle
  - Simultaneously determined: position and velocity
- Particle can „leave“ the box
### Electroluminescent light sources

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#### Luminescence

- light emission in non thermal equilibrium
- LED vs. incandescent bulb
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Working principle

- Phosphor particle (ZnS:Mn)
- Electrodes
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Working principle

ACTFEL

History

Fundamental Terms

Working Principle

Production

Materials

Applications
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Working principle

OLED Structure
- Cathode
- Emissive Layer (Organic Molecules or Polymers)
- Conductive Layer (Organic Molecules or Polymers)
- Anode
- Substrate
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Atomic layer deposition

1) Exposure of the first precursor
2) Purge or evacuation of the reaction chamber
3) Exposure of the second precursor
4) Purge or evacuation of the reaction chamber
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Atomic layer deposition

Reacting chamber
Atomic layer deposition

- Adjusted parameters like interaction time or temperature are element depending
- Time for one cycle round about 0.5 sec
- Layer thickness of 0.1 nm - 3.0 nm per cycle
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Sputtering

- releasing of atoms through electron bombardement

![Diagram showing the sputtering process with labels for Target atom, Target (Cathode), Plasma, Gas inlet, Deposited layer (Anode), and Ar.]
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Doctor blade coating

- Applying a paste via a template
- space resolved applying possible
- just drying after printing process
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Materials

Substrate

- good transmission
- high electric resistance
- stable against H₂O and O₂

→ PMMA, PC, special silicate glasses
**Materials**

**Electrodes**

- good electric conductivity
- good adhesion to the insulator
- has to be stable up to $10^8 \text{ V/m}$
- good transmission (vis)

⇒ ITO, Aluminium, Polymers
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Materials

ITO

• very good electrical conductivity, very transparent

• consists of 90% In$_2$O$_3$ and 10% SnO$_2$
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Materials

Insulating layers

- wide band gap
- high penetration voltage
- free of defects
- high dielectric constant

⇒ Al₂O₃, AlOₓNᵧ, BaTiO₃, SrTiO₃
**Materials**

**Phosphors**

- high luminescent density
- high quantum efficiency
- good colour saturation
- good chemical stability

⇒ ZnS:Mn, ZnS:Tb, CaS:Eu, CaS:Ce, SrS:Ce
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Applications

- Displays (OLEDs, LED LCD)
- Backlighting
- Decorative elements
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