Objective

• Demonstrate that Coated Trichromatic (RGB) Phosphors with ZnO using ALD methods improve efficiency, lifetime, good spectrum, thermal and electrical conductivity of commercial phosphors and white-mixture of phosphor for Field Emission display and lighting sources

Atomic Layer Deposition

CL Phosphor
Arrangement of particles (nm-μm), under irradiation or stimulation from electrons beam, emit cathodoluminescent light (CL)

Phosphor spectrum & chromatic visions
Contrary to popular belief, “color” is not really an intrinsic property of the things we see around us. Rather, it is the sensation resulting from a given spectral distribution of light, detected by the three color-sensors in the eye and interpreted by the brain.

1931 CIE Chromaticity diagram
The chromaticity diagram plots the entire gamut of human-perceivable colours by their co-ordinates defined in terms of X, Y and Z

Limitation of conventional phosphor coating
• Surface defects-Trapping centers
• Poor electrical conductivity
• Poor thermal dissipation due to phosphor excess stored heat (phonons)
• Use of non-luminescence binders for adherence
• Poor electrical conductivity
• Results:
  • diminished efficacy
  • diminished lifetime
  • Poor Color quality

ZnO coating layer too thick and defective causing electron charge-up of phosphor & Poor Heat dissipation
Phosphor aging (coulomb aging) due to high power density
Contamination of phosphors:
  • O₂ forms recombination center (Ag-O) in ZnS particles which gives rise to additional luminescence band on the long-wavelength side of the main blue band of Ag Cl pair recombination centers.

Phosphor degradation
The spectrum content shift

Plankian Spectral Standards
Incandescent “Soft- light” (3500K) very inefficient: most of wavelength in IR spectrum
Natural-light daylight (5500K): best acuity & minimal eye fatigue

Unavoidable Loss mechanisms
1. Energy conversion from an electron flood to light emission
2. Degradation of phosphor efficacy due to heat
3. Loss of efficacy due to over charging on the phosphor materials
4. Capture of the electron source current by non-luminescent materials
5. Non-luminescent electronic processes in the phosphors
6. Loss due to non-optimizing screening techniques

Poor Phosphor Efficacy
Conductivity increases as the coating thickness is reduced

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