Contribution ID: **188** Type: **Oral Presentation**

Low voltage electron beam induced degradation and surface chemical changes of Zn3(PO4)2:Tb phosphor

Wednesday, 13 July 2011 15:00 (15 minutes)

<p>The investigation of low voltage electron induced cathodoluminescence (CL) degradation of Zn3(PO4)2:Tb phosphor has been extended for possible application in low voltage field emission displays (FED). There are two important reasons for studying phosphate based phosphors. These are their chemical, thermal stability and variation in emission colour, which is influenced by the site occupied by the light emitting cations. The CL degradation phenomenon under low voltage electron beam irradiation of Zn3(PO4)2 has however not been reported so far. The primary objective of this study was to investigate the correlation between the CL emission intensity, CL degradation behaviour and the changes on the surface chemistry from the Zn3(PO4)2:Tb phosphor after prolonged electron beam exposure. The Zn3(PO4)2:Tb3+ phosphors was synthesized by a sol-gel combustion method. The surface chemical reactions and influence on the CL intensity induced by a prolonged electron beam bombardment were monitored using in situ Auger electron spectroscopy (AES) combined with CL spectroscopy. The chemical state of the surface before and after prolonged electron exposure of Zn3(PO4)2:Tb3+ phosphor to electron beam was determined using X-ray photoelectron spectroscopy (XPS). The bluish green CL emission that were obtained with minor emission peaks at 380, 420, 440 nm were due to the transition from excited level 5D3 ⟶ 7F6, 7F5, and 7F4 levels of Tb3+ ions, while the peaks at 490, 542, 584 and 620 nm were due to 5D4 ⟶ 7F6,5,4,3 transitions when the powders were irradiated with a 2 keV and 10 uA electron beam. AES data suggested that the Tb3+ CL intensity decreases with an increase in the electron dose rate. The XPS data suggested that a thermodynamically stable ZnO and P2O5 layer formed on the surface as a result of the electron stimulated surface chemical reactions (ESSCRs). The continues growth of this layer is contributing to the continues CL degradation of the Zn3(PO4)2:Tb phosphor.

Level (Hons, MSc,
   PhD, other)?

Post Doc

Consider for a student
   award (Yes / No)?

yes

Would you like to
 submit a short paper
 for the Conference
 Proceedings (Yes / No)?

Yes

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Session Classification: CMPMS1

Track Classification: Track A - Condensed Matter Physics and Material Science