# $Tb^{3+}$ Activated Green Phosphors for PDP Applications

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The plasma display panel (PDP) as a medium of large format (60+") TV is gaining attention due to the high performance and scalability. The performance and lifetime of a PDP is strongly related to the nature of phosphors and their resistance to energetic discharge ions, electrons, and solarization from VUV arising from Xe/Ne gas discharge. Lifetime and persistence are main concerns in case of green phosphor. Efforts are being made to develop better phosphor and replace the existing $ZnSiO_4$:Mn phosphor (1,2). The preparation and characterization of terbium activated yttrium, gadolinium borate ($YBO_3:Tb^{3+}$ and Y,Gd$BO_3:Tb^{3+}$) and lanthanum, yttrium phosphate ($YPO_4:Tb^{3+}$ and $LaPO_4:Tb^{3+}$) are presented in this paper. The morphology of borate and phosphate phosphors is much superior to zinc silicate phosphors. Particle shape and size of typical silicate, borate and phosphate phosphors are studied with the help of SEM (Fig.1). The emission spectra of silicate and borate phosphors are shown in Fig.2. The relative intensity is very high in case of borate phosphor when compared to silicate phosphor. In addition to a sharp peak in the green region, there is a small peak (doublet) in the blue region. Using suitable optical filter one can eliminate the blue emission. In spite of high quantum efficiency, zinc silicate green has a serious problem because of higher persistence (>10ms). The persistence (10%) of $Tb^{3+}$ activated phosphors is in range of 8 to 10 ms, required for typical TV operation. Borate based green phosphor improved the uniformity of discharge characteristics in AC PDPs (3). 42" AC PDPs were made with conventional zinc silicate and Tb activated yttrium, gadolinium borate phosphors at Plasmaco and studied the optical characteristics as well as lifetime were studied over two years of continuous operation. The life data reveal that borate base phosphor is very stable. Some of data related to morphology, and luminescence characteristics $ZnSiO_4:Mn^{+}$ (ZNS), $YBO_3:Tb^{3+}$ (YB), $(Y,Gd)BO_3:Tb^{3+}$(YGB), $LaPO_4:Tb^{3+}$ (LP) and $YPO_4:Tb^{3+}$ (YP) are shown in Table 1. To over come the blue peak and take advantage of higher lifetime of yttrium borate, Matsushita is using a blend of zinc silicate and yttrium borate phosphor in the manufacturing of large area PDPs.

References:
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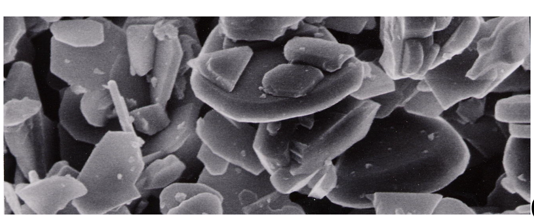
3. H.Tachibana, et. al. Proc. IDW'00 (2000) pp651.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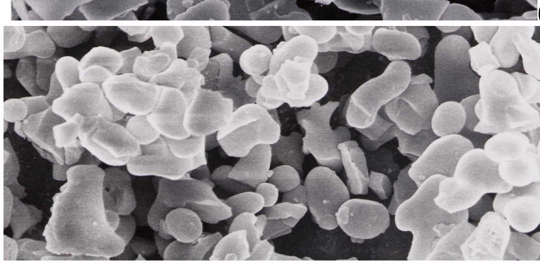
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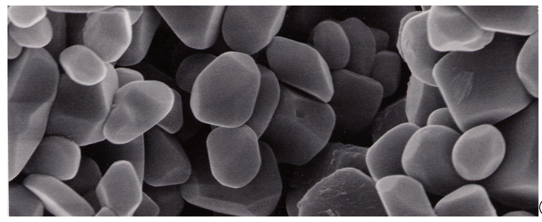
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Fig. 1 Scanning Electron Micrographs of (a) zinc silicate, (b) yttrium borate and (c) lanthanum phosphate

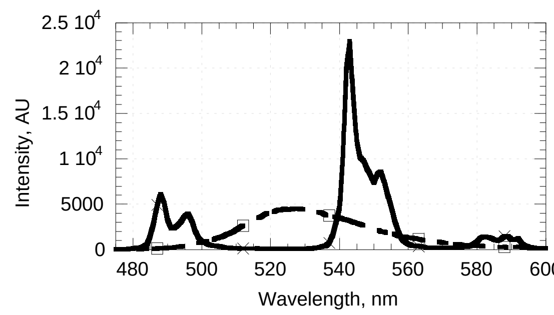


Fig. 2 Emission spectra of ZNS[❑] & YB[X] phosphor powders excited by 147nm at RT

Table 1

| *Phosphor* | *Brightness (Cd/m²)* | *Peak Ems. (nm)* | *Peak Half Width (nm)* | *Persistence (10%) (ms)* |
|---|---|---|---|---|
| ZNS | 330 | 528 | 39 | 8-16 |
| YB | 338 | 542 | 4.2 | 6-9 |
| LP | 335 | 543 | 4.5 | 6-9 |
| YP | 342 | 542, 548 | 12 | 6-9 |

| *Phosphor* | *Color Coordinates with out filter* x | y | *with filter* x | y | *Particle Size (μm)* | *Particle* Shape |
|---|---|---|---|---|---|---|
| ZNS | 0.322 | 0.592 | | | 5 –8 | plate |
| YB | 0.271 | 0.718 | 0.347 | 0.643 | .5 –3 | spherical |
| LP | 0.276 | 0.712 | | | 1 –4 | semisphr |
| YP | 0.284 | 0.630 | | | 1 –3 | spherical |