Coating of $BaSi_2O_5$:Pb by La_2O_3

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Pb^{2+} phosphors based on a silicate host lattice are used in low-pressure Hg lamps for tanning purposes. Most commonly used materials are $BaSi_2O_5$:Pb (BSP) and $Sr_2MgSi_2O_7$:Pb [1]. Both phosphors degrade substantially during lamp manufacturing and operation. The efficiency loss during lamp manufacturing is related to the hydrolysis in the water based phosphor suspension, that is accompanied by an increase of the pH value.

$$BaSi_2O_5 + 2\,H_2O \rightarrow H_2Si_2O_5 + Ba^{2+} + 2\,OH^-$$

Low-pressure Hg lamps employing these phosphors show a strong decline of the light output due to the high Hg consumption of silicate phosphors. This observation is in line with the low point of zero charge (PZC). Therefore, these materials tend to be negatively charged at the surface. This causes a fast take-up of Hg^+ ions from the discharge [2]. As a result the phosphor powder becomes grayish which reduces the lamp light output.
Presently, the stabilization of the light output of tanning lamps is achieved by the application of an Al_2O_3 coating onto the BSP particles [3]. This measure requires a gas phase process, since the wet-chemical precipitation of $Al(OH)_3$ has to be performed at an acidic pH, i.e. in an environment which is hazardous to BSP.
We have developed a wet-chemical coating process for BSP that can be performed at a high pH and is thus harmless to the phosphor. The process yields a very thin La_2O_3 coating (fig. 1), that does not reduce the quantum efficiency, since it hardly absorbs the incident Hg radiation at 185 and 254 nm. La_2O_3 coated BSP has a much higher stability towards hydrolysis in water (fig. 2). In addition, its point of zero charge increases substantially with increasing coating thickness (fig. 3). This is an advantage for lamp operation, since it will result in a reduced Hg take-up and thus in an improved lamp maintenance.

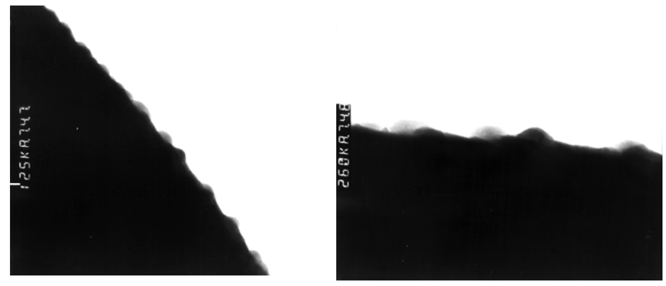

Fig. 1: *TEM photos of the surface of a La_2O_3 coated $BaSi_2O_5$:Pb particle*

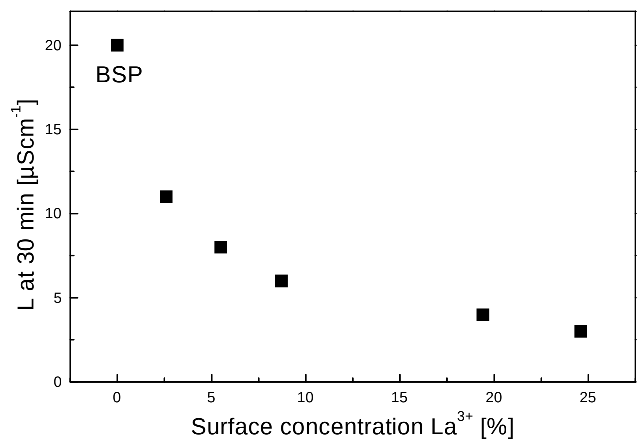

Fig. 2: *Conductivity of a BSP suspension in demi water after 30 minutes stirring at RT*

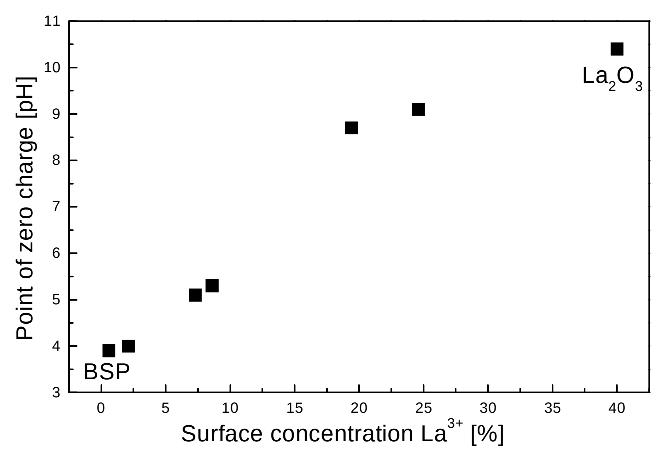

Fig. 3: *Point of zero charge of BSP, La_2O_3, and La_2O_3 coated BSP.*

References

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[2] T. Oguchi and M. Tamatani, J. Electrochem. Soc. **133**, 841 (1985).

[3] Y. Sakakibara, Y. Takahashi, H. Shima, US patent 4,491, 140.