Red Mn-Phosphors - Crystal Chemistry and Derived Mixed-Layer Structures in the System CaO-Al2O3-MgO-MnOx

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The improvement and development of red phosphors for fluorescent lamps is one of the important research fields in materials science. Recently the luminescence properties of red phosphors with a nominal composition referring to the formula for the Ca-hexa-aluminate $CaAl_{12}O_{19}$:Mn^{4+} were reported by Murata et al. 2005 and Park et al. 2007. They found a strong dependence of the luminescent intensity by doping with Mg and Mn. In addition the presence of fluxes like CaF_2 and MgF_2 seem to increase the reactivity and subsequently also the luminescent intensity. Crystal chemical, structural and phase related aspects have not been studied.

In the group of hexa-aluminates compounds exhibiting magnetoplumbite- and beta-alumina structures are stable. A wide crystal chemical variety gives rise to numerous properties with large potential for chemical fine tuning. The crystal structures present can be explained as mixed layer structures (Göbbels 2004).

Among the hexa-aluminates the most well known and important compounds are the blue phosphor BAM $BaMgAl_{10}O_{17}$:Eu^{2+} (Göbbels, et al. 2002) and the green phosphor $BaMgAl_{10}O_{17}$:Eu^{2+}, Mn^{2+} both exhibiting the beta-alumina crystal structure. The close related but slightly different structure of magnetoplumbite is found in the case of $CaAl_{12}O_{19}$. It was sort of surprising finding in this magnetoplumbite compound such strong luminescence.

Comparing this reported compound with the already known phase relations in the system CaO-Al_2O_3-MgO (Göbbels, et al. 1995) the question arises if the “higher” hexa-aluminates reported (Iyi et al. 1995) could also be found in the system CaO-Al_2O_3-MgO-MnO.

In this presentation the existence of the compounds $Ca_2(Mg,Mn)_2Al_{28}O_{46}$ and $Ca(Mg,Mn)_2Al_{16}O_{27}$ and more detailed phase relations and crystal chemical correlations will be presented.

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