Cathodoluminescence in electron microscopy: from phosphor evaluation to single particle analysis
Philippe F. Smet\textsuperscript{a,b}, Lisa I.D.J. Martin\textsuperscript{a,b}, Jeroen Wattez\textsuperscript{a,b,c}, Filip Strubbe\textsuperscript{b,c}, Dirk Poelman\textsuperscript{a,b}

\textsuperscript{a}Lumilab, Department of Solid State Sciences, Ghent University, Belgium
\textsuperscript{b}Center for Nano- and Biophotonics (NB-Photonics), Ghent University, Belgium
\textsuperscript{c}Liquid Crystals and Photonics Group, Ghent University, Belgium
philippe.smet@ugent.be

Impurity doped phosphors often show a close relationship between their luminescent and structural properties. When a phosphor is characterized by a distribution of structural properties (such as local compositional variations, dopant clustering, impurity phases or particle size inhomogeneity), the luminescence can show similar variations. If synthesized phosphors are only evaluated at the macroscopic scale, all contributions are averaged out, which can lead to a broadened emission spectrum, a luminescence decay profile featuring multiple exponential contributions or a peculiar thermal behavior [1,2].

In this presentation we discuss cathodoluminescence (CL) spectroscopy in a scanning electron microscope (SEM) as a tool to study emission characteristics in phosphors at the microscopic scale [1,3]. In SEM-CL simultaneous identification of the morphology, the chemical composition and the spectral distribution can be performed in imaging mode. When using a fast beam blanker, local decay time analysis and spectrally resolved decay time mapping can be performed [1]. A temperature stage allows to evaluate thermal quenching at the sub-micron scale [4].

Correlation of simultaneously obtained structural, compositional and luminescence properties leads to a profound understanding of a phosphor’s behavior. It can be used to identify minority phases in phosphors, e.g. the formation of EuGa\textsubscript{2}S\textsubscript{4} when preparing ZnGa\textsubscript{2}S\textsubscript{4}:Eu [3]. The light outcoupling of single phosphor particles can be studied, as well as the occurrence of whispering gallery modes in highly symmetric particles [5].