# DETERMINATION OF DOPING LEVELS OF TWO-DOPANT PHOSPHOR MATERIALS FROM X-RAY SIGNAL INTENSITY RATIOS AND INTENSITY CORRECTION ANALYSIS

Gary Darsey
Cabot Superior MicroPowders, 5401 Venice Ave. NE, Albuquerque, NM 87113

Randy Cone
Thermo Fisher Scientific, 1400 Northpoint Parkway, West Palm Beach, FL 33407

Doping certain crystalline host materials with small amounts of activator elements, generally transition metals or rare earths, creates phosphor materials with a wide variety of photoluminescent properties, which are employed in a wide range of applications. In a single dopant material, such as Mn-doped $Zn_2SiO_4$, determination of the dopant level can be made without mathematical matrix correction by varying the dopant level while holding the host element levels constant in an aqueous solution specimen. Thus the matrix effects are held constant by careful solution specimen preparation. However, this approach does not work for a two-dopant material, such as (Eu, Dy)-doped $SrAl_2O_4$, in which there is observed matrix effects between the two dopant elements of mutually varying concentration even with constant host element levels in the prepared solution specimen. These matrix effects are effectively compensated for using an intensity correction model with a calibration based on atomic ratios and X-ray signal intensity ratios. The doping levels of the two dopants can be determined directly from the atomic ratios without determination of any solution concentrations.

At Cabot Superior MicroPowders, phosphor powders are produced from liquid precursors using proprietary spray pyrolysis methods. This EDXRF method can be used as a quality control check to ensure the proper doping level in the liquid precursor. It can also be applied to solid phosphor materials after appropriate sample preparation to obtain an aqueous solution specimen for presentation to the spectrometer.

This EDXRF method is highly suitable for a production environment due to instrument compactness and minimal services required as compared with other methods for determination such as ICPOES. The EDXRF method also provides better precision for the doping levels in these phosphor systems than an ICPOES method provides.