Cathodoluminescence spectroscopy of trivalent REEs: A useful tool for materials characterization

Hanchar, J.M.*

Department of Earth Sciences, Memorial University of Newfoundland, St. John's, NL, A1B 3X5 Canada
**e-mail: jhanchar@mun.ca*

In order to evaluate the utility of cathodoluminescence (CL) spectroscopy as a tool for material characterization, I have acquired high-resolution CL spectra from a several trivalent REE doped synthetic compounds. These include silicate and phosphate minerals, glasses, and other ceramic compounds. Although it is commonly assumed that the crystal field of the host material exerts little influence on the REE 4*f* electrons, it will be demonstrated that this is not the case and that each of the REE-doped materials has a unique CL emission spectrum. In order to measure these subtle differences in the CL emissions a high-resolution spectroscopy system with a spectral resolution of ~0.15 nm is required (Figs. 1 and 2).

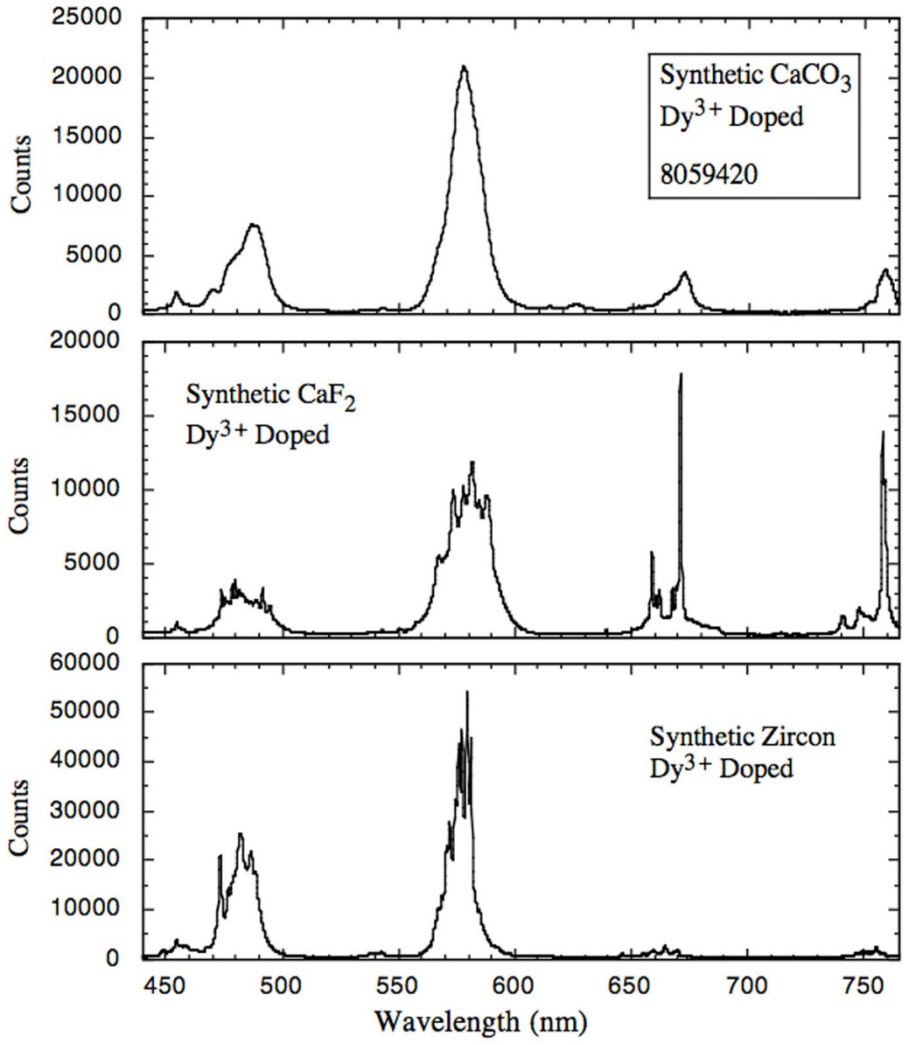

Fig. 1. *Cathodoluminescence spectra of Dy^{3+} doped calcite, fluorite, and zircon.*

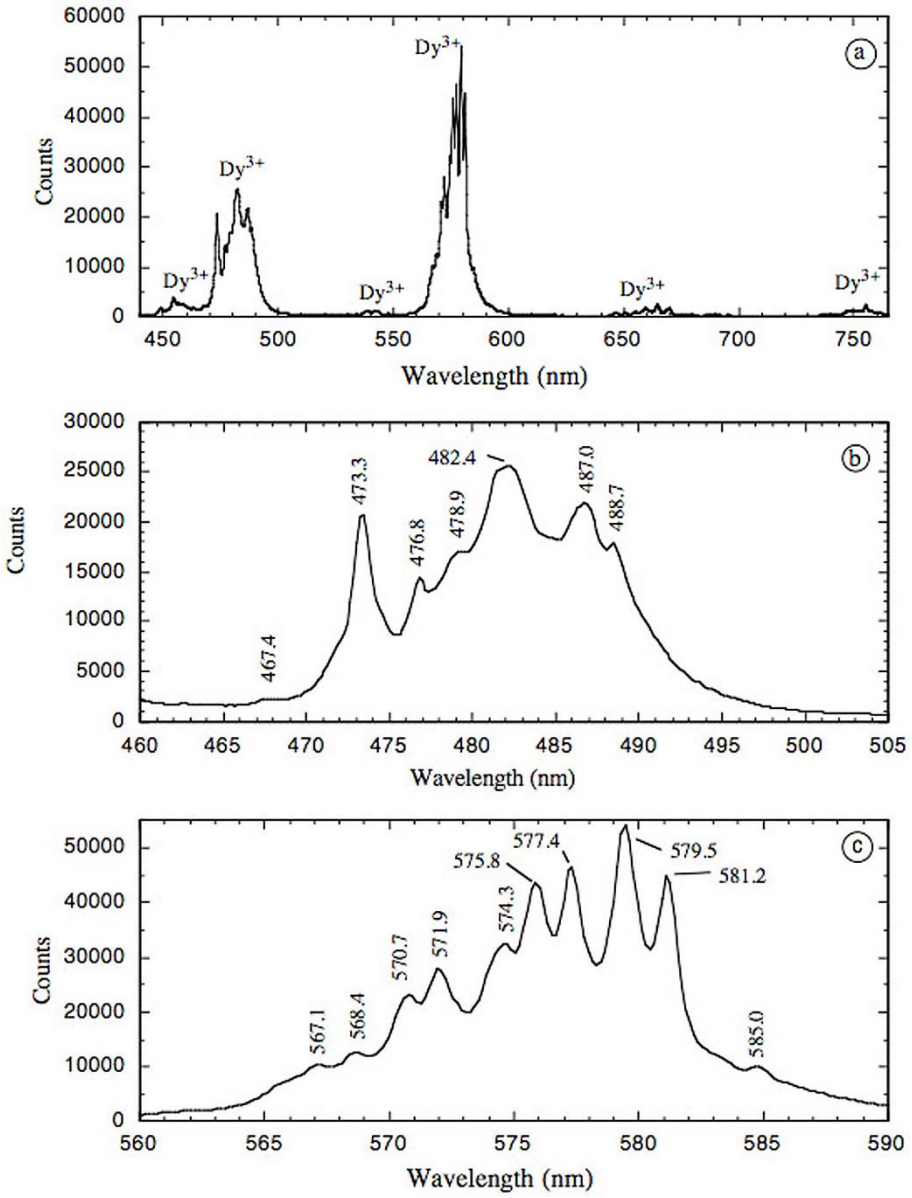

Fig. 2. *Cathodoluminescence spectrum of Dy^{3+} doped synthetic zircon (a) with the two main 4f transitions expanded in the x-axis (b and c).*

The CL spectra were acquired using an imaging spectrograph-CCD (charge-coupled device) detector CL spectroscopy system. This kind of system has advantages over conventional CL spectroscopy systems: 1) high spatial resolution with the ability to accurately collect CL spectra from regions as small as 10 × 10 μm^2 in materials; 2) a spectral resolution of ~0.15 nm suitable for studying the rare earth elements in a wide range of materials; and 3) this system allows for the acquisition of high-resolution CL spectra in bulk specimens as well as isolated regions in mineral grains in thin sections or in epoxy mounts.