Cr$^{3+}$ optical properties of Brazilian beryl and chrysoberyl (alexandrite and emerald)

Ollier Nadège(1), Fuchs Yves (2), Rossano Stéphanie(2), Bordage Amélie(2), Leal Jose Maria(3), Horn Adolph Heinrich(3).

(1)Laboratoire des Solides Irradiés, Ecole Polytechnique, Palaiseau, France
(2) Laboratoire Géomatériaux et Environnement (LGE), Université Paris Est-Marne la Vallée, France
(3) Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil.

Time-resolved photoluminescence experiments were performed on natural alexandrite and emerald from Minas Gerais (Brazil) with a 532 nm laser excitation at 300 K.

The Cr$^{3+}$ host crystals for emerald and alexandrite are beryl (Be$_3$Al$_2$(SiO$_3$)$_6$) and chrysoberyl (BeAl$_2$O$_4$) respectively. The chrysoberyl is a well known hexagonal structure where Cr$^{3+}$ ions substitutes for the Al$^{3+}$ ions and occupy mainly the mirror sites (C$_s$ symmetry) or the inversion sites (C$_i$ point group) [1]. In emeralds, the site symmetry of Cr$^{3+}$ is D$_3$.

We could detect contrasted emission shapes of Cr$^{3+}$ with various crystal field intensities in the different minerals. The aim of the present study is to link information obtained from the Cr$^{3+}$ spectroscopic features (emission and lifetimes) to the site occupation of Cr$^{3+}$ in alexandrite and emeralds as a function of the Cr$^{3+}$ concentration and impurity level (Ti, Fe and Mg).

References: