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 ($Be_3Al_2(SiO_3)_6$) and chrysoberyl ($BeAl_2O_4$) 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:
[1] R. C Powell, L. Xi, X. Gang, G. J Quarles Phys. Rev B 32 (1985) 2788.