The peculiarities of emission spectra in Cr^{3+}:YGG nanocrystals

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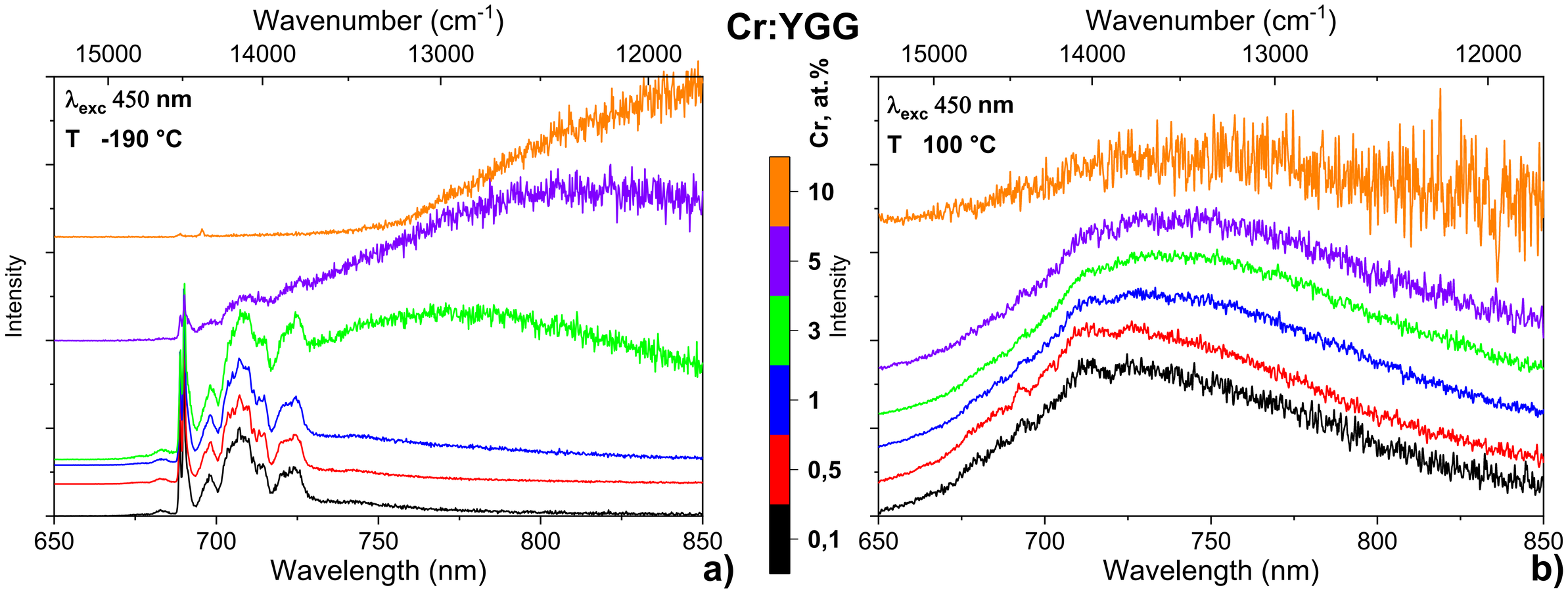
The problem and results

Cr^{3+}-doped phosphors are widely used for their tunable luminescence, but performance variations highlight the need for further investigation into their spectroscopic behavior. Cr-doped phosphors play an important role in daily life. Cr^{3+}-doped garnets are one of the best light converters for NIR LEDs. This application potential relies on the spectroscopic characteristics of Cr^{3+} ions, such as the spectral position and emission intensity. One of the challenges encountered in this context is the variability in the properties of Cr-doped phosphors, even for the same chemical composition. Investigating these irregularities will help to improve their functional characteristics.

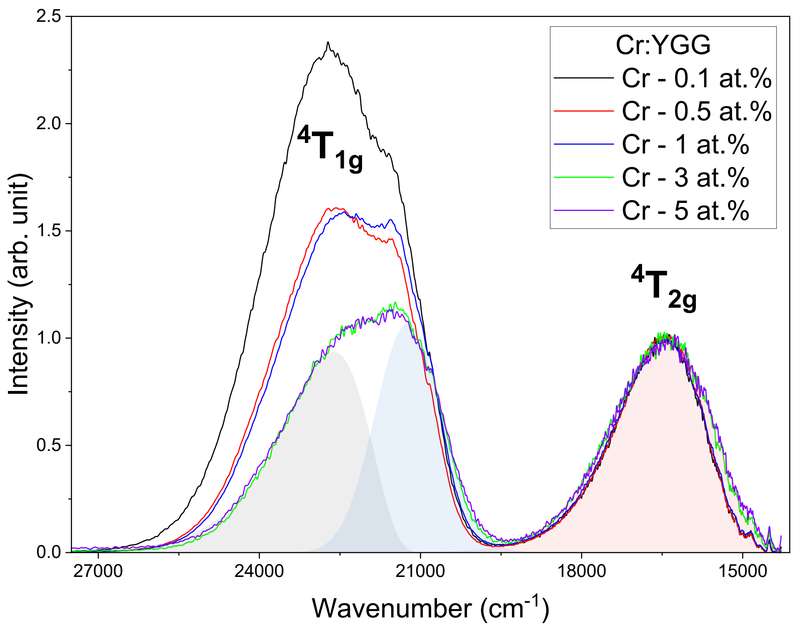
The present work focuses on the study of the spectroscopic properties of Cr^{3+}:YGG nanopowders, focusing on energy transfer between ions in different crystal field environments. The concentration of Cr^{3+} ions varied from 0 to 30 at. %. Excitation, emission, and luminescence decay curves were collected in the temperature range of −190 °C to 500 °C. It was shown that increasing the concentration of Cr^{3+} ions caused a redshift in the emission spectra. The detected features were explained by the energy transfer process between Cr^{3+} ions in octahedral sites with different local crystal field strengths.

Emission spectra



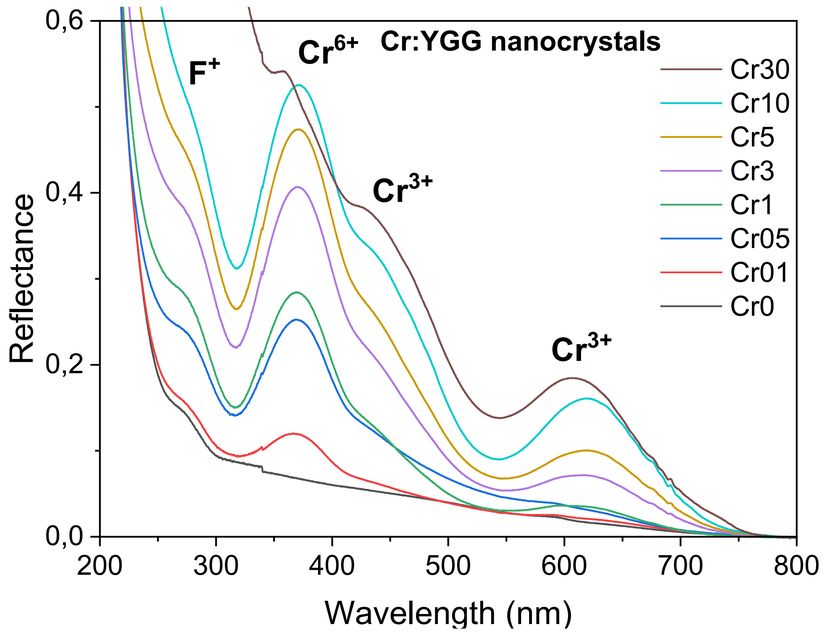
Emission spectra of Cr^{3+} ions in Cr^{3+}:YGG nanocrystals measured at λ_{exc} – 450 nm and a) T – -190 °C, b) T – 100 °C.

Excitation spectra



Cr:YGG excitation spectra measured at λ_{em} – 710 nm and T – 80K.

Absorption spectra



Diffuse reflectance spectra of the Cr:YGG nanocrystals

denote	Cr, at.%	Dq/B
Cr01	0.1	2.14(5)
Cr05	0.5	2.17(5)
Cr1	1	2.20(5)
Cr3	3	2.25(5)
Cr5	5	2.32(5)
Cr10	10	2.24(5)
Cr30	30	2.32(5)