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MID-IR spectroscopy of Nd^{3}+ and Ce^{3}+ ions in crystals

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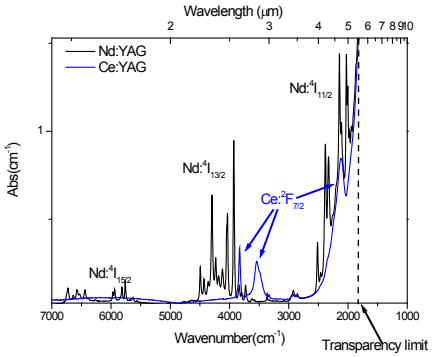
The mid-infrared (MID-IR) region is very interesting for a large number of applications because vibro-rotational levels of many molecules lie in this region. Therefore, the search for new light sources in this range is a very important research topic. Moreover, MID-IR energy levels of rare earth ions in crystals are usually the bottom laser levels for visible or near infrared lasers based on these materials. For these reasons, we performed MID-IR spectroscopy of the Nd^{3+}-Ce^{3+}:YAG system. Ce^{3+} ions are added as sensitizers for Nd^{3+} because Ce^{3+} possesses a strong absorption band at around 450 nm where powerful diode lasers exist. The efficient energy transfer mechanism at visible energy that transfers the Ce excitation to the upper Nd laser level has already been studied, but, at the best of our knowledge, no detailed investigation has been performed about the possible interaction between the MID-IR energy levels of the two ions. This might play an important role in the laser efficiency because of the possible energy match with the bottom laser level of the near-infrared Nd emission. Absorption spectra of Nd:YAG, Ce:YAG and Nd,Ce:YAG have been performed as a function of temperature in the 7000-1000 cm^{-1} wavenumber range to identify the transparency limit of the crystal matrix and the MID-IR energy levels of the two ions. Ce:$^{2}F_{7/2}$ together with Nd: $^{4}I_{15/2}$, $^{4}I_{13/2}$ and $^{4}I_{11/2}$ Stark sublevels have been observed and identified. Good spectral overlap has been observed between the Ce:$^{2}F_{7/2}$ Stark components and Nd: $^{4}I_{13/2}$, and $^{4}I_{11/2}$ multiplets. This might help in depopulating the lower laser level of the 1.06μm and 1.3 μm laser emission of Nd thus favoring the laser emission at these wavelengths. Moreover, the 4.8-5 μm Nd emission has been observed and characterized at room temperature.



Recent Publications

1. R Marino, I Lorgeré, O Guillot-Noël, H Vezin, A Toncelli, M Tonelli, J-L LeGouët, P Goldner (2016) Energy level structure and optical dephasing under magnetic field in Er^{3+}:$LiYF_4$ at 1.5 μm. *J. Lumin.*; 169: 478-482.
2. N Hamza Belkhir, A Toncelli, Abdul K Parchur, E Alves, R Maalej (2017) Efficient temperature sensing using photoluminescence of Er/Ybimplanted GaN thin films. *Sensors and Actuators B*; 248: 769–776.

Biography

Alessandra Toncelli has obtained her PhD in Physics in 1998 at the University of Pisa. Since 2017 she is Associate Professor at the Physics Department of Pisa. Her scientific interest was initially aimed to the growth and spectroscopy of crystalline materials for photonic applications in visible and near infrared regions. In particular, she studied and characterized the optical and spectroscopic properties of oxide and fluoride crystals with rare earths for laser applications. She has published more than 160 articles on International journals. She currently holds an h-index of 41 both in Scopus and in ISI web of knowledge.

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