Light Science & Applications

Judd-Ofelt calculation approaches for rare earth ions doped opaque materials

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Judd-Ofelt theory has attracted growing interest since it came to the world. Nowadays, the Judd-Ofelt theory is still the only effective tool for exploring the optical transition properties of trivalent rare earth ions in hosts. A standard Judd-Ofelt calculation procedure for transparent luminescence materials has already been established and widely adopted. However, the standard Judd-Ofelt calculation procedure cannot be applied to rare earths doped opaque hosts, because the absolute absorption spectra for these materials cannot be observed. To solve this problem, we proposed some approaches to calculate the Judd-Ofelt parameters for rare earths doped opaque materials. For Eu^{3+}, Tb^{3+}, Sm^{3+}, and Dy^{3+} doped materials, an approach of Judd-Ofelt calculation using the emission spectrum was proposed and validated for Eu^{3+} and Tb^{3+} doped phosphors. To find a universal calculation approach suitable for all rare earth ions, a Judd-Ofelt calculation method in which the diffuse reflection spectrum and the fluorescence lifetime for a selected level are used was proposed. This Judd-Ofelt calculation approach was examined in Er^{3+} doped phosphors. Moreover, a fluorescence decay approach of the Judd-Ofelt calculation was also proposed for the studied system in which more than three decays for the sample could be observed. This approach was examined for Er^{3+} doped fluoride phosphor.

Short Bio:

Baojiu Chen received his PhD degree in Condensed Matter Physics from Changchun Institute of Physics, Chinese Academy of Sciences. He is a professor of Dalian Maritime University.