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Recent advances in lanthanide spectroscopy in Brazil

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Abstract

This review discusses recent advances in lanthanide spectroscopy involving luminescence applications carried out in Brazil. The revised topics include glasses, sol-gel, light-emitting diodes, nanoparticles, metal-organic frameworks, coordination polymers, thin films, energy transfer processes, upconversion and development of new theoretical tools. The important role played by Prof. Oscar L. Malta on this subject is evidenced by his many contributions to the broad range of investigations reported here and this review is dedicated to him, on the occasion of his 60th birthday.

Keywords: Lanthanide, rare earths, luminescence, glasses, sol-gel, crystals, light-emitting diodes, nanoparticles, metal-organic frameworks, coordination polymers, thin films, energy transfer, upconversion, theoretical methods.

1. Introduction

The great interest in trivalent lanthanide (Ln^{3+}) compounds is in part due to their strong luminescence observed in a broad spectral range and to their long-lived excited states. For this reason, lanthanide compounds have been used in a variety of applications involving sol-gel, glasses, light-emitting diodes (LEDs), metal-organic frameworks (MOFs), among others. In many investigations of lanthanide-based systems, experimental measurements are interpreted with the help of theoretical models, through which properties and processes of excited and ground states are also described [1]. The development of new theoretical models and methodologies in this field has been shown to be very important in the last decades, since they nicely complement and enrich experimental investigations, as well as guide new experiments. Theoretical models addressing energy transfer processes [2,3], ligand field interactions [4], electronic transitions [5], chemical bond properties [6], geometry optimization [7], among others [1], have been extensively used due to their large applicability to this research field. Many of these theoretical models and investigations carry the name of Prof. Oscar L. Malta, who has done pioneering work in the field of lanthanide spectroscopy in Brazil for almost four decades, and whose contributions are also internationally recognized.

The aim of this review is to describe the recent advances in the field of lanthanide luminescence in Brazil and to highlight the important contributions of Prof. Malta in honor of his 60th birthday. The revised topics include glasses, sol-gel, LEDs, nanoparticles, crystals, metal-organic frameworks, coordination polymers, thin films, energy transfer, upconversion, and the development of theoretical methods. Spectroscopic treatments in general are discussed inside each topic.

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