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Physical Chemistry of Solid State Materials

- REMCES VI -

Proceedings of the 6th International Seminar on the Physical Chemistry of Solid State Materials, El Jadida, Morocco, 1993

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Physical Chemistry of Solid State Materials

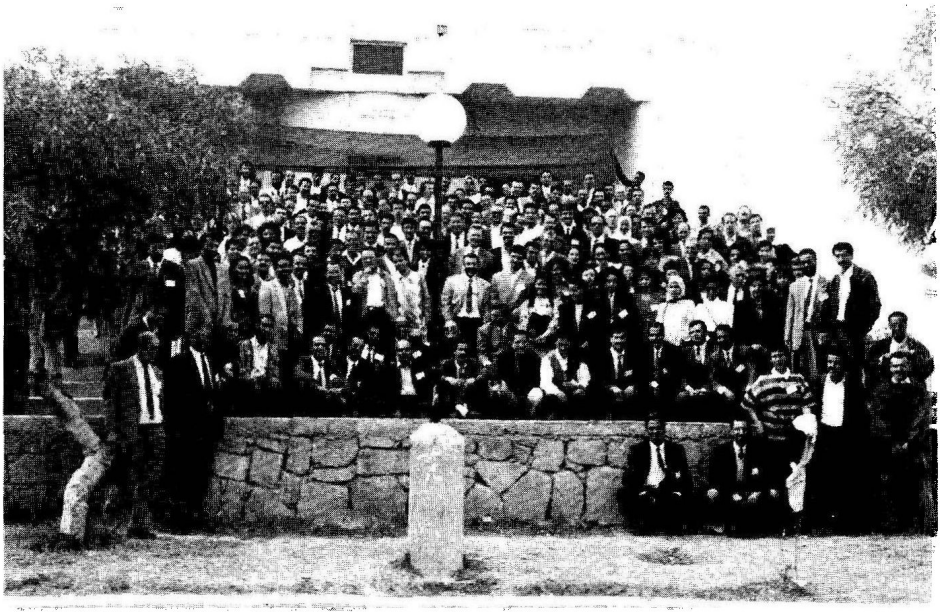
PREFACE :

REMCES (the acronym is formed from the Frenche title of the Moroccan Forum for Solid State Chemistry) meets every two years to discuss the latest advances in the physical chemistry of solid state materials. Numbers of participants have grown from **50 participants** at the first meeting, held in **Rabat** in **1983**, to **300** at the sixth meeting which took place in **El Jadida** from October 28 to 30, **1993**.

This sixth meeting, entitled International Seminar of Physical Chemistry of Solid State Materials, brought together researchers from Algeria, France, Germany, Japan, Spain, Switzerland and Tunisia, as well as from Morocco itself.

The aims of the seminar were to discuss the progress of scientific research, strengthen ties between industry and universities, and promote cooperation in the field of solid state chemistry at national and international level. The topics presented covered methods of preparing solid state materials, their physical properties and industrial appilcations.

The coordinating committee



Group photo

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The organizing committee wishes to thank the following :

- **The Minister for National Education** for his interest in this meeting, for his encouragement and support, and for the honour he conferred on us by chairing the opening session of the meeting;

- **The Governor** of the Province of El Jadida for the facilities he generously accorded us ;

- **The Rector of Chouaïb Doukkali University, El Jadida**, for his help and encouragement during the preparation of the meeting ;

- **The Dean of the Faculty of Science of Chouaïb Doukkali University, El Jadida**, for his interest in the meeting and his encouragement throughout the period of preparation.

- **The Municipal Council of the Town of El Jadida**, for contributing materially to the organisation of this meeting.

We thank the following warmly for their support and financial assistance :

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- The Rectorate of Cadi Ayad University, Marrakesh
- The Rectorate of Moulay Ismaïl University, Meknes
- The Faculties of Science at the following Universities :

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  • Moulay Ismaïl University, Meknes

- Ecole Supérieure de Technologie, Casablanca
- Centre National de Coordination et de Planification de la Recherche Scientifique et Technique.

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LIGHT-CONVERTING MOLECULAR DEVICES: ENERGY-TRANSFER PROCESSES IN LANTHANIDE DINUCLEAR COMPLEXES

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Keywords: Lanthanide, Rare Earth, Luminescence, Energy Transfer, Probe, Light Conversion, Calixarene, Dinuclear Complexes, Self-Assembly, Triple Helical Complexes, Aromatic Polyamines

Abstract

The design of efficient light-converting molecular devices containing a lanthanide ion is discussed. In order to unravel the energy transfer processes taking place in such a device, two series of model dinuclear complexes are studied : coordination compounds with calixarenes and self-assembled triple helical complexes based on aromatic polyamines.

Introduction

The 4f-block elements form an extended series of trivalent cations with the same formal charge and with similar chemical properties, mostly due to very weak ligand-field effects. The $4f^n5s^25p^6$ electronic configuration is indeed special in the sense that 4f electrons are shielded by the 5s and 5p subshells, resulting in atom-like absorption and emission spectra. The latter are easy to identify and make luminescent probes based on Eu(III) and Tb(III) especially efficient (Fig. 1). The development of luminescent chemical probes and sensors is the subject of intensive research, both in natural and medical sciences [1][2]. Furthermore, trivalent lanthanide ions may be incorporated into supramolecular complexes acting as molecular photonic devices [3]. In these nanometric machines, the various steps of the overall process involving absorption of light, transfer and re-emission at another wavelength are performed separately by distinct parts of the complex molecule. Such supramolecular constructions are termed light-conversion molecular devices.

To design a good europium (or terbium) luminescent sensor, a unique combination of features must be realized : (i) protection of the included ion from quenching due to the interaction with solvent molecules and/or high-energy vibrations from the ligating groups, (ii) presence of multiple absorbing groups suitable for energy transfer (antenna effect [2]), (iii) high thermodynamic stability and kinetic inertness, and (iv) non-toxicity of the sensor if it is to be used in *in vivo* applications.

The yield of the energy transfer between the donor and the acceptor is related to the donor-acceptor distance. Determination of this distance allows one to realize a fluorescent mapping of large molecules such as proteins, leading to useful structural information, or to calculate the distance between ion sites [1]. In order to unravel the intimate mechanism of energy-transfer processes both between an organic chromophore and a Ln(III) ion and between two lanthanide ions, we have undertaken the study of several classes of heterodinuclear complexes. This paper presents some of the results obtained these last three years on dinuclear complexes with calixarenes and planar multidentate nitrogen-containing ligands analogous to terpyridine.

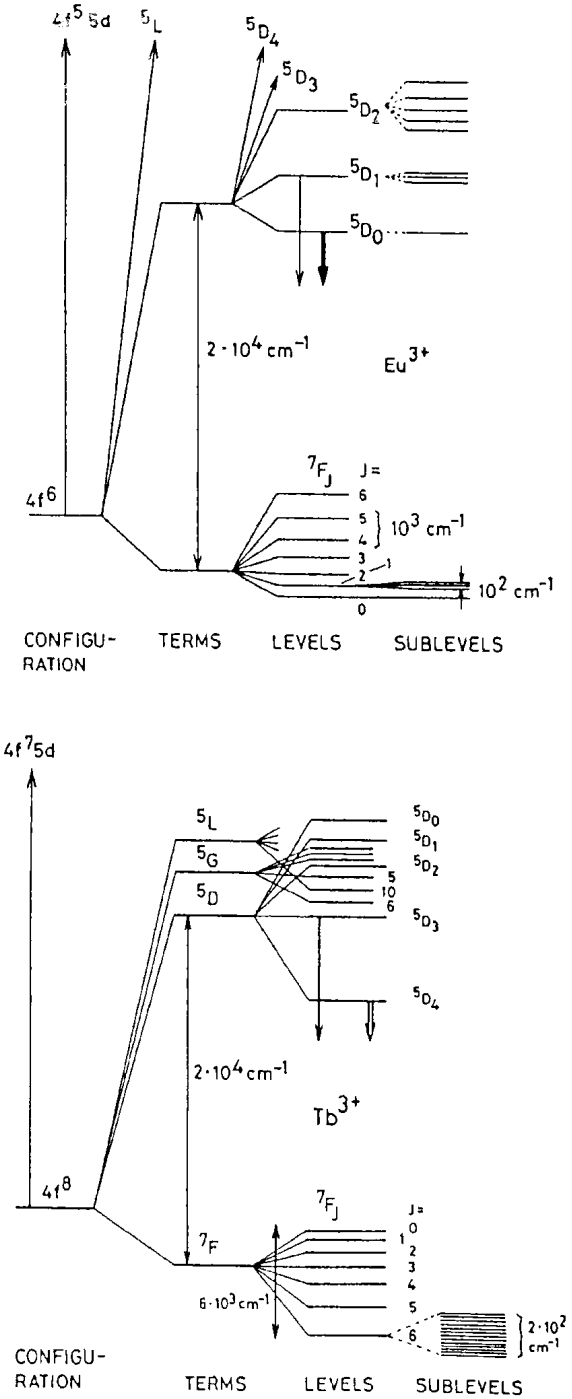

Figure 1 : Partial energy level diagrams for Eu^{III} and Tb^{III}.