

Bio Inorganic Chemistry of Lanthanides: New Vista

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Abstract

Bio-inorganic chemistry explores the interactions between inorganic elements and biological systems, providing important insights into the roles and applications of metal ions in living organisms. Among the metallic elements, lanthanides have attracted increasing scientific interest because of their distinctive electronic configurations, coordination chemistry, luminescence, magnetic properties, and potential biological applications. This paper presents an overview of the emerging field of bio-inorganic chemistry of lanthanides, with emphasis on their interactions with biomolecules and their potential applications in biomedical and biological sciences. Lanthanide ions can interact with proteins, nucleic acids, phosphates, carboxylates, and other biologically relevant ligands, forming coordination complexes with diverse structural and functional characteristics. Their ability to exhibit strong and characteristic luminescence has generated interest in their use as probes for biological sensing, imaging, and analytical applications. Certain lanthanide complexes are also being investigated for potential antimicrobial, anticancer, diagnostic, and therapeutic applications. The paper discusses the influence of ionic radius, coordination number, ligand environment, and electronic properties on the biological behaviour of lanthanide complexes. Particular attention is given to the design of stable and biocompatible lanthanide-based compounds and the importance of ligand selection in controlling their solubility, cellular interactions, and biological activity. At the same time, issues related to toxicity, bioavailability, stability, and selective delivery require careful investigation. The integration of coordination chemistry, biochemistry, materials science, and pharmacology may open new possibilities for developing functional lanthanide-based systems. Thus, bio-inorganic chemistry of lanthanides represents a promising interdisciplinary field with significant scope for future research.

Keywords: Bio-Inorganic Chemistry, Lanthanides, Coordination Chemistry, Lanthanide Complexes, Biomolecules, Luminescence, Biological Applications, Metal Ions, Biomedical Chemistry, Bioactive Compounds