Přírodovědecká fakulta

Department of Inorganic Chemistry,
Faculty of Science, Palacky University Olomouc
and
Czech Chemical Society – Olomouc branch

invite you together to the invited lecture

# Ln(III) complexes of teraazamacrocyclic ligands: from basic research to analytical chemosensors


## prof. RNDr. Přemysl Lubal, Ph.D.

**(Department of Chemistry, Faculty of Science, Masaryk University, Brno, Czech Republic)**



***Abstract***: Ln(III) complexes of tetraazamacrocyclic ligands based on cyclen rim (*e.g.*, $H_4$dota and its derivatives) are utilized in preclinical research and many areas of medicine for diagnostics or cancer treatment (*e.g.*, radioisotopes as $^{90}$Y, $^{153}$Sm, $^{166}$Ho, $^{177}$Lu in nuclear medicine, Gd(III)/Eu(II) complexes as MRI contrast agents, Eu(III) or Tb(III) complexes as luminescent probes). Such Ln(III) complexes should exhibit a high thermodynamic stability as well as kinetic inertness under physiological conditions and therefore knowledge of these properties is important for any biomedical applications. In the first part, the kinetic study of metal complexes with chosen tetraazamacrocyclic ligands will be presented to see the impact of ligand denticity or of kind of pendant arm(s) (*e.g.*, phosphonic/phosphinic/carboxylic acid) on formation and dissociation of chosen Ln(III) complexes (mostly Ce(III)/Eu(III)/Tb(III)). The results can be compared with Cu(II) complexes for the same ligands. The detailed reaction mechanism describing both formation and dissociation of Eu(III) and Tb(III) complexes was proposed by new methodology based on experimental data obtained by luminescence spectroscopy in steady-state or time-resolved mode. This general experimental procedure was recently also developed for determination of stability constants of Ln(III) complexes. The binding of antenna functional group in binary or ternary Ln(III) complexes exhibits significant increase of brightness of luminescence due to the efficient transfer of absorbed energy from ligand to Ln(III) ion. In the second part, the development of new luminescent chemosensor for analysis of Ln(III) ions in mixture or traces of water in organic solvents or ionic liquids will be shortly discussed. In addition, the dual chemosensor based on Eu(III) or Tb(III) complexes can be employed for direct detection of carbonate/carbon dioxide. The Ln(III) complexes can be also used for the proposal of biosensor using enzymes producing carbon dioxide (*e.g.*, urease) or utilizing redox pair NAD(P)+/NAD(P)H as co-factor (*e.g.*, alcohol-dehydrogenase).


The lecture will take place on Friday, **October 15**, 2021 at **1:00 pm** in the lecture room LP **3.003**, 17. listopadu 12, Olomouc.

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# Ln(III) complexes of teraazamacrocyclic ligands: from basic research to analytical chemosensors

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Ln(III) complexes of tetraazamacrocyclic ligands based on cyclen rim (*e.g.* $H_4$dota and its derivatives) are utilized in preclinical research and many areas of medicine for diagnostics or cancer treatment (*e.g.* radioisotopes as $^{90}$Y, $^{153}$Sm, $^{166}$Ho, $^{177}$Lu in nuclear medicine, Gd(III)/Eu(II) complexes as MRI contrast agents, Eu(III) or Tb(III) complexes as luminescent probes) [1, 2]. Such Ln(III) complexes should exhibit a high thermodynamic stability as well as kinetic inertness under physiological conditions and therefore knowledge of these properties is important for any biomedical applications.

In the first part, the kinetic study of metal complexes with chosen tetraazamacrocyclic ligands will be presented to see the impact of ligand denticity or of kind of pendant arm(s) (*e.g.* phosphonic/phosphinic/carboxylic acid) on formation and dissociation of chosen Ln(III) complexes (mostly Ce(III)/Eu(III)/Tb(III) [2-11]). The results can be compared with Cu(II) complexes for the same ligands [12, 13]. The detailed reaction mechanism describing both formation and dissociation of Eu(III) and Tb(III) complexes was proposed by new methodology based on experimental data obtained by luminescence spectroscopy in steady-state or time-resolved mode [9, 11, 14, 15]. This general experimental procedure was recently also developed for determination of stability constants of Ln(III) complexes [11].

The binding of antenna functional group in binary or ternary Ln(III) complexes exhibits significant increase of brightness of luminescence due to the efficient transfer of absorbed energy from ligand to Ln(III) ion. In the second part, the development of new luminescent chemosensor for analysis of Ln(III) ions in mixture [16] or traces of water in organic solvents or ionic liquids [17, 18] will be shortly discussed. In addition, the dual chemosensor based on Eu(III) or Tb(III) complexes can be employed for direct detection of carbonate/carbon dioxide [19, 20]. The Ln(III) complexes can be also used for the proposal of biosensor using enzymes producing carbon dioxide (*e.g.* urease [21]) or utilizing redox pair $NAD(P)^+$/NAD(P)H as co-factor (*e.g.* alcohol-dehydrogenase [22]).

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