Thermodynamic and kinetic study of Ln(III) complexes of NOTA

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Lanthanide(III) complexes of polyaza-macrocyclic ligands (primarily DOTA-like ligands) are utilized in many areas of medicine (*e.g.* complexes of metal radioisotopes as ^{90}Y, ^{153}Sm, ^{166}Ho, ^{177}Lu in nuclear medicine, Gd(III) complexes as MRI contrast agents, Eu(III) or Tb(III) complexes as luminescent probes). For any biomedical applications, such metal complexes should exhibit a high thermodynamic stability as well as kinetic inertness under physiological conditions and, therefore, knowledge of these properties is important.

One of frequently used triazamacrocycle-based ligands is NOTA (1,4,7-triazacyclononane-1,4,7-triacetic acid; Fig. 1). Since basic data regarding thermodynamic properties of its complexes are, surprisingly, very scarce [1], we report here on its protonation constants as well as on stability constants of its complexes with selected Ln(III) ions. Their values show that NOTA cavity is too small for large Ln(III) ions in comparison with that of DOTA-like ligands. In addition, stability constants of Ln(III) complexes are significantly increasing for smaller Ln(III) ions. Kinetic properties of several Ln(III) complexes of NOTA were studied by molecular absorption and luminescence spectroscopies in UV/VIS region. Reaction mechanisms of formation (pH = 4.0–6.0, t = 25 °C, I = 0.1 M KCl) and acid-assisted dissociation (t = 10–37 °C, I = 3.0 M (Na,H)ClO_4) of Eu(III) complex were proposed from time-resolved luminescence spectroscopy. The results were compared with data obtained for Ln(III) complexes of similar tetraaza-macrocyclic ligands [1, 2].

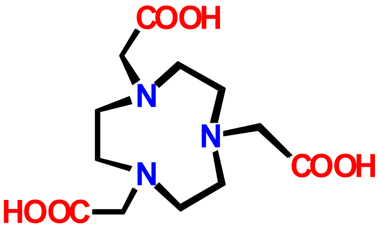

Figure 1. 1,4,7-triazacyclononane-1,4,7-triacetic acid (NOTA)

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