THE SYNTHESIS OF HIGHLY SELECTIVE IMMOBILIZED LIGANDS FOR EXTRACTION OF TOXIC METAL IONS FROM WASTE WATER AND BRINE

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ABSTRACT

Keywords: Crown based ligands, Immobilization, Selectivity

Contaminated water from heavy industries ends up in drainage run-offs, streams and rivers and this water contains various kinds of toxic metal ions such as Cr^{6+}, As^{5+}, Sr^{2+}, U^{6+}, Hg^{2+} and Cd^{2+}. Not only are the natural habitats poisoned and destroyed, but people who are dependent on these streams and rivers, are also affected.

It was decided to synthesize highly selective crown-based ligands that are water soluble, but to then immobilize these ligands on insoluble Si substrates so that these ligands as well as the metal ions can be easily recovered. Two new highly selective ligands THTD (Fig. 1) and THTUD (Fig. 2) were successfully synthesized and characterized[1]. The free ligands were tested and displayed great selectivity towards Cd^{2+}. Furthermore, 2 types of crown ethers that are selective towards U^{6+} and Sr^{2+} were also used.

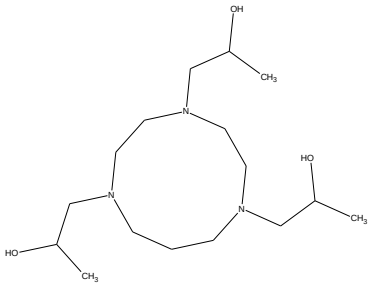


Figure 1 1,4,7,-tris-[(*S*)-2-hydroxypropyl]1,4,7-triazacyclodecane (THTD)

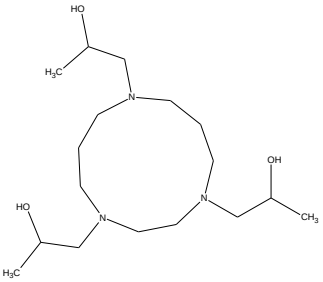
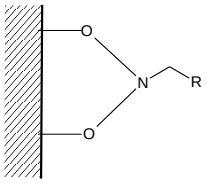


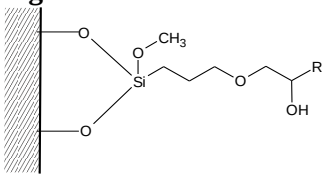
Figure 2 1,4,8,-tris-[(*S*)-2-hydroxypropyl]1,4,8-triazacycloundecane (THTUD)

The amino crown ethers were first immobilized directly on the Si substrates (fig. 3). A subsequent method was employed to immobilize all 4 ligands by means of a glymo spacer (fig. 4) in order to increase the distance between the substrate and the ligand, thereby minimizing the influence of the substrates[2]. The ligands were subsequently immobilised on 4 different Si substrates i.e. Si-gel (60Å), SBA-15, HMS, MCM-41. These substrates differ in surface area and pore size.



R_1 = 15-crown-5
R_2 = 18-crown-6

Figure 3 Direct immobilizationof the crown ethers



R_3 = (2-aminomethyl)-15-crown-5
R_4 = (2-aminomethyl)-18-crown-6
R_5 = THTD
R_6 = THTUD

Figure 4 Immobilization through the glymo spacer

Extraction experiments were carried out to evaluate the efficiency of the immobilized ligands, and to establish whether and how the different substrates influence this action.

References:

1. Sabatini, L and Fabbrizzi, L., *Inorg. Chem.*, 1979, **18**, 438-444
2. Kramer, J in *Chelating Ion Exchangers for the Recovery of Rhodium, PhD Thesis*, 2002