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MOLECULAR RECOGNITION WITH NOVEL CHROMATOGRAPHIC PHASES BASED ON COMBINATION OF PORPHYRINS AND EXPANDED PORPHYRINS WITH CHIRAL BINAPHTHYL DERIVATIVES: APPLICATION FOR THE SEPARATION OF BIOLOGICALLY IMPORTANT SUBSTRATES*

IVANA KAVENOVÁ[a], ROMAN HOLAKOVSKÝ[b], MARTIN HOVORKA[b], VÁCLAV KŘÍŽ[a], PAVEL ANZENBACHER JR.[a], PAVEL MATĚJKA[a], VLADIMÍR KRÁL[a], JOHN W. GENGE[c], and JONATHAN L. SESSLER[c]

[a]Department of Analytical Chemistry, [b]Department of Organic Chemistry, Institute of Chemical Technology, 166 28 Prague 6, Technická 5, Czech Republic, [c]Department of Organic Chemistry and Bio chemistry, University of Texas at Austin, Austin, Texas, 78712, USA

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The chemistry of porphyrins and expanded porphyrins has made a significant progress due to the development of host ligands for the separation of biologically important compounds. Recently, it has been shown, that the porphyrins[1,2], expanded porphyrins sapphyrins[3], and metalated texaphyrins[4] are capable of binding anions in solution with varying degree of affinity.

Covalent attachment of a molecular receptor to a solid support can provide valuable insight into the understanding of receptor-substrate interactions and gives a possibility to determine the thermodynamic and kinetic factors of particular binding. This approach allows for the quick evaluation of receptor's ability to bind substrates and their possible use in chromatography.

Recently, Meyerhoff[1,2] has used metallated porphyrin macrocycles appended to silica gel to act as anion selective agents.

Monoprotonated sapphyrin[3,5,6], a pentapyrrolic expanded porphyrin, possessed properties that included a new selective interaction between the sapphyrin macrocycle and certain anionic species including phosphate.

Variety of spectroscopic studies as well as X-ray crystallography have shown the mode of phosphate binding based on combination of hydrogen bonding with coulombic attraction. Binding mode for anions by metalloporphyrins and texaphyrins is based on the axial ligand chelation.

Previously we have reported that, when attached to a silica gel solid phase, monoprotonated sapphyrin effectivelly separated mono-, di-, a triphosphate nucleotides under isocratic HPLC conditions[7,8].

We have used solid state ^{31}PNMR and IR methods for determination of binding mode and the geometry of complexes ligand-phosphorylated substrates.

As a continuation of this line of research, we designed ligand sorbents of macrocycle-chiral binaphthol mixed type for chiral separation modes.

The idea behind is to use the multiple recognition process for enantioselective separation of important substrates such as unnatural amino acids, nucleotide analogs, and modified oligonucleotides and oligopeptides.

The synthetic strategy is based on coupling of carboxy-substituted macrocycles and binaphthyl derivatives with aminopropylsilica gel (Fig. 1).

The recognition process is based on anion complexation (carboxylate, phosphate) by the above mentioned macrocyclic compounds and simultaneous complexation of protonated amino group or sugar unit with chiral binaphthyl unit. This chiral selector has been chosen for the following reasons: it offers an oriented hydrogen bonding for interaction with substrates and provides the chiral binding mode with protonated aminogroups of aminoacids or with sugar part of modified nucleotides, as well as hydrophobic and *n-n* stacking interaction. The proof that this combination of binding modes is based on IR study in the solid state. Preliminary results indicate the ability of novel chiral sorbents to provide enantioselective separation of biologically important compounds.

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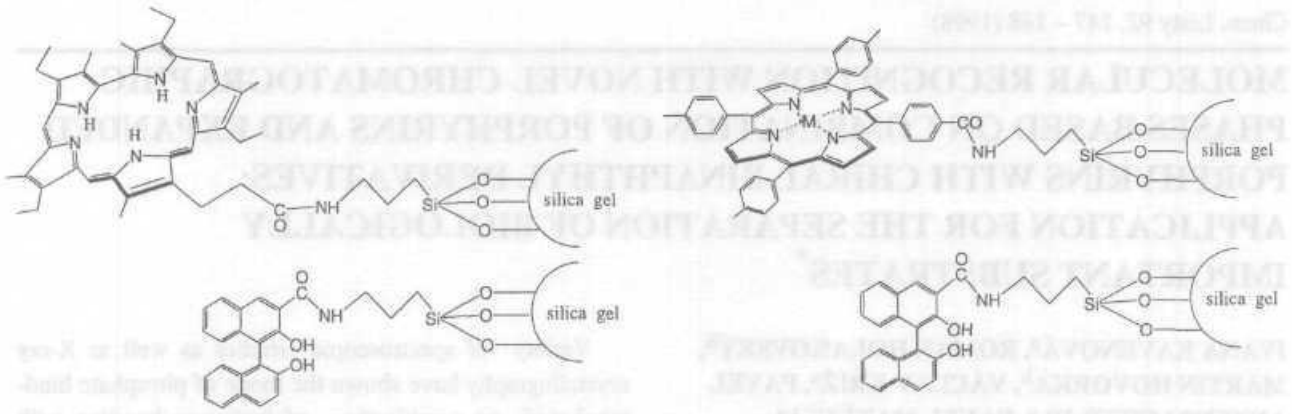

Fig. 1. **Macrocycle (metalloporphyrin or sapphyrin) - binaphthyl derivatized aminopropylsilica gels as sorbents for enantioselective HPLC separation**

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I. Kavenová[a], R. Holakovský[b], M. Hovorka[b], V. Kříž[a], P. Anzenbacher Jr.[a], P. Matějka[a], V. Král[a], J. W. Genge[c], and J. L. Sessler[c] *("Department of Analytical Chemistry, [b]Department of Organic Chemistry, Institute of Chemical Technology, Prague, [c]Department of Organic Chemistry and Biochemistry, University of Texas at Austin, Austin, Texas, USA):* **Molecular Recognition with Novel Chromatographic Phases Based on Combination of Porphyrins and Expanded Porphyrins with Chiral Binaphthyl Derivatives: Application for the Separation of Biologically Important Substrates**

A novel possibility for the chiral separation mode based on multiple recognition by mixed macrocycle-binaphthyl ligands on derivatized aminopropylsilica gel HPLC sorbents is presented. These novel chromatographic sorbents showed a great potential for aminoacid and saccharide separations.