USING METALS FOR THE SEPARATION OF ORGANIC ANALYTES: LIGAND EXCHANGE CHROMATOGRAPHY

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There are many separation mechanisms used in chromatography but ligand exchange chromatography (LEC) is not particularly well known despite having some unique properties. Only for some purposes are such stationary phases in common use, e.g. for the resolution of enantiomers.

LEC is based on the complexation of the analyte with a metal ion irreversibly bound in the stationary phase. The analyte is temporarily incorporated into the coordination sphere of the metal ion – this reaction must be reversible so that the analytes can be eluted from the column. The analytes are set free either through the use of a higher temperature or the use of a competing solvent.

LEC can be used for either the analysis of individual compounds or for the group separation. The latter situation is found in the sample preparation of fossil material. In such cases a group separation is desirable, i.e. a complexation of all compounds in the sample containing a certain chemical functionality. For instance, in the analysis of sulfur containing compounds in fuels, a stationary phase containing a Pd(II)-complex is used. The sulfur atom coordinates with the metal ion and the sulfur compounds are retained while the hydrocarbons are washed off the column. A stronger eluent elutes the aromatic sulfur compounds, and an eluent with even stronger characteristics can elute the sulfide forms. In this way a sorting of the components depending on their sulfur functionality is achieved by LEC.

Commercial phases containing copper ions are available for the separation of amino acids; here the amino group and the carboxylic acid group coordinate with the ion. Since the Cu ion is held in the stationary phase in the form of an enantiopure complex, a resolution of the D- and the L-forms of the amino acid is achieved. Hydroxy carboxylic acids likewise can be complexed.

The concept of LEC has also been employed in gas chromatography, for instance by first complexing oxygen compounds in the sample on a phase containing europium ions and, following removal of non-oxygen compounds, desorbing these for sensitive GC analysis.