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Abstract (Doctor)

Title of Thesis	Extraction and Separation Media with Synthetic Polymers for High Performance Chromatographic Analysis
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Approx. 800 words

Chromatography is a high-performance separation technique that is commonly used in a variety of fields, including the medical, environmental, and food industries. Liquid chromatography (LC) is a representative technique of chromatographic methods that uses a liquid, such as organic solvents, as the mobile phase for the separation. In gas chromatography (GC), which is carried out with a gaseous the mobile phase, an efficient separation performance can be achieved especially for the separation of complex sample mixtures consisted of closely-related volatile organic compounds. Recently, the requirements for analytical techniques in separation science have been significantly increased on the basis of the enhanced demands for these methods. The development of appropriate separation and extraction media designed for the target analytes has been significantly desired in chromatographic analysis.

In this thesis, several synthetic polymers have been introduced as extraction and separation media for high performance chromatographic analysis.

First, a poly(4-vinylpyridine) (P4VP) stationary phase has been introduced as separation media in LC, and the molecular shape selectivity for a group of polycyclic aromatic compounds (PACs) on P4VP phase was evaluated. The results was compared with that obtained on conventional chemically-bonded stationary phases. In contrast to a conventional octadecylsilica (ODS) phase, the chemical structure of the P4VP phase is consisted of linear poly(4-vinylpyridine) on a silicagel support. On the P4VP phase, a high linear correlation between the logarithmic retention factor and F number was observed for planar PACs, and smaller retention for non-planar PACs was also observed than planar PACs. The selectivity for planar/non-planer analytes on the P4VP phase was significantly better than that of a conventional polymeric ODS.

Another stationary phase on the basis of a different type of synthetic polymer, a poly(butylene terephthalate) (PBT)-coated silica has also been applied to the stationary phase in LC. The retention trends for various aromatic compounds on the PBT phase were studied along with the effect of column temperature on the retention behavior. In the case of the PBT stationary phase, a good selectivity for planar/non-planar analytes was observed for PACs. The trend was quite similar to that of the P4VP stationary phase described above. However, retention trend on the PBT phase showed that "rod-like" molecules were retained longer than "square-like" molecules, suggesting a different separation mechanism between P4VP and PBT phases. In addition, the selectivity for quinoline/isoquinoline on the PBT stationary phase was better than that on the conventional stationary phases. The results suggest that the PBT recognizes the position of the nitrogen atom in the analyte molecule.

Next, synthetic fibrous polyimide (PI) has been introduced as a separation medium in

GC. Fiber-packed capillary column was prepared by packing the PI filaments into a fused-silica capillary and the retention performance as a GC stationary phase was studied. In the PI phase, a good linear relationship between the carbon number and the logarithmic retention factors of alkane analytes was observed along with linear van't Hoff plots where the logarithmic retention factors was plotted against the reciprocal absolute column temperature. Taking advantage of the synthetic PI filaments with a good heat-resistance, temperature-programmed GC separations with the fibrous PI stationary phase was demonstrated.

Synthetic filaments have been also applied as the extraction medium for the GC analysis of monoethanolamine (MEA), one of the hazardous volatile organic compounds in air samples. Simultaneous extraction and derivatization process was studied with the specially-designed needle-type device packed with fibrous Zylon as the extraction medium. Furthermore, the needle-type device was applied to the sample preparation of other volatile amines. Introducing derivatization reaction with cyclohexanone, the sensitivity of MEA was significantly improved, and the method was possible to be applied to the sample preparation of other volatile amines existed in air samples. Taking advantage of the specially-designed needle, the needle was able to be stored for several days at room temperature after the sampling, where the derivatives of the volatile amines were stably trapped on the surface of the Zylon filaments in the needle.

Introducing braided arrangements with Zylon filaments as an extraction medium, further possibilities of synthetic fibrous materials were studied. Preconcentration of aromatic compounds in water samples with the braided extraction medium was established. By connecting metal wire inside of the braid to a power supply and applying voltage to the wire, heat-assisted desorption with resistive heating was demonstrated. On the basis of a low voltage application to the metal wire in the center of braided fiber as a extraction medium, the temperature of the extraction capillary was elevated and the desorption efficiency was clearly improved by applying a voltage during the desorption process.