SILESIAN UNIVERSITY OF TECHNOLOGY
FACULTY OF CHEMISTRY
DEPARTMENT OF ORGANIC CHEMISTRY, BIOORGANIC CHEMISTRY AND BIOTECHNOLOGY

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DOCTORAL DISSERTATION

Rozdział mieszanin nanorurek węglowych metodą dwufazowej ekstrakcji wodnej

Separation of carbon nanotube mixtures by aqueous two-phase extraction method

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Abstract

Due to their physical and chemical properties, single-walled carbon nanotubes (SWCNTs) have been of great interest to the scientific community for several decades. The current level of technological advancement does not yet offer effective synthesis methods of SWCNTs with precisely defined properties, so separation methods that would enable efficient isolation of material with specific characteristics are highly wanted. One of the commonly employed techniques is aqueous two-phase extraction (ATPE), based on the preferential migration of analytes to one of two aqueous phases formed by compounds of significant difference in hydrophilicity.

This work is a collection of published articles about effective, one-step methods for separating SWCNTs by ATPE using an extraction system composed of dextran and polyethylene glycol. Commercially available mixtures of SWCNTs (of both small and large diameters) were used as starting materials.

Firstly, the influence of low-molecular inorganic compounds on separation, which enabled the isolation of SWCNTs with a (6,5) chirality index, was examined. Then, another low-molecular inorganic compound was engaged to develop a way of isolating SWCNTs of particular nature of conductivity. Fractions isolated using the devised approach were purified from contamination, and their physicochemical properties were measured.

Further works were focused on analyzing the influence of non-ionic surfactants on the separation process. The study was of high degree of novelty as such compounds had not yet been tested in the context of the isolation of SWCNTs by the ATPE method before. The developed extraction protocols enabled the isolation of the material by chirality. Moreover, combined experimental data and modeling approaches provided the details required to understand the separation mechanism.