Abstract: *Preparation and Characterization of Activated Carbons Produced from Polymers* by M.Sc. Eng. Marcin Kaliszewski, supervised by dr. hab. Rafał J. Wróbel, Prof. ZUT

This thesis presents a review of the literature on the preparation of carbon materials and activated carbons derived from polymers, particularly poly(furfuryl) alcohol, aramid fibers (Kevlar), and used car tires. The advantages and disadvantages of polymer-derived carbon materials are discussed.

In the experimental part, poly(furfuryl) alcohol was obtained through polyfurfuryl alcohol condensation, and commercially available aramid mats (Kevlar) were used. These polymers underwent pyrolysis in a nitrogen atmosphere to produce carbonizates. For rubber from used car tires, a commercially available carbonizate from Contec Sp. z o.o. in Szczecin was used. The carbonizates were then physically activated with carbon dioxide. Both the carbonizates and activated carbons were tested for gas sorption applications, particularly for carbon dioxide and ethylene. Sorption capacities for n-butane were also measured for carbon materials from tire pyrolysis.

The highest sorption capacities for carbon dioxide and ethylene were obtained from poly(furfuryl) alcohol-based materials, reaching 2.4 and 4.1 mmol/g at 30°C. The CO_2/C_2H_4 sorption ratios were 0.5–1.0, 0.5–1.2, and 0.5–3.0 [mol/mol] for activated carbons from Kevlar, poly(furfuryl) alcohol, and tire rubber, respectively. The high ratio for the inexpensive tire-based material suggests potential for carbon dioxide-ethylene separation applications.

The carbon materials were characterized by BET, TGA, XPS, XRD, SEM, EDS, and MS to identify key parameters influencing sorption capacities. The presence of nitrogen and oxygen heteroatoms reduced ethylene sorption, and the satellite in the XPS C1s spectrum correlated strongly with ethylene sorption. Micropore volumes of up to 0.7 and 0.8 nm were crucial for carbon dioxide sorption at 30°C and 0°C.

Ultrapure activated carbon from poly(furfuryl) alcohol was also used as a support for an iron catalyst in methane pyrolysis to produce hydrogen. The catalyst was made using iron(II) sulfate(VI) heptahydrate, a byproduct from Grupa Azoty Police S.A. The results demonstrated significant acceleration of methane pyrolysis, showcasing the advantages of ultrapure carbon materials in fundamental research.

Data i odręcznych podpis

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