MODERN POROUS POLYMER AND CARBON MATERIALS BASED ON POLYURETHANES FOR APPLICATIONS IN MEDICAL DIAGNOSTICS

ANDRZEJ S. SWINAREW[1,2]*, KLAUDIA KUBIK[1], JADWIGA GABOR[1], JAROSŁAW PALUCH[3], MAGDALENA POPCZYK[1], ARKADIUSZ STANULA[2], HUBERT OKŁA[1], ADAM ŚWIERCZYŃSKI[4]

[1] UNIVERSITY OF SILESIA IN KATOWICE, FACULTY OF SCIENCE AND TECHNOLOGY, POLAND
[2] DEPARTMENT OF SWIMMING AND WATER RESCUE, INSTITUTE OF SPORT SCIENCE, THE JERZY KUKUCZKA ACADEMY OF PHYSICAL EDUCATION, KATOWICE
[3] DEPARTMENT OF ENT, FACULTY OF MEDICAL SCIENCES IN KATOWICE, MEDICAL UNIVERSITY SILESIA, KATOWICE, POLAND
[4] BRING IT TO EUROPE ADAM ŚWIERCZYNSKI, KATOWICE POLAND
*E-MAIL: ANDRZEJ.SWINAREW@US.EDU.PL

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Introduction

The analysis of biological samples dates back to the age of Hippocrates, who described halitosis (fetor oris) and hepatic stink (fetor hepaticus) in a treatise on the smell of breath and disease [1]. The potential for using the breath as a diagnostic sample has grown significantly with the advent of modern chemistry, materials, and biomedical engineering. In 1784 Antoine Lavoisier proved that the human body consumes oxygen and produces carbon dioxide, and six years later, he published a scientific article, "Experiments on animal respiration and changes occurring when air passes through the lungs" [2]. Based on Lavoisier's work almost 100 years later, in 1874, Francis Anstie observed that small amounts of alcohol were excreted in the exhaled air [3]. In 1897, Nebalthau showed that people with diabetes exhale acetone [4]. More systematic research and breathing tests did not appear until around 1927 when Bogen [5] and McNalley [6] developed alcohol tests, which initiated the development of the first device for testing sobriety in drivers developed by Harger in 1931 and patented in 1936 [7]. The modern era of respiratory phase testing began in 1971 when Pauling analyzed volatile organic compounds (VOCs) in the exhaled air that had been condensed in a chilled stainless steel tube. He found that normal human breathing contains over 250 different VOCs [8]. Since then, the area of respiratory phase analysis has attracted the attention of scientists as well as large interested physicians.

Materials and Methods

In this study, the activities related to the process of producing carbon foams (synthesis, carbonization) were described and their extensive characterization was made using the following research techniques: light microscopy, scanning electron microscopy (SEM), infrared spectroscopy (FT-IR), computer microtomography (μCT) and gas chromatography linked to a mass detector (GC-MS).

The results of the research were used to select foams with the best sorption properties, with a focus on the possibility of their further application for diagnostic tests of the respiratory phase.

Results and Discussion

The conducted research made it possible to identify porous materials with the best properties. Depending on the used substrates, their proportions and catalysts used, porous materials were obtained that differed from each other in terms of physical and mechanical properties. It was also found high homogeneity and chemical purity as well as no release of own volatile compounds, which could have an impact on the obtained results of the respiratory phase analysis. An additional advantage is the ability to manipulate the shape and size of the pores in the synthesis process.

Conclusions

The conclusions have to be based on the facts in evidence and should be limited to minimal speculation about the significance of the work. The proposed method of respiratory phase analysis based on the use of synthesized porous polymeric materials is non-invasive and easy to carry out. Also, the method of obtaining material for research related to desorbing the respiratory phase from the foam is not difficult and is much simpler than in the techniques used so far.

References

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