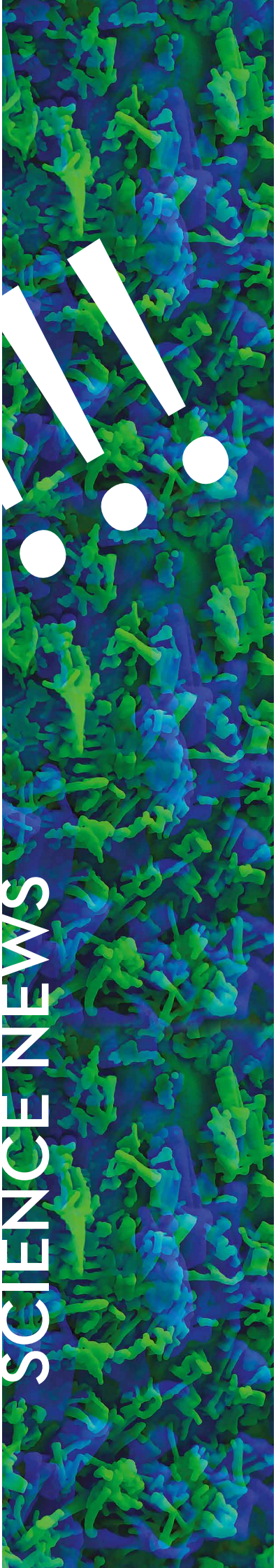


MEMBRANES BASED ON NANOMATERIALS

Scientists associated with the Institute of Chemistry at the University of Silesia have developed a method to create special membranes from graphene oxide (or its derivatives) and cellulose. Due to the high graphene oxide content (in relation to the membrane's cellulose) and increased absorptive capacities, these membranes can remove residual amounts of heavy metals (e.g. cadmium, lead, or cobalt) from water solutions and, with the use of spectroscopic methods, mark the ions of these metals contaminating, among others, water and soil.

Previous solutions made use of graphene but displayed significantly smaller absorptive capacities with regard to heavy metal ions. Moreover, toxic compounds were used in their production process. Thanks to the new solution, the manufacturing of membranes from graphene oxide or its derivatives and cellulose will become easier, quicker, and cheaper. Most importantly, however, this will permit to produce homogeneous materials with good adsorptive qualities, retreated multiple times, durable and stable in acidic, neutral, and, what has previously been rare, basic environments. These qualities permit to use them in more diverse ways, e.g. in analytical chemistry – in spectroscopic techniques; in order to mark or concentrate even residual amounts of heavy metal ions.

NEW SUBSTANCES IN THE FIGHT AGAINST ALZHEIMER'S DISEASE

A group of scientists including chemists from the University of Silesia developed two new carbamate derivatives which can be used in pharmaceutic drugs designed to alleviate the symptoms of Alzheimer's disease.

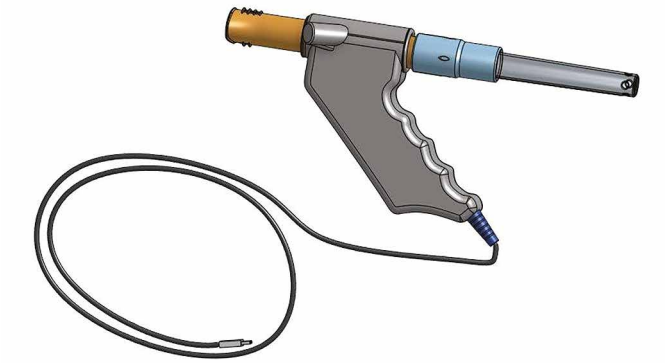
In patients' brains, proteins (betaamyloids) are deposited and form so-called senile plaques. The deposits grow and cause neurons and synapses of the cerebral cortex to gradually disappear, which in turn reduces the person's intellectual capacities. In the currently used drugs, which merely alleviate the symptoms, enzymes responsible for the breakdown of acetylcholine are predominantly used. Due to the blocking of this process, the neurotransmitter's level in the patient's brain rises, and this compensates for its decreased concentration caused by the death of cholinergic neurons. Carbamates belong to the group of substances responsible for blocking their breakdown.

By modifying their structure, a selective or non-selective substance interacting with certain enzymes can be obtained. Depending on the stadium of Alzheimer's disease, the concentration of enzymes responsible for the breakdown of acetylcholine changes. In early and middle phases of the disease only three substances are used, however, they show low bioavailability, poorly pass the blood-brain barrier, and can cause numerous adverse effects. Moreover, on the drug market, there is demand for substances which will regulate the breakdown of acetylcholine in more advanced stadiums of the disease.

The new carbamate derivatives were obtained by scientists from Poland, the Czech Republic, and Slovakia. The end goal is to study these compounds as active substances designed to alleviate symptoms of Alzheimer's disease by means of interacting with enzymes responsible for regulating the breakdown of acetylcholine in early and advanced stadiums of this condition.

BREATH-BASED DIAGNOSTICS

The importance of breath testing in the diagnostic of numerous diseases, such as bacterial infections, allergies, respiratory insufficiency, liver failure, or even tumor-related changes, is becoming increasingly important in research. Such analyses are patient-friendly, non-invasive, secure, and do not cause adverse effects.



Scientists from the University of Silesia, the Jerzy Kukuczka Physical Education Academy, and the Medical University of Silesia developed a special device for diagnosing squamous cell carcinoma of the upper respiratory tract and pulmonary hypertension by means of a breath test. The device, which collects and stores gas phases, was granted protection for the industrial design in the European Union.

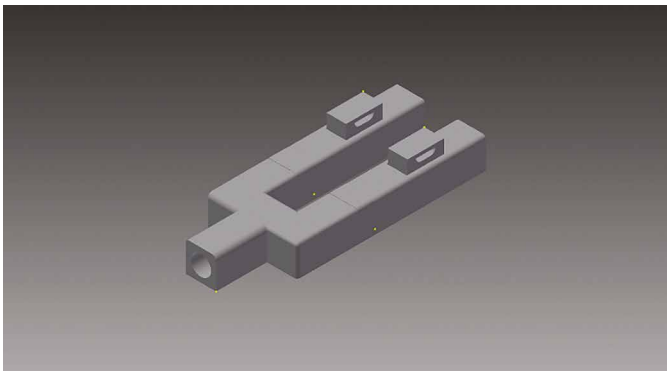
In a human breath sample, there are up to several hundred volatile compounds, and their analysis permits to identify e.g. cancer markers. The device consists of a short tube where porous carbon is placed. The carbon adsorbs markers which are of interest to the diagnostician. Subsequently, the carbon itself is placed in the analyzing device where further tests are performed and permit to differentiate between various compounds. The device also features an exchangeable mouthpiece which can be repeatedly used (after being sterilized each time).

– Thanks to our mouthpiece, it will be possible to perform e.g. screening tests for asthma in schools. It is sufficient to carry out breath tests by means of our newly designed device, and the laboratory diagnostician will be able to quickly and effectively provide diagnoses for a large group of people on the basis of the collected material, explains Dr. Andrzej Swinarew, Materials Engineer at the University of Silesia and co-author of the device. – We will get to know how many children can contact bronchial asthma in the future, and this will provide opportunities for specific actions and enable us to introduce therapeutic measures in early stages of the disease when it is fully curable. This also applies to cancer markers. The earlier an illness is diagnosed, the greater the chances for curing it.

A MOUTHPIECE WHICH WILL HELP TO DIAGNOSE E.G. LUNG CANCER

Scientists from the Faculty of Science and Technology at the University of Silesia developed a special mouthpiece which can be applied in diagnostics of upper and lower respiratory tract diseases, including lung and laryngeal cancer as well as bronchial diseases.

The growing importance of early cancer diagnostics leads scientists to look for new ways to quickly recognize disease symptoms. Modern, non-invasive analyses of the chemical composition of exhaled air are used with increased frequency. Due to analytical chemistry tests, a relationship between certain types of proteins and lung or laryngeal cancer can be identified and determined. Cancer markers are collected by means of so-called Tedlar bags into which the exhaled air containing proteins is blown in. The downsides of this solution are a small amount of air, low concentration in the samples, and the risk of damage in transport. Therefore, the scientists decided to replace the bags with porous polymer materials featuring a complex inner structure and to use special mouthpieces.



The patented two-corner mouthpiece can be produced from modified polyester by means of 3D printing. It has antibacterial properties, is reusable (after being sterilized each time), and will meet all requirements to be approved for medical application. Moreover, it will be possible to filter the inhaled air and to direct it to the porous material, a process which will reduce the contamination of the sample and make it possible to target more cancer markers in a single test.

text: Dr. Małgorzata Kłoskowicz