Researchers plan DNA-based nanorobot for cancer diagnostics

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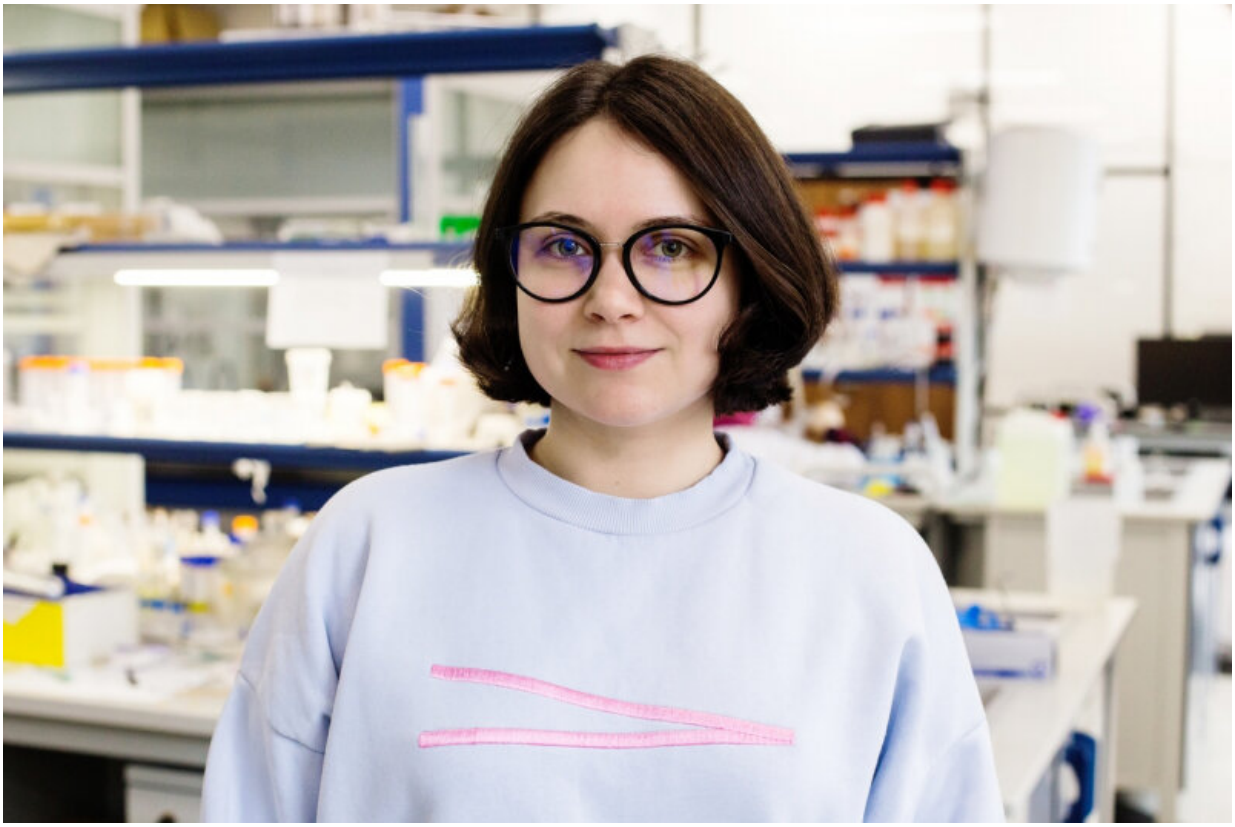

Ekaterina Goncharova, a Master Degree student at ITMO University's International Research Center SCAMT, a co-author of the research. Credit: ITMO.NEWS

A group of researchers from ITMO University has come up with the

concept of a new drug against cancer: a nanorobot made of DNA fragments, which can potentially be used not only to destroy cancer cells, but also to locate them in the body. The research is published in *Chemistry—A European Journal*.

The development of effective cancer treatment drugs without severe side effects is now one of the most important tasks faced by chemists, pharmacists, and biologists. Scientists have high hopes for gene therapy, which combats mutations that occur in cells.

"DNA is the foundation of the cell, it contains its genetic material, which is needed to encode proteins that are vital for the existence of the cell," says Ekaterina Goncharova, a co-author of the research. "When a cell becomes cancerous, it leads to the change in the genome, after which it begins to synthesize "bad" proteins, not the ones that our body needs. As a result, the cells begin to multiply uncontrollably and the tumor grows bigger and bigger."

However, if the production of disease-related proteins is blocked, the cancer cells will no longer be able to multiply and will start to die out. DNA enzymes called deoxyribozymes can, under certain conditions, cleave bonds in an RNA strand. The researchers decided to use this property and created the so-called nanorobots based on artificially synthesized deoxyribozymes.

"Our DNA-based nanorobot consists of two parts: a detection one and a therapeutic one," explains Ekaterina Goncharova. "The therapeutic part destroys a pathogenic RNA strand: the more we destroy it, the less harmful protein is produced. The second part of our robot allows us to detect pathogenic cells: if there is an 'incorrect' RNA molecule in the cell, our substance binds with an chemically modified oligonucleotide, which is artificially introduced into the cell, cleave it, and a fluorescence occurs."

Another significant advantage of the newly proposed concept is its price. The creation of such a nanorobot for laboratory research costs just about USD 15 to 25.

At the moment, the experiments have been carried out in chemically created environments using the KRAS gene, which serves in most oncological diseases as a "molecular switch" for the induction of cell division. The nanorobot was able to detect a pathogenic RNA strand and destroy it. These experiments will be followed by experiments on living cells and, potentially, on animals. One of the most important problems that the researchers have to solve is how to deliver the nanorobot to the affected cells. The work on such a drug delivery system is currently carried out at various laboratories, including ITMO University.

More information: Aleksandr A. Spelkov et al. Bifunctional RNA-targeting deoxyribozyme nanodevice as a potential theranostic agent, *Chemistry – A European Journal* (2020). DOI: 10.1002/chem.201905528

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