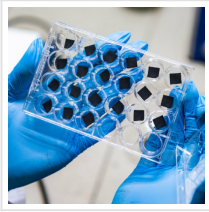
Boron Nitride Nanofilms Will Replace Antibiotics While Protecting Against Bacterial and Fungal Infections



2020-09-22
NUST MISIS material scientists have presented antibacterial nano-coatings based on boron nitride, which are highly effective against microbial pathogens (up to 99.99%). They can become a safe alternative to the usual antibiotics in implantology since they do not have typical negative side effects.

Nowadays, due to the significant increase in the number of surgical procedures around the world, scientists are solving the problem of microbial infections caused by implants.
It is especially serious during orthopedic and dental operations. It is no secret that concomitant drug therapy for inflammation around implants often leads to side effects due to the characteristic properties of the antibiotics, as well as its high doses.

A group of young scientists from NUST MISIS has proposed a non-standard solution to the problem by investigating the interaction of antibiotic-resistant gram-negative bacteria Escherichia coli (E.coli) and a nanofilm consisting of a structured boron nitride surface.
It turned out that such a coating inactivates 100% of bacterial cells after 24 hours.

“Hexagonal boron nitride has a complex of unique physicochemical and mechanical properties. As a result of the experiments, we have found out that the special specific structure of boron nitride nanoparticles provides a bactericidal effect comparable to that of an antibiotic: bacteria die as a result of direct physical contact with a special needle-shaped surface of the nano-film. At the same time, there are no side effects typical of an antibiotic on the tissues of the body, and boron nitride itself does not cause cytotoxicity,” said Christina Gudz, co-author of the study, a researcher at the NUST MISIS Inorganic Nanomaterials Laboratory.

The researchers went further and filled the micro-pores of a thin coating of boron nitride with the gentamicin antibiotic. The result is an antibacterial effect due to the complete release of the drug in a short initial period. Moreover, its dose was an order of magnitude less than

with a conventional injection.

“Taking into account an average patient weight of 60 kg, his daily antibiotic dose is approximately 180 mg; provided that the implant area is, say, 30 cm2 and given that 55 µg of antibiotic is released from the nano-coating under study on the first day, it turns out that the proposed method assumes 100 times less antibiotic than with a standard injection,” added Christina Gudz.

According to the authors of the development, the application of an antibacterial film based on boron nitride nanoparticles to the implant can minimize the risk of bacterial contamination due to the physical properties of the surface itself, as well as, in the case of antibiotic modification, local delivery of a minimum amount of the bactericidal component without weighting the implant.

At present, the team is completing in vitro studies of the obtained coatings and is also working on optimizing the coating method for its future use.

The results of the work are published in the international scientific journal ACS Applied Materials & Interfaces.

Read the original article on NUST MISIS.