# Scientists develop a biodegradable alloy for bone implants for fractures, osteoporosis and myeloma

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The head of the Hybrid Nanostructured Materials Laboratory at NUST MISIS Alexander Komissarov. Credit: Maria Brodskaya/NUST MISIS

Material scientists from NUST MISIS and the University of Western

Australia have presented an innovative bioresorbable alloy based on magnesium, gallium and zinc. The material can be used for the manufacture of temporary implants in the treatment of fractures and the restoration of surgically removed areas of the bone, as well as in the treatment of osteoporosis, multiple myeloma, Paget's disease. The results of the study are published in the international scientific journal *Journal of Magnesium and Alloys*.

In modern bone implantology and cardiovascular surgery, biodegradable implants, which gradually dissolve and are replaced by body tissues are increasingly being used. This approach helps minimize the inflammation of the surrounding tissue caused by the implant and eliminates the need for an implant removal operation. The benefits of using such implants are especially noticeable in pediatric orthopedics, since permanent implants can limit bone development in a growing body.

Scientists find magnesium alloys especially interesting as biodegradble materials for the manufacture of implants due to their high biocompatibility, sufficiently high mechanical strength and an acceptable rate of biodegradation. In addition, the density and elasticity of magnesium alloys are close in characteristics to the human cortical bone.

The international scientific team of materials scientists from Russia and Australia has presented an innovative biodegradable alloy based on magnesium, gallium and zinc, which can be used for osteosynthesis in cases where additional treatment of diseases associated with the destruction and reduction of bone strength is required. An implant from this material can become a temporary "skeleton" safe for the patient to replace the damaged bone, and as the bone tissue grows, which the implant material stimulates itself, it will be "dissolved" by the body.

"We have choosen gallium as an alloying element due to its unique properties," said co-author Alexander Komissarov, head of the Hybrid Nanostructured Materials Laboratory at NUST MISIS. "Gallium, known as an inhibitor of bone resorption, is effective in treating disorders associated with accelerated bone loss, including osteoporosis, hypercalcemia, Paget's disease, and multiple myeloma. In addition, gallium is involved in biochemical regeneration processes, increasing the thickness, strength and mineral content of the bone. And finally, it has an antibacterial effect, which is especially important in implantology."

According to the developers, a rather low rate of biocorrosion is also a valuable property of the developed alloy. This means that an implant made of such an alloy does not undergo too rapid decomposition in the environment of the human body that is aggressive for metals and will retain its supporting functions throughout the healing process.

"We were able to experimentally establish that the Mg-4%, Ga-4% Zn alloy, after deformation processing using equal channel angular pressing, has a unique profile of characteristics for use in bone implants due to the optimal combination of mechanical properties and corrosion rate," said Komissarov.

Currently, the team is completing a series of laboratory experiments and is preparing for the preclinical phase of research.

**More information:** Viacheslav Bazhenov et al. Gallium-containing magnesium alloy for potential use as temporary implants in osteosynthesis, *Journal of Magnesium and Alloys* (2020). DOI: 10.1016/j.jma.2020.02.009

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