

SECTION 9.

PHYSICS AND MATHEMATICS

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DEVELOPMENT OF BIOMATERIALS WITH REGULATED PHYSICAL PROPERTIES IN UKRAINE

The basis of bioengineering technologies that are actively developing in the world is modern biomaterials science. New materials with specified physical properties make it possible to create unique systems: from coatings for implants to high-precision biosensors. Ukrainian scientists make a significant contribution to the development of biomaterials science [1].

The research institutions of the National Academy of Sciences of Ukraine carry out fundamental and applied research in the following main directions:

- structure and properties of new composite nanomaterials with biological and mechanical compatibility, creation of titanium alloys and bioactive ceramics with adjustable properties, bioinert ceramics with phase stability to aging processes;
- multifunctional biocompatible nanocontainers and nanocarriers for delivery, diagnosis and treatment, methods of immobilization of organic matter on the surface of nanoparticles;
- technologies of microplasma sputtering of biocompatible coatings of implants with a controlled structure, composite coatings based on alloys and compounds with an amorphous and nanocrystalline structure, which ensures high strength, wear resistance and corrosion resistance;
- electrochemical enzymes biosensors using the method of immobilization of biological material;
- methods of synthesis of thermosensitive physically cross-linked nanogels and nanocomposites with increased mechanical strength; composite systems based on organic and inorganic compounds with adjustable properties for biomedicine, bionanocomposites using supramolecular structures;
- methods of growing cells on bioactive ceramics for new generation implants; creation of the latest biocompatible materials for antibacterial surfaces;
- amorphous and nanostructured high-strength alloys for use in medicine, nanocoatings with high hardness and wear resistance;
- technologies for obtaining nanohybrids of biological molecules with 2D materials, nanocomposites of conductive polymers, hybrid materials based on substances of biological origin for biosensors;
- technologies for creating hybrid medical implants based on nanoceramics with nanostructured ones biocompatible coatings on titanium substrates that have antibacterial properties;
- production of functional polymer composites with adjustable structure based on polysaccharides and nanofillers of various nature; composite coatings for medical adsorbents, which increases biocompatibility;

- 3D printing of implants from bioactive ceramics for the restoration of bone tissue and bone function;
- the latest biopolymers for the regeneration of bone and nerve tissues, skin;
- atomic-molecular engineering, creation of the latest multi-component high-entropy systems with high thermal stability, strength, hardness, plasticity, corrosion resistance, etc. [2].

Most of these studies have no analogues, and their implementation in practice will ensure the development of bioengineering in Ukraine and the world.

References:

1. Holovko, M.V. & Arkhyrei, M.V. (2023) Achievements and Current Tasks of Biomaterial Science in Ukraine. *Biomedical Engineering and Technology*, (9), 71–83. (in Ukrainian).
2. Firstov, S. (2017). New trends in materials science. *Bulletin of the National Academy of Sciences of Ukraine*, (5), 18–21. (in Ukrainian).