FACULTY of PHYSICAL ENGINEERING

Department of High Temperature Materials and Powder Metallurgy

BACHELOR'S THESIS

ON THE TOPIC:

«STRUCTURE AND ADSORPTION ACTIVITY OF HYDROXYAPATITES OF DIFFERENT NATURE»

Completed by: 4th year student, group FK-32

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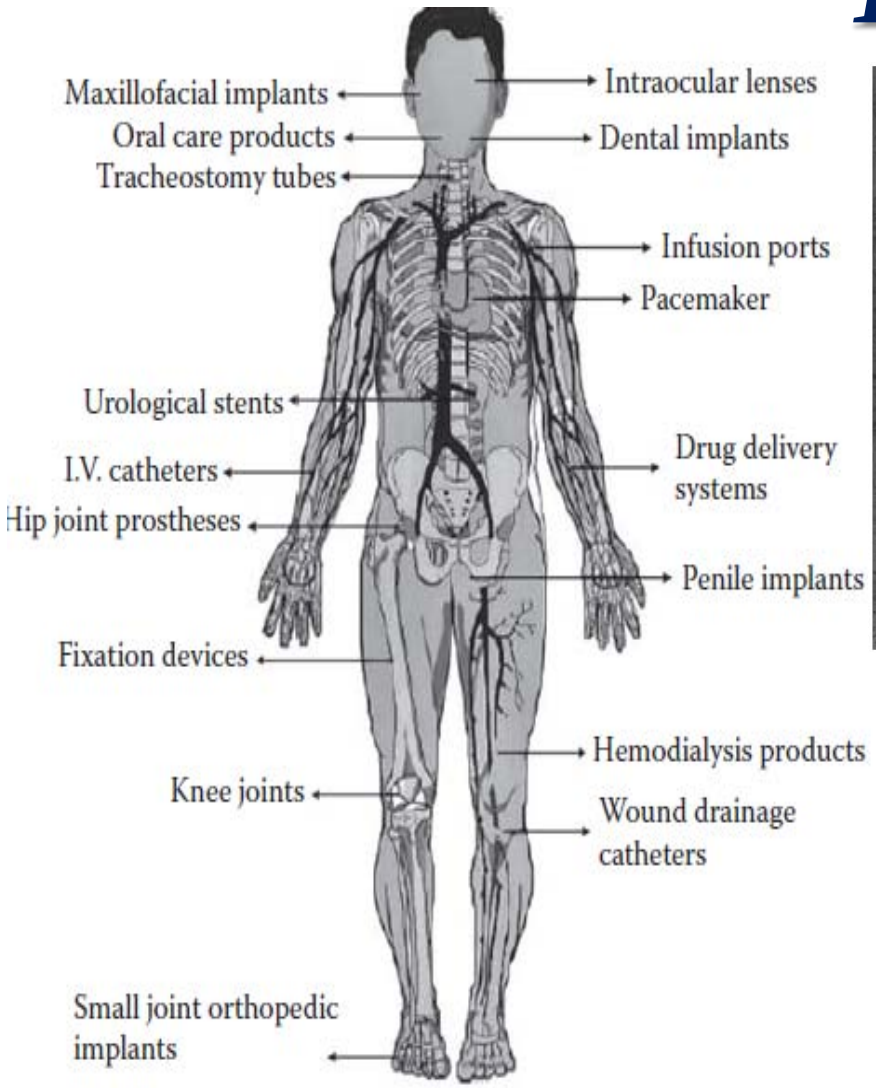
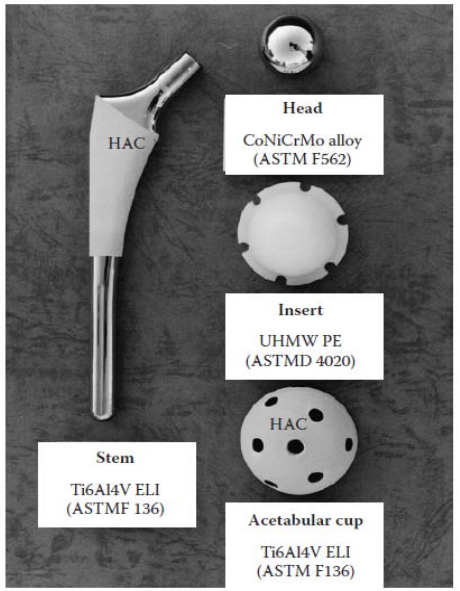
supervisors: PhD in Technical Sciences **Sysoiev M. O.,**

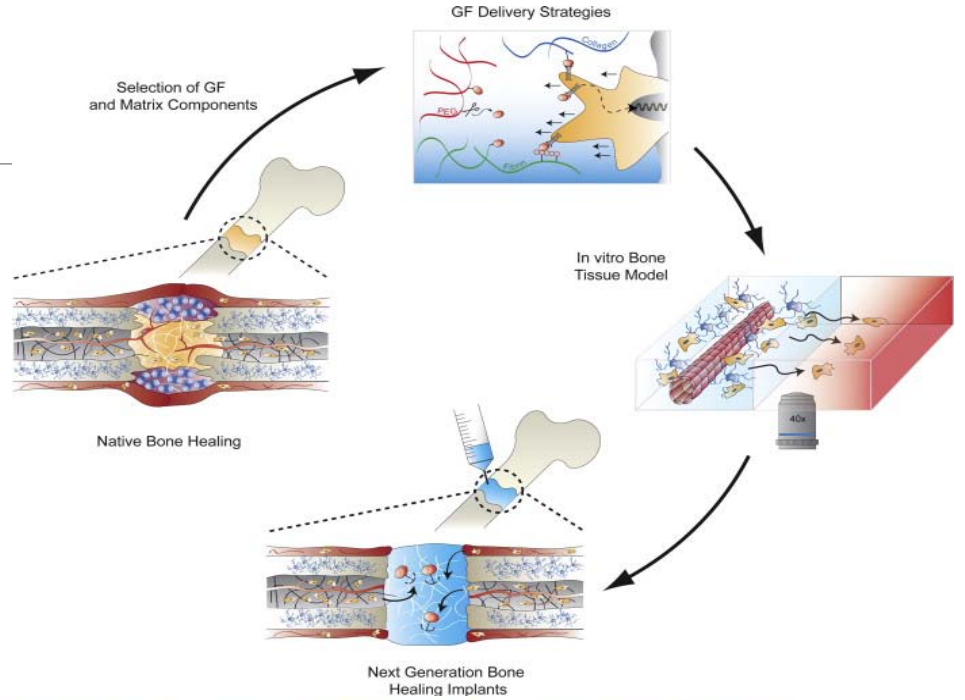
PhD in Technical Sciences, Senior Researcher of IPMS NASU
Sych O. Ye.

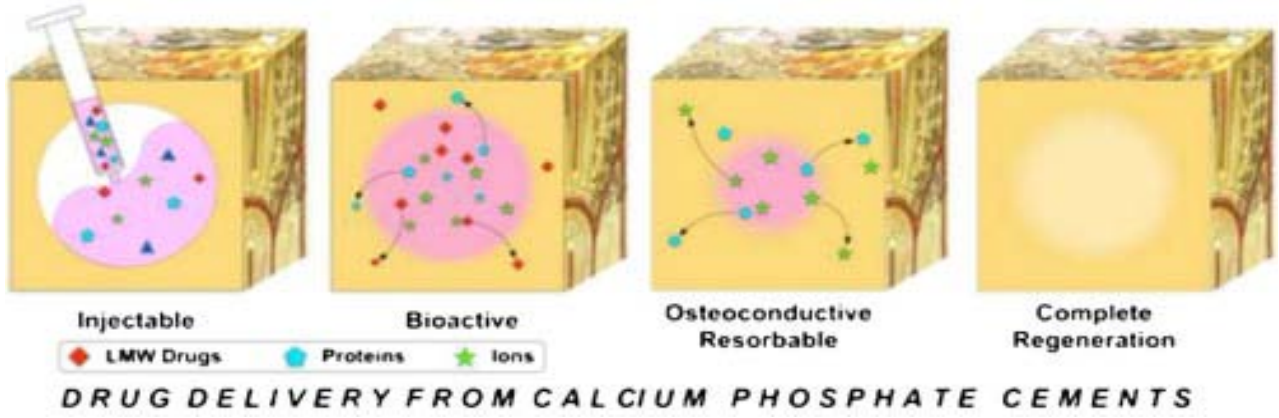
Kyiv - 2017

RELEVANCE


Maxillofacial implants
Oral care products
Tracheostomy tubes
Urological stents
I.V. catheters
Hip joint prostheses
Fixation devices
Knee joints
Small joint orthopedic implants
Intraocular lenses
Dental implants
Infusion ports
Pacemaker
Drug delivery systems
Penile implants
Hemodialysis products
Wound drainage catheters


HAC
Head
CoNiCrMo alloy
(ASTM F562)
Insert
UHMW PE
(ASTMD 4020)
HAC
Stem
Ti6Al4V ELI
(ASTMF 136)
Acetabular cup
Ti6Al4V ELI
(ASTM F136)


GF Delivery Strategies
Selection of GF
and Matrix Components
In vitro Bone
Tissue Model
Native Bone Healing
Next Generation Bone
Healing Implants


Injectable
Bioactive
Osteoconductive
Resorbable
Complete
Regeneration
LMW Drugs
Proteins
Ions
DRUG DELIVERY FROM CALCIUM PHOSPHATE CEMENTS

PURPOSE OF THE WORK: is to compare the composition and structural state of hydroxyapatites of different origin, with the level of properties that confirm the expediency of their use for medical purposes, including as capsules for directional drug transfer.

The main tasks of the research:

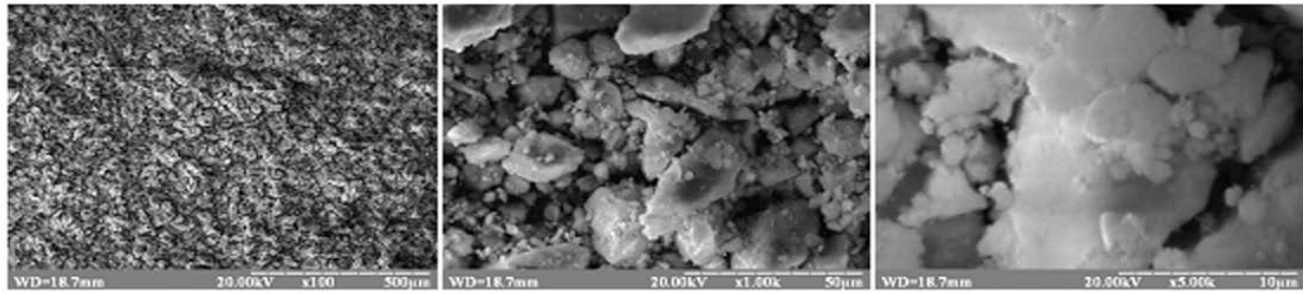
- **to investigate the process of obtaining the process of obtaining stoichiometric and non-stoichiometric synthetic and biogenic hydroxyapatite;**
- **to conduct saturation of powders of hydroxyapatite with methylene blue;**
- **to explore morphology, chemical composition and adsorption capacity of hydroxyapatite powders.**

CHARACTERISTICS OF THE STARTING MATERIALS

Powder	Abbreviation	Manufacturer	Particle size, µm	Percentage composition, mass %						Specific surface area, m^2/g
				Ca	P	O	H	Fe	Sr	
Synthetic stoichiometric hydroxyapatite	S-HAP-1	«Biomin H», Ukraine	< 40 µm	39,804	41,4	18,49	0,2	0,035	0,051	209,5
Synthetic non-stoichiometric hydroxyapatite	S-HAP-2	«Biomin H», Ukraine	< 40 µm	37,274	41,4	20,49	0,2	0,322	0,294	90,0
Biogenic hydroxyapatite	B-HAP	«Osteoapatyt keramichnyi», Ukraine	< 50 µm	40,937	39,4	18,49	0,2	0,192	0,071	10,8

MORPHOLOGY AND SPECIFIC SURFACE AREA OF HAP, OBTAINED BY VARIOUS METHODS

a



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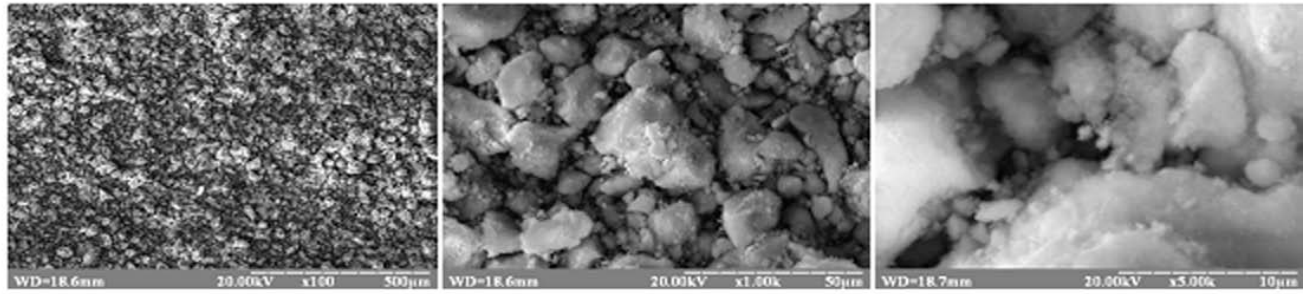
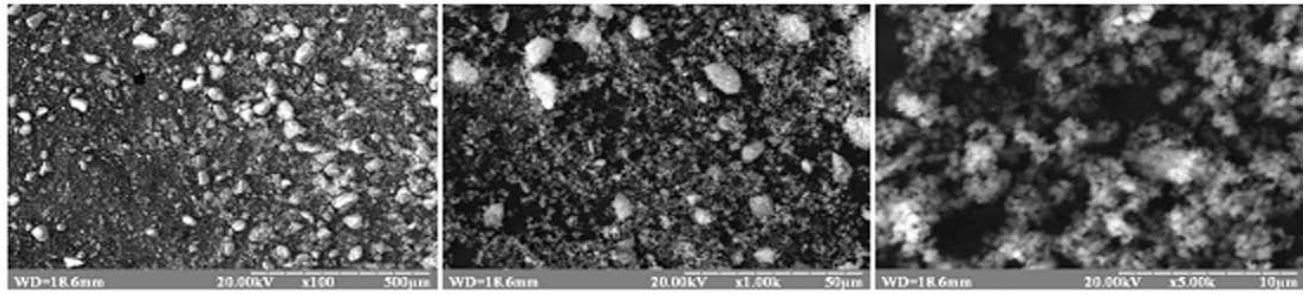
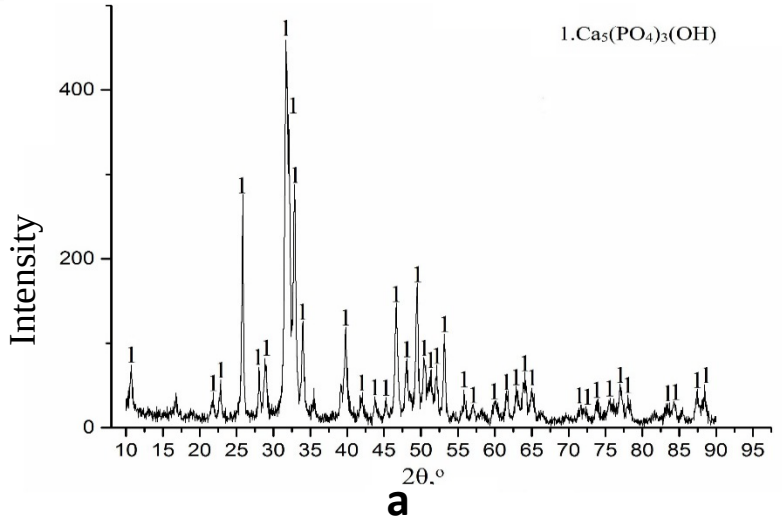


c

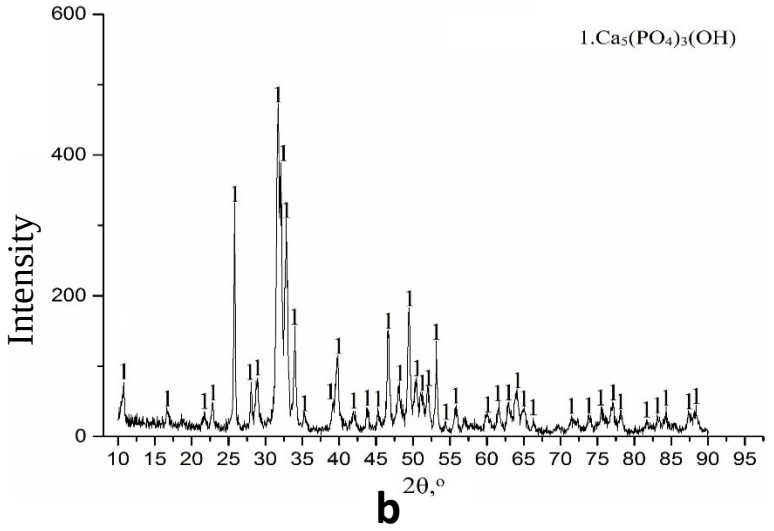


a – S-HAP-1; b – S-HAP-2; c – B-HAP

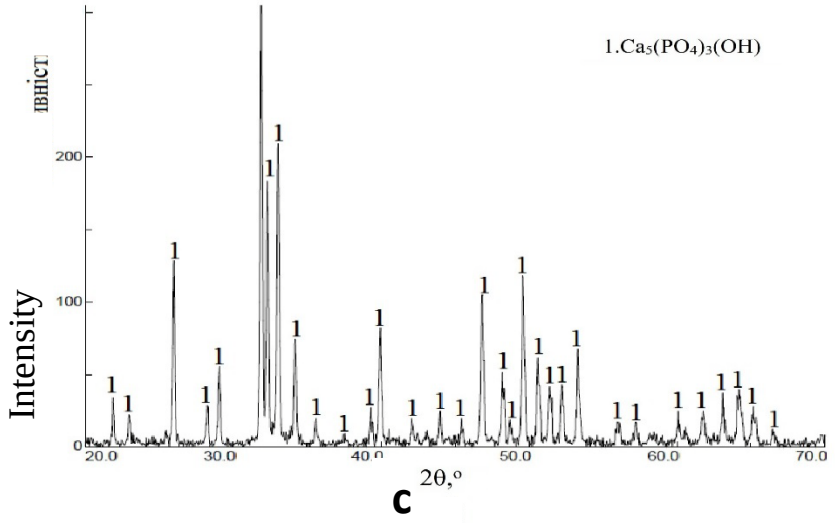
X-RAY ANALYSIS OF THE INITIAL COMPONENTS



a



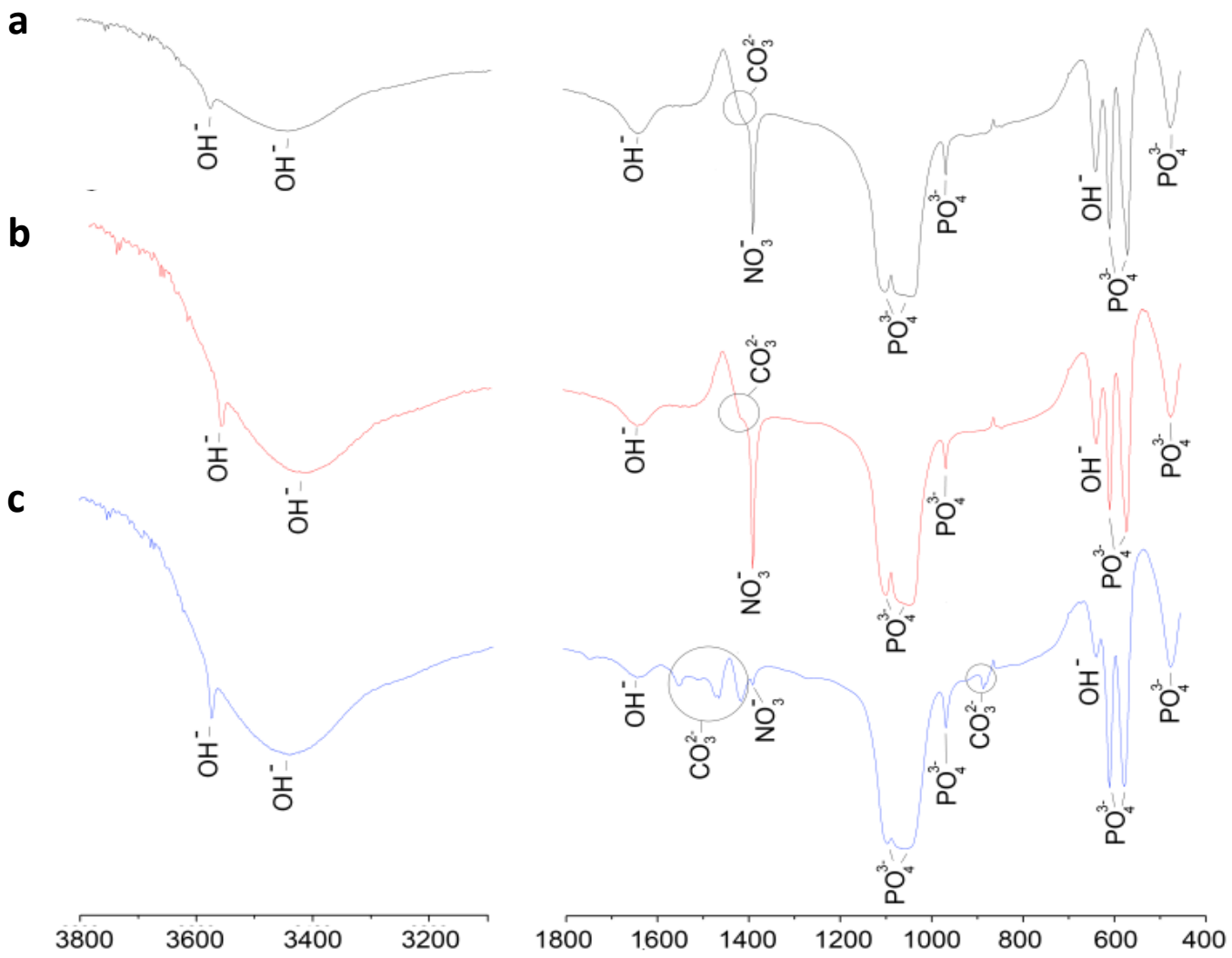
b



c

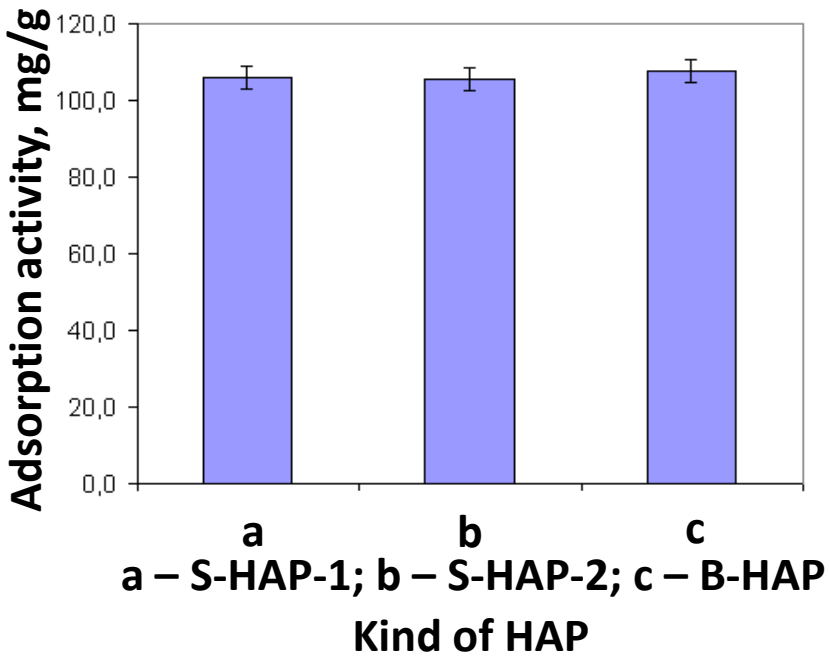
a – S-HAP-1; b – S-HAP-2; c – B-HAP

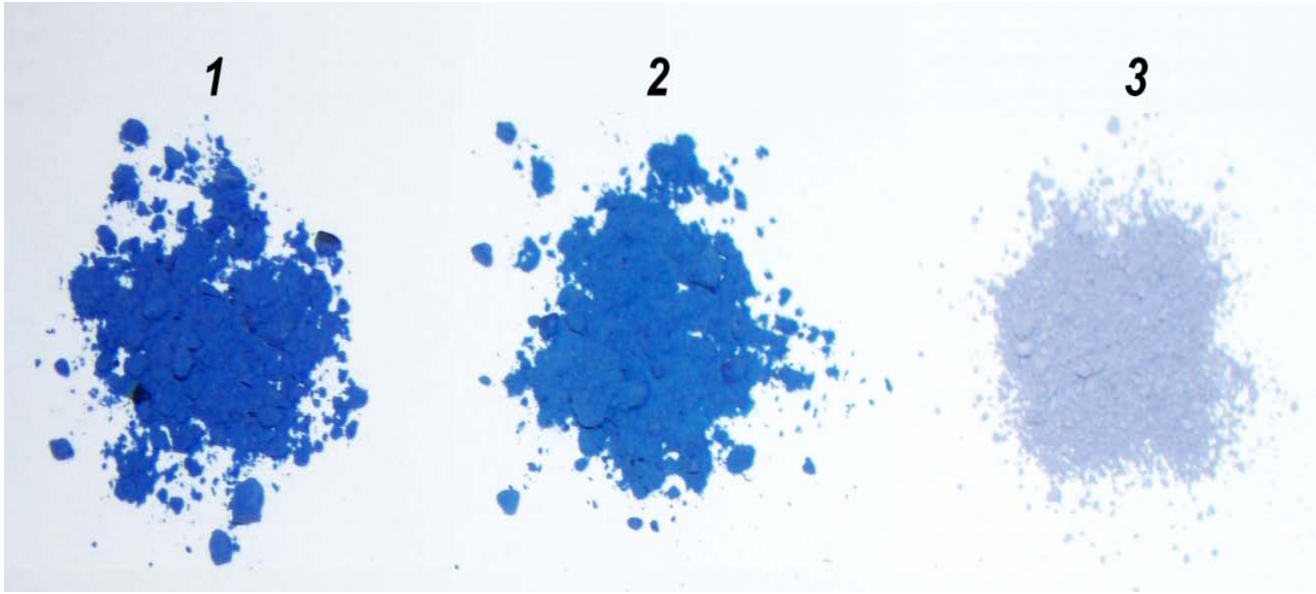
INFRARED SPECTROSCOPY



a – S-HAP-1; b – S-HAP-2; c – B-HAP

ADSORPTION CAPACITY OF HAP





1 – S-HAP-1; 2 – S-HAP-2; 3 – B-HAP

$$X = \frac{(C_1 - C_2 \cdot K) \cdot 0.025}{m}$$

Where C1 - mass concentration of the initial solution of methylene blue, mg / l;
C2 - mass concentration of the solution after contact with hydroxyapatite powder, mg / l;
K is the dilution factor of the solution taken for analysis, after contact with hydroxyapatite powder (K = 5, 10);
M is the mass of the sample of hydroxyapatite, g
0,025 - volume of methylene blue solution taken for illumination, l.

CONCLUSIONS:

- The analysis of literary and patent searches has shown that today the problem of correct choice of materials for medical purposes is acute. One of the promising materials is hydroxyapatite.
- Therefore, on the basis of a comparative study of the structure and adsorption properties of the biogenic and synthetic hydroxyapatites, was found that, despite the significant differences in the morphology of particles and specific surface area of powders of various origins, the adsorption activity of hydroxyapatites doesn't depend on the type (nature) of the powder and is 106-108 mg/g, which in case of synthetic hydroxyapatite is provided by the high specific surface area (90.0-209.5 m2/g) of the powder, and in the case of biogenic hydroxyapatite – is associated with nanostructured porosity of powder particles.
- X-ray analysis shows the existence only of HAP peaks at powders obtained by different methods.
- In the section on labor protection was stablished that the rules of conduct in the laboratory were observed, the ecological state in this laboratory is clean, which means there are no sources of pollution. The analysis of the presence of harmful and dangerous factors was held. Microclimate and workplace organization, in the laboratory where experiments were conducted, comply with sanitary norms and does not go beyond the limits of the permissible.
- In the section of the economic part, scientific and technical relevance of research on this topic is justified. The planned estimate cost of scientific research work is carried out taking into account the costs of all types of resources. The indicator of conditional economic efficiency of carrying out of work is developed.

PUBLICATIONS ON THE TOPIC:

1. Демида М.Б. Порівняльне дослідження структурних властивостей гідроксиапатитів різної природи для біокераміки / Демида М.Б., Сич О.Є. // Хімія та сучасні технології: матеріали VIII Міжнародної науково-технічної конференції. – Дніпро. – 2017. – Т. II. – 144 с. (С. 125)

2. Структура та адсорбційна активність гідроксиапатитів різної природи // Сич О.Є., Отиченко О.М., Ульянчич Н.В., та ін. // подано до друку

THANK YOU FOR ATTENTION!