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Master's Student Guo Luying
Scientific Supervisor Senior Lecturer H.M. Shymanskaya
(Department of Glass, and Ceramics and Binding Materials Technology, BSTU)

SYNTHESIS OF CERAMIC MATERIALS IN THE SYSTEM $CaO–ZrO_2–P_2O_5$

The aim of this work was to develop a ceramic mixture composition and technological parameters for obtaining porous materials in the system $ZrO_2 – CaO – P_2O_5$, and to establish the relationship between chemical composition, structure, and physicochemical properties.

The following components were used to synthesize porous ceramic materials: 1) nanodispersed zirconium dioxide – 40–90 wt. %; hydroxyapatite synthesized by precipitation method – the rest; 2) nanodispersed zirconium dioxide – 40–90 wt. %; calcium orthophosphate – the rest; 3) nanodispersed zirconium dioxide – 40–90 wt. %; calcium dihydrogen orthophosphate monohydrate – the rest; 4) nanodispersed zirconium dioxide – 40–90 wt. %; calcium dihydrogen orthophosphate – the rest.

The samples were prepared by pressing the powders with poly(vinyl alcohol) used as a binder. The obtained samples were fired in an electric furnace in air at temperatures from 1400 to 1500 C. The heating rate was 250 °C/min.

The synthesized materials had a homogeneous porous structure, and their physical and chemical properties are given in the table.

Table – Physical and chemical properties of the samples

Composition	Water absorption, %	Open porosity, %	Apparent density, kg/m^3	Mechanical compressive strength, MPa
1	7.3–13.6	25.3–35.0	2509–3694	29.6–61.7
2	9.8–14.8	32.1–41.2	2569–3507	8.8–39.8
3	1.0–5.4	2.9–21.8	2716–4255	43.3–129.8
4	1.1–5.7	3.1–19.7	2705–4547	52.4–167.3

Using a JSM–5610 LV scanning electron microscope and a D8 ADVANCE Bruker diffractometer, it was established that the main crystalline phases in the synthesized materials were zirconium dioxide ZrO_2 and calcium orthophosphate $Ca_3(PO_4)_2$, the amounts of which depended on the content of components in the ceramic mass.

As is known, porous ceramics based on zirconium dioxide are highly desirable for filling bone defects, calcium phosphates improve biocompatibility, osseointegration, and bioactivity of the materials. Thus, the obtained materials can be considered as promising materials for bone tissue engineering applications.