

The characteristics of nanocrystalline hydroxyapatite doped with ions of the rare earth elements – Pr^{3+} , Sm^{3+} , and Gd^{3+}

Akhmadullina Daria¹, Ekaterina Chikanova¹

¹NUST MISIS

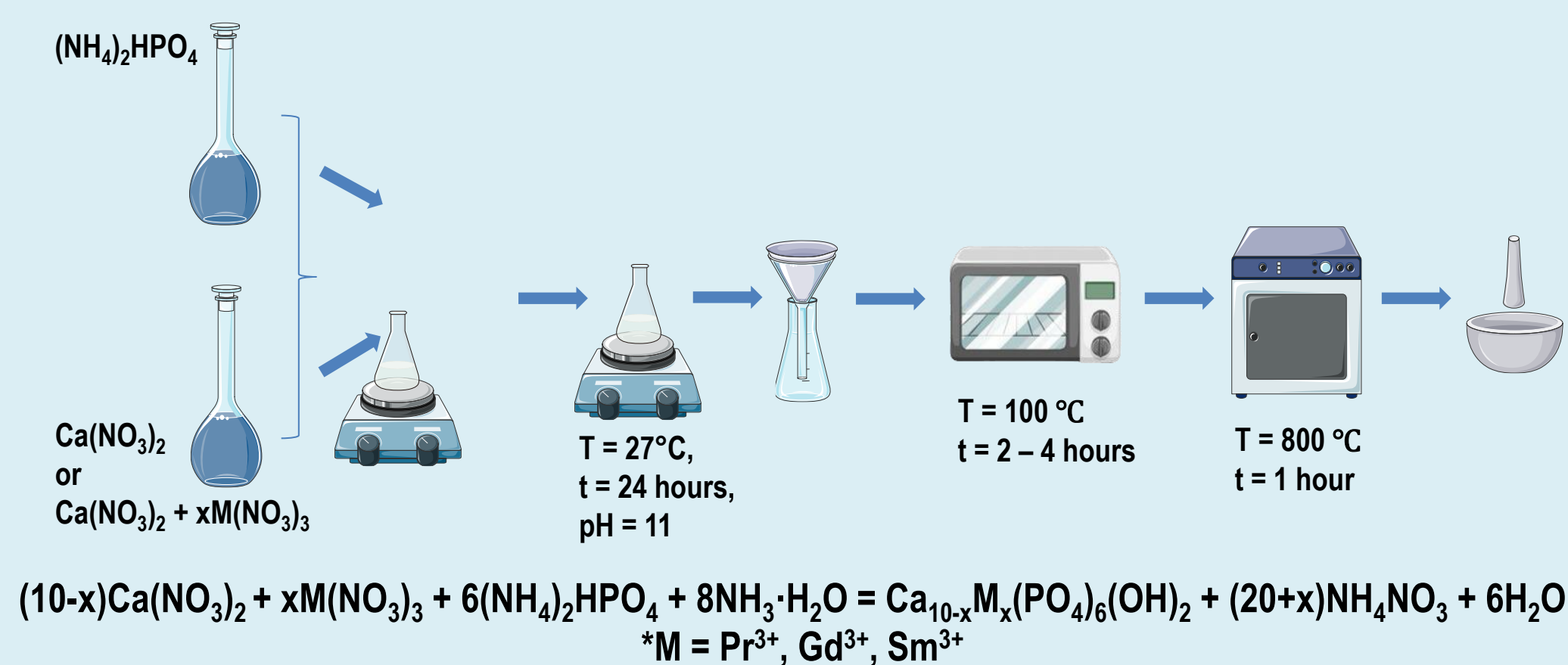
INTRODUCTION & AIM

Nowadays materials based on hydroxyapatite (HA) doped with rare earth elements (REE) are widely used in medical practice, for example, as transplants. In the last few decades, the positive effect of REE on bone restoration has been fully studied, since, based on various studies, the introduction of additives of this type allows stimulating osteogenesis processes and achieving optimized bone restoration indices.

Based on this, the development and application of such structures is of interest and remains relevant.

The **aim** of this work is to synthesize nanosized hydroxyapatite with partial cationic substitution (0%, 6%, 9%) for rare earth element ions – Pr^{3+} , Sm^{3+} , Gd^{3+} , followed by a study of the physicochemical properties of the resulting compositions.

METHOD



RESULTS & DISCUSSION

Fig. 1. The results of XRD and IR-Fourier Spectroscopy

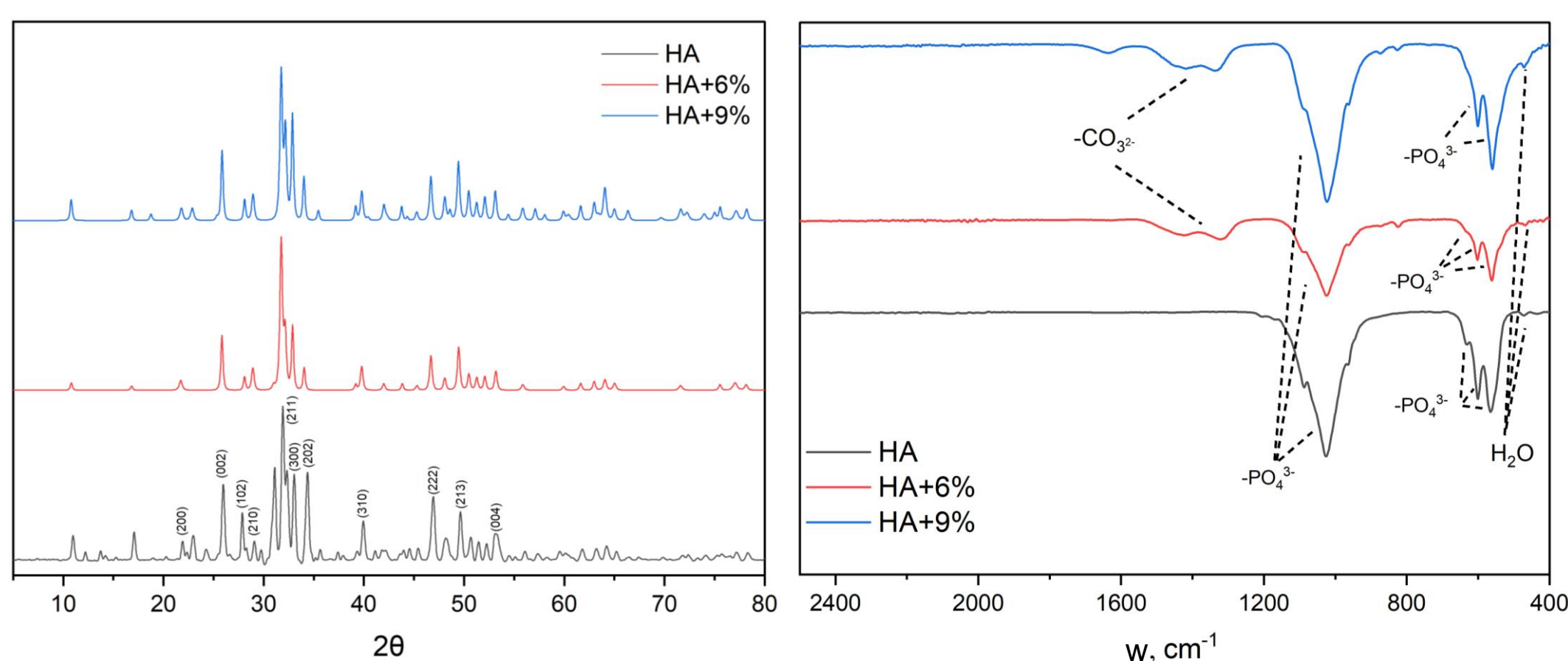
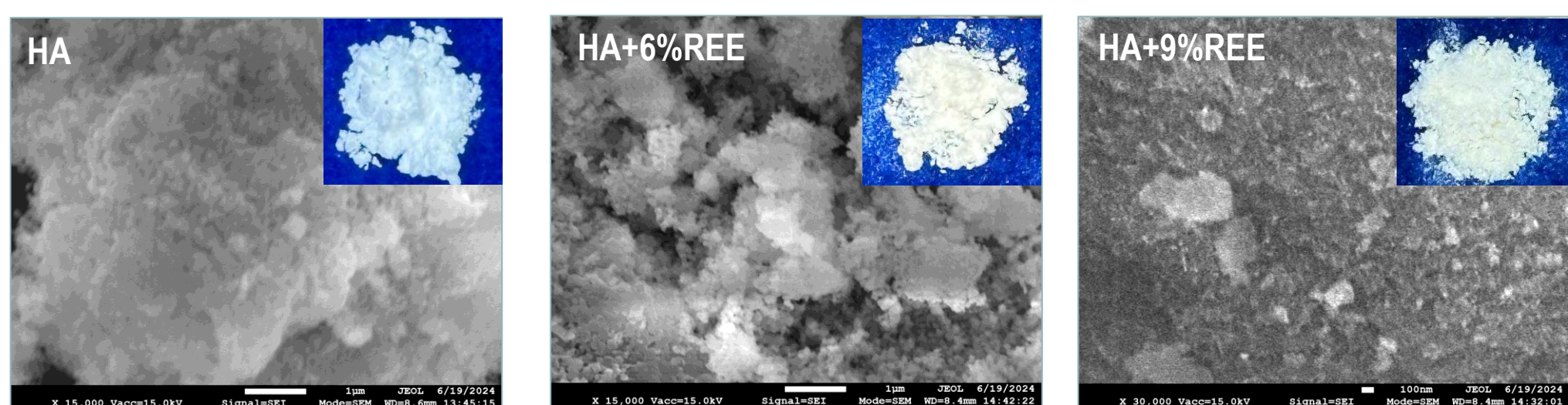


Table 1. The average size of crystallites in materials

The material	HA	HA+6%REE	HA+9%REE
The average size of crystallites, nm	24.35	24.73	25.61

Fig. 2. The results of Optical microscopy and SEM



RESULTS & DISCUSSION

Fig. 3. The element distribution map for HA+9%REE based on EDX results

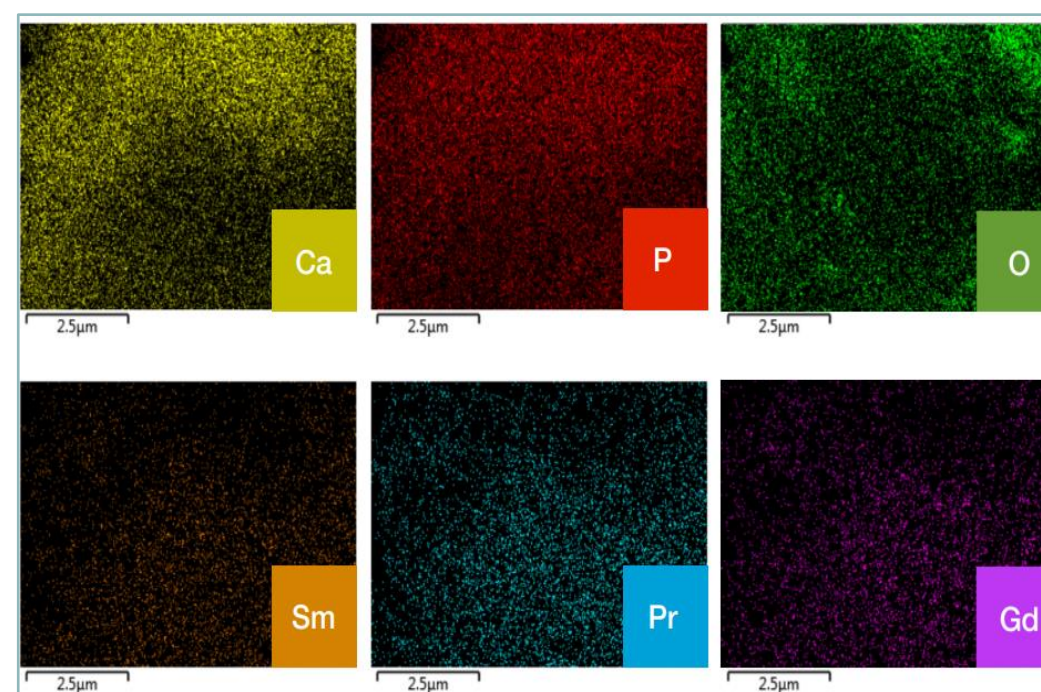


Fig. 4. The histogram of pore size distribution

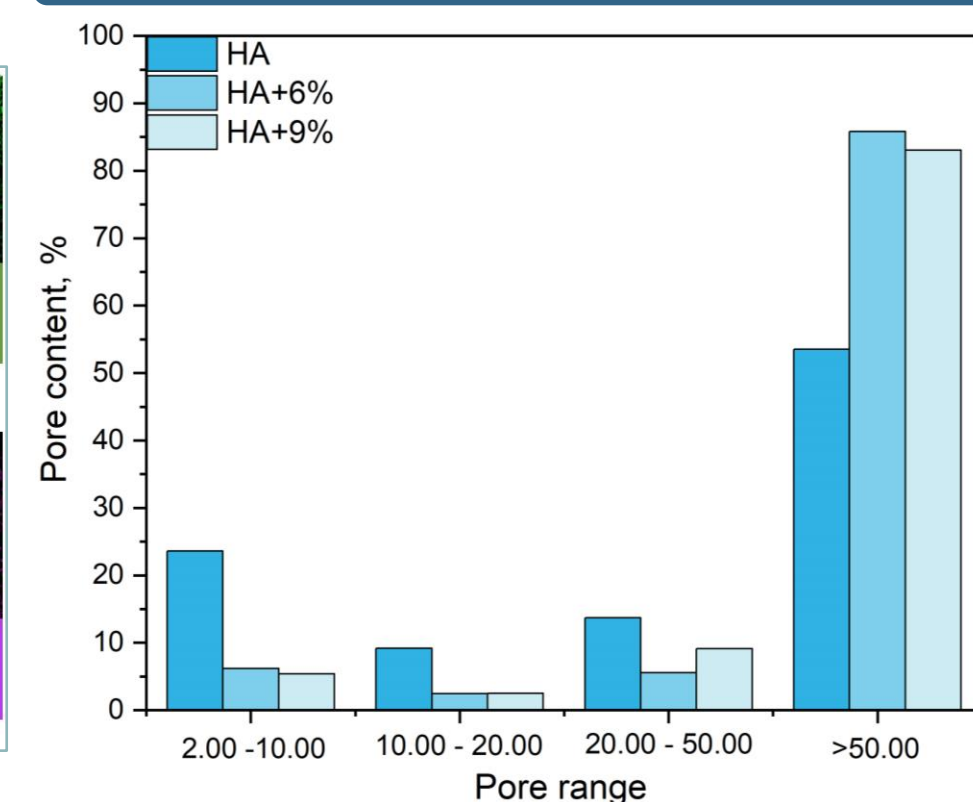


Table 2. The results of EDX

The material / The element	O	Ca	P	Pr	Sm	Gd
HA	72.8	16.4	10.8	-	-	-
HA+6%	70.6	16.2	11.8	0.5	0.4	0.4
HA+9%	50.0	20.9	19.5	3.4	3.1	3.1

Table 3. The results of BET

The material	Surface Area, m ² /g	Total pore volume, cm ³ /g	Average pore diameter, nm
HA	16.54	0.05	12.21
HA+6%	18.46	0.13	27.60
HA+9%	21.96	0.20	35.69

Fig. 5. The concentration of Ca^{2+} , PO_4^{3-} and change of pH in 0.9% NaCl solution

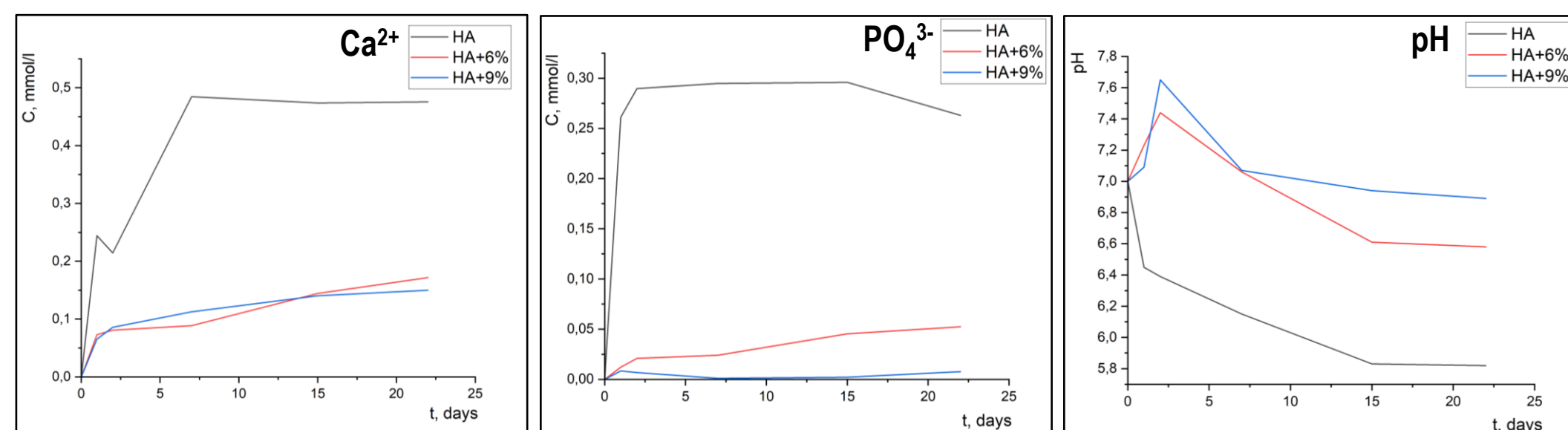


Fig. 6. The concentration of Ca^{2+} , PO_4^{3-} and change of pH in tris-buffer

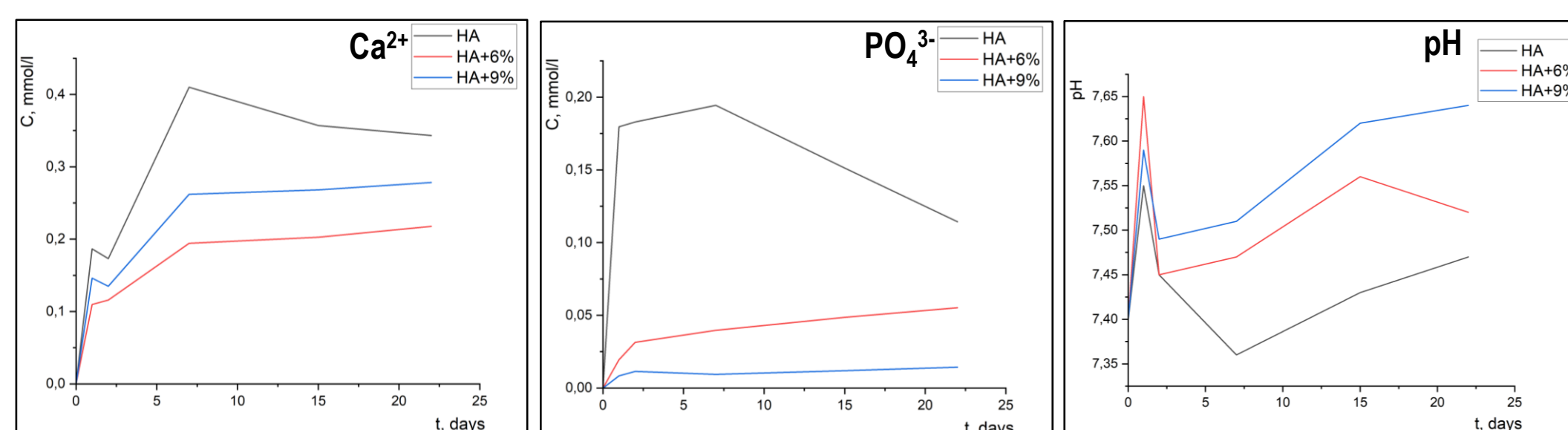


Table 4. The rate constants of HA dissolution in model biological systems by Ca^{2+} , c^{1-n} , t^{-1}

The material	Isotonic solution, $\cdot 10^{-2}$	Tris-buffer, $\cdot 10^{-2}$
HA	10.71	8.65
HA+6%	4.05	5.79
HA+9%	4.29	6.75

CONCLUSION

The method of precipitation from aqueous solutions was used to synthesize hydroxyapatite samples with different cation substitution (0%, 6%, 9%) by ions of rare earth elements of the lanthanum series - Pr^{3+} , Sm^{3+} , Gd^{3+} . It was found that the introduction of these additives into the structure of the original hydroxyapatite affects the morphology and size of the particles. Based on the results the obtained samples can be considered as perspective biomaterials.

FUTURE WORK / REFERENCES

Suha Q. Al-Shahrabalee. Bioinorganic Preparation of Hydroxyapatite and Rare Earth Substituted Hydroxyapatite for Biomaterials Applications / Suha Q. Al-Shahrabalee, Hussein Alaa Jaber // Bioinorganic Chemistry and Applications. – 2023. - Volume 2023. – P. 1-12.