ANNUAL INTERNATIONAL CONFERENCE
SARATOV FALL MEETING XXVII
25-29 september, 2023, Saratov, Russia

Examination of the surface and supramolecular structure of thin hydrogel plates of chitosan L- and D-aspartates

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Abstract

The surface morphology and supramolecular structure of thin hydrogel plates of chitosan L- and D-aspartates were examined by atomic force microscopy and small-angle X-ray scattering. Such materials are promising for designing thin-film nanocomposite materials for solving applied problems of optoelectronics, optosensorics and optophotonics, in particular, for creating highly sensitive and highly selective planar waveguides, SPR and GRS detectors, and optical sensors for diagnosing biological macromolecules, cells and genetic markers, and monitoring small organic biomolecules, etc. A comparative analysis of the surface microrelief and roughness, the average size of nanosized aggregates and their volumetric distribution in the material depending on the enantiomer (L or D) of aspartic acid was carried out.

List of abbreviations and symbols:
CS – chitosan
GM – glucomannan
L-(D-)AspA – L-(D-)aspartic acid
$Si(OGly)_3$ – silicon polyolate in three-molar excess of glycerol
AFM – atomic force microscopy
SAXS – small-angle X-ray scattering

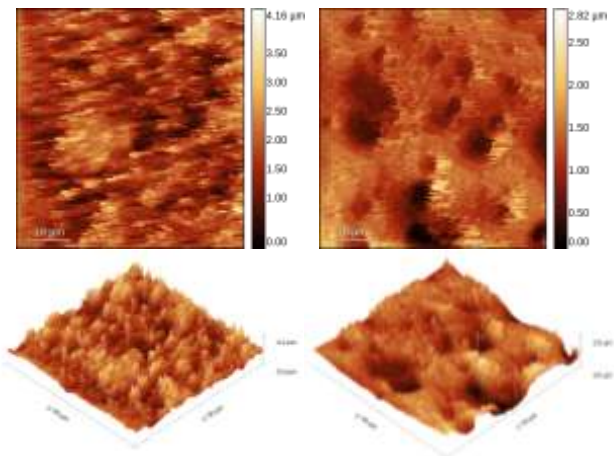
Composition of the composition for the preparation of hydrogel plates

Component	CS	GM	L-(D-)AspA	$Si(OGly)_3$	Glycerol	Water
***C*, wt.%**	0.39	0.13	0.26	19.25	13.54	64.79

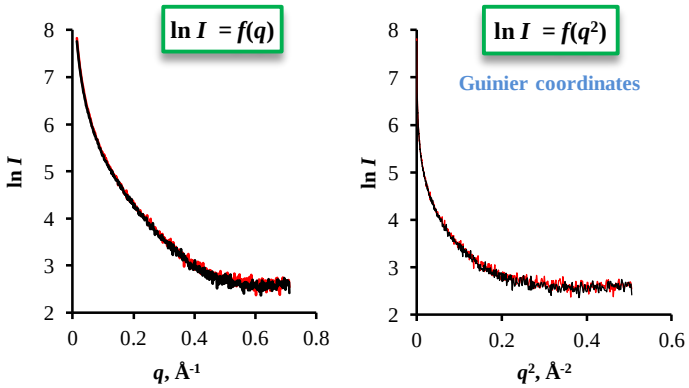
Structural and dimensional characteristics of supramolecular ordering of chitosan L- and D-aspartate hydrogel plates according to AFM and SAXS data

Parameter		Sample	
		CS·L-AspA	CS·D-AspA
AFM			
Average roughness **Ra**·10^{-3}		25.14	24.25
Root mean square roughness **Rq**·10^{-3}		36.68	39.35
Asymmetry **Rsk**		0.08	2.28
Excess **Rku**		6.84	17.08
Maximum peak height **Rp**		0.18	0.29
Maximum cavity depth **Rv**		0.20	0.12
SAXS			
Dependency power decay indicator $\ln I(q) = f(\ln q)$, ***n***	I	1.25	
	II	0.49	0.34
Average radius of gyration of scattering inhomogeneities, ***Rn*** (Å)		1-33	1-41
Average size of the predominant fraction of scattering domains, ***R*** (Å)		1-23	1-25
Volume fraction of the predominant fraction of scattering domains, D_V·10^{-4}		2.98	2.68

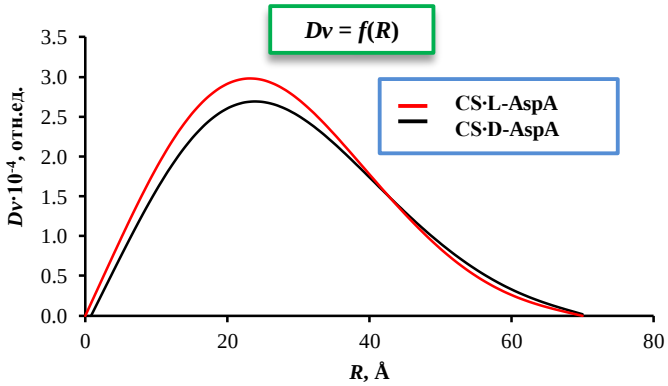
Chitosan L-aspartate **Chitosan D-aspartate**



Atomic force microscopy images of the surface of thin hydrogel plates of chitosan L- and D-aspartates



Small-angle X-ray scattering curves for hydrogel plates based on chitosan L- and D-aspartates



Functions of volumetric size distribution of scattering domains for hydrogel plates based on chitosan L- and D-aspartates

The study was supported by a grant from the Russian Science Foundation № 22-23-00320, https://rscf.ru/project/22-23-00320/.