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Influence of the dimethylsulfoxide-water mixtures on the properties of poly(vinyl alcohol) cryogels.

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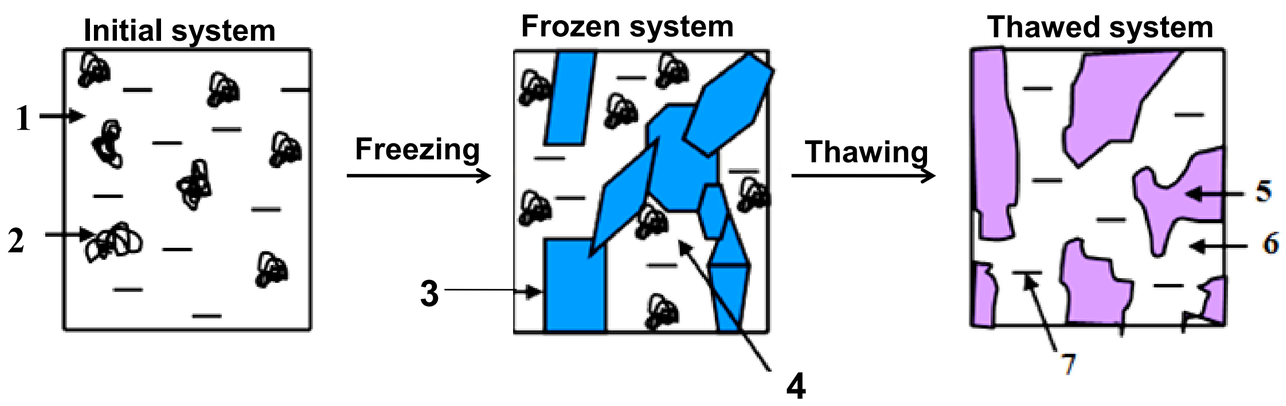
INTRODUCTION & AIM

Poly(vinyl alcohol) cryogels (PVACGs) are the noncovalent macroporous gels formed as a result of freeze-thaw processing of concentrated PVA solutions. Such cryogels are widely used as biomedical materials due to their mechanical durability, biocompatibility and also viscoelastic properties similar to those of soft biological tissues. In clinical practice PVA cryogels have been applied as functional materials like the wound dressings, artificial skin, cardiovascular devices, drug delivery matrices, spine disc replacements, etc.

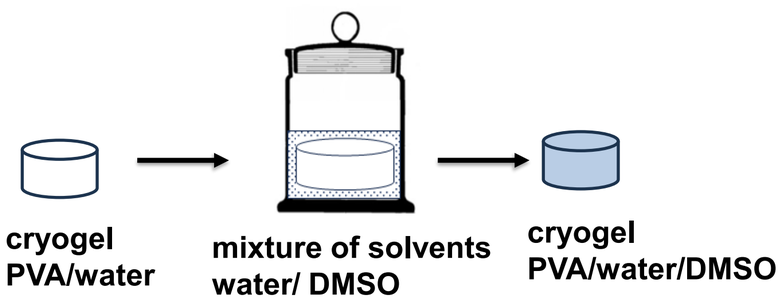
Principle scheme for the formation of the polymeric cryogels

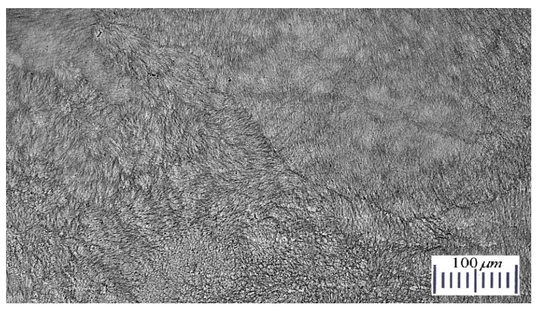


1 - high-molecular-weight precursor;
2 - solvent;
3 – polycrystals of the frozen solvent;
4 – unfrozen liquid microphase;
5 – polymeric framework of the cryogel (gel walls of macropores);
6 – macropores;
7 – defrosted solvent.

METHOD

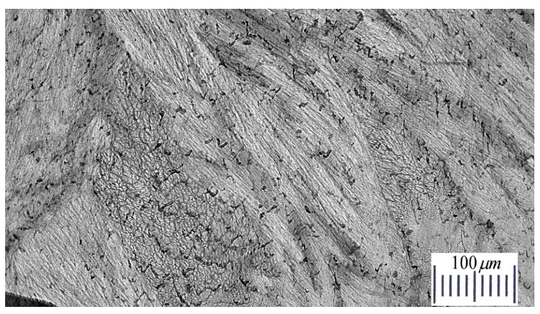
PVACGs were prepared by the “freezing-thawing” technique originating from the 100 g/L aqueous solutions of this polymer that have been frozen and incubated at -20°C for 12 h. Further the temperature was raised to 20°C at the rate of 0.03°C/min. The resultant samples were than saturated with the water-DMSO mixed solutions of different volumetric ratio: 100/0, 75/25, 50/50, 25/75 and 0/100. (water-DMSO: 100%-0%; 25%-75%: 50%-50%; 75%-25%; 0%-100%), and thereafter Young’s modulus and the fusion temperature values of the resultant cryogels were measured.





Optical microphotographs of the thin sections of PVACGs prepared by freezing at -20.0°C of the 100 g/L PVA solutions in water and then saturated in mixture of solvents

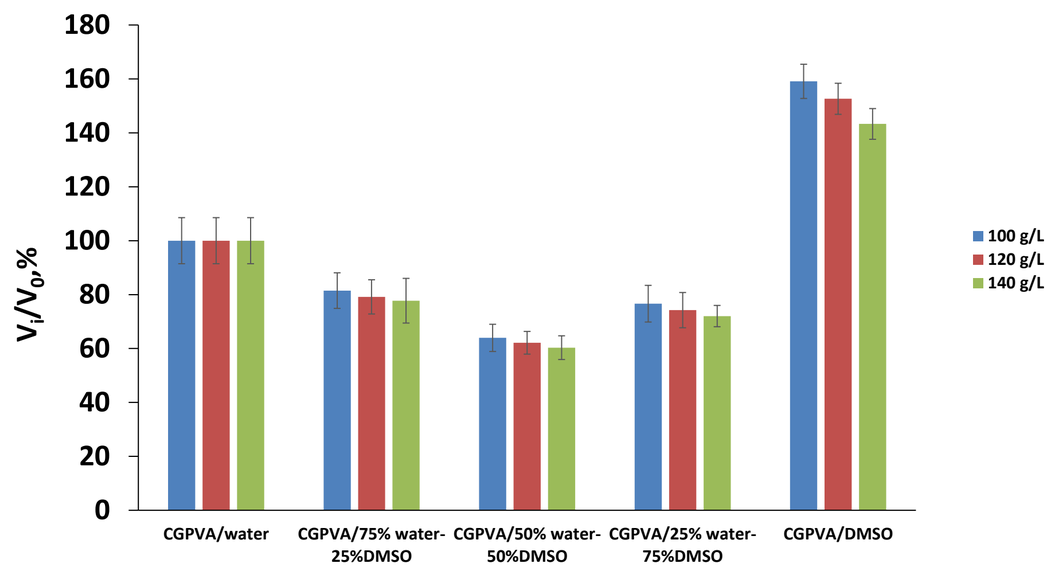
Cryogel PVA / 25% DMSO-75% water

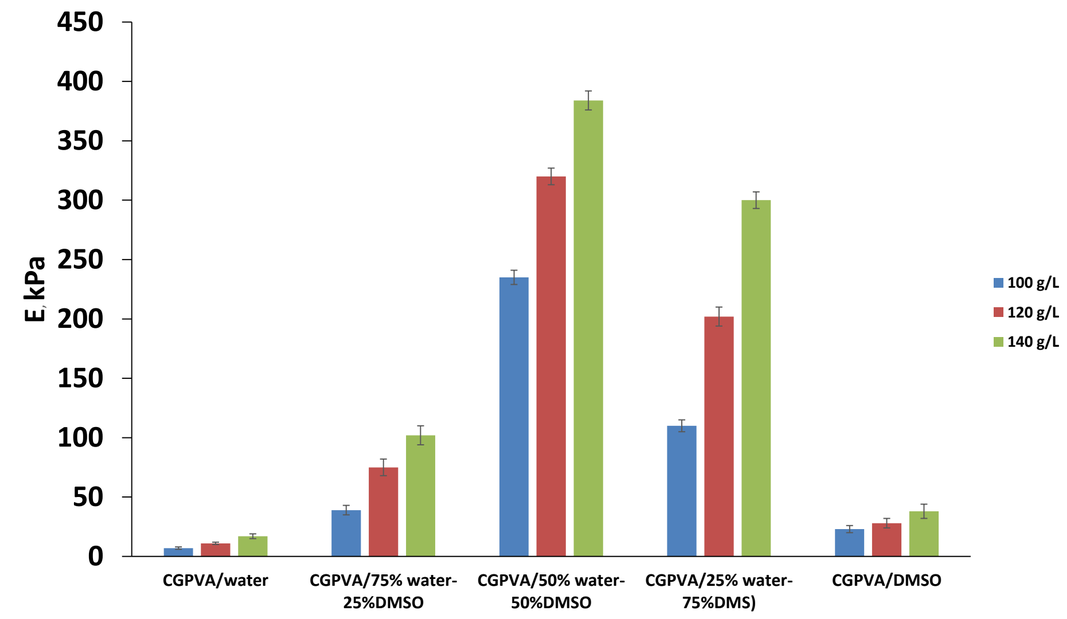


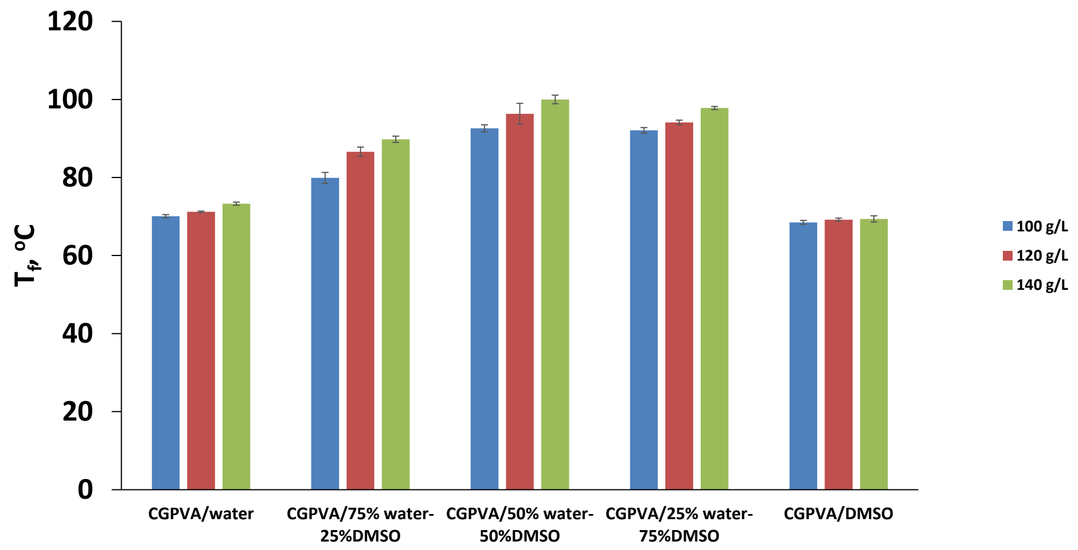
Cryogel PVA / 50% DMSO-50% water

Cryogel PVA / 75% DMSO-25% water

RESULTS & DISCUSSION







Dependences of volumes (V_i/V_0), E modulus and fusion temperature values of PVA cryogels on the composition of water-DMSO solvents

CONCLUSION

So, in this work we suggested the unique method of preparing of macroporous PVA cryogels filled with different water-DMSO mixed solvents. This approach resulted in increase in the elasticity of PVACGs. It is supposed that these materials based on such PVA cryogels could be of interest in various areas of application.

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FUTURE WORK / REFERENCES

V.I. Lozinsky, O.Yu. Kolosova, D.A. Michurov, A.S. Dubovik, V.G. Vasil’ev, V.Ya. Grinberg Cryostructuring of polymeric systems. 49. Unexpected “kosmotropic-like” impact of organic chaotropes on freeze-thaw-induced gelation of PVA in DMSO.// Gels. -2018 - №4 –P.81-99