SYNTHESIS OF POROUS MATERIALS BASED ON POLY(STYRENE-CO-DIVINYLBENZENE) FROM HIGH INTERNAL PHASE EMULSIONS

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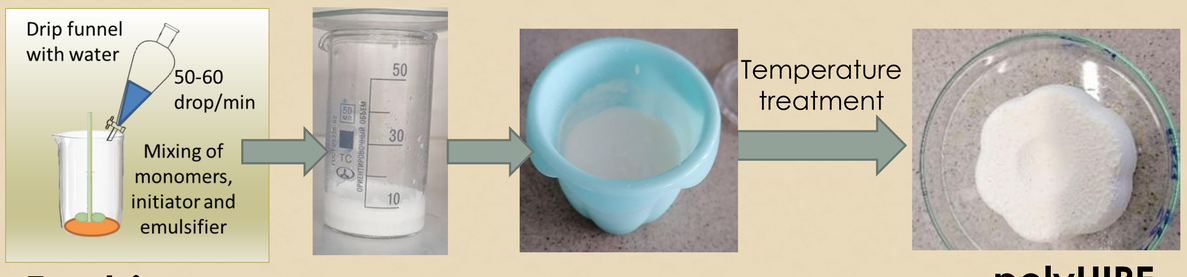
Introduction

Polymerization of a high internal phase emulsions (HIPEs) makes it possible to obtain porous polymers with a fraction of the internal phase - ϕ (i.e. voids) up to 0.99. HIPEs, as a rule, contain ϕ > 0.74, with an internal phase content in the range of 0.30-0.70, emulsions are called medium-concentrated. Emulsions with an internal phase content of less than 0.3 are called low-concentrated. Highly porous materials obtained from highly concentrated emulsions have found a wide range of applications in various fields, in particular for: separation of water/oil mixtures, creation of functionalized macroporous catalysts, electrochemical sensors, cell and tissue cultivation. The most widely used for 3D cell culture applications are polystyrene-based polyHIPEs.

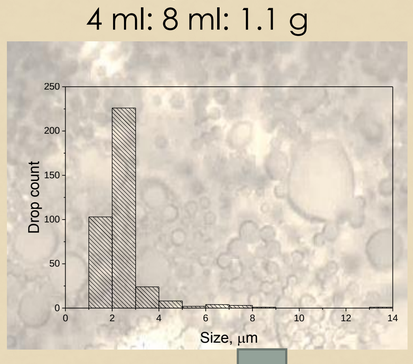
Experimental section

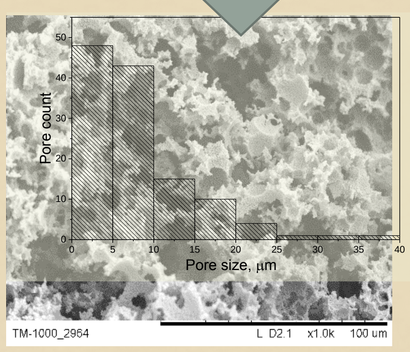


Results and discussion

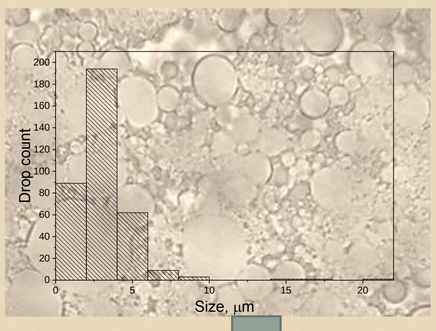
Optical microscopy images of styrene-DVB-water medium-concentrated emulsions

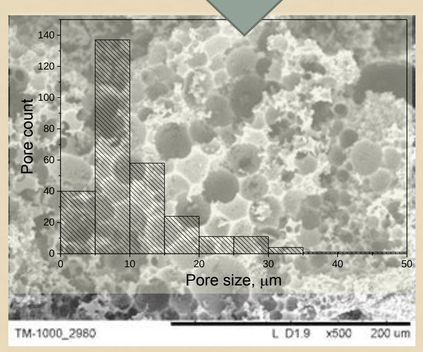
Styrene:DVB-80:water:Span-80 – 4 ml: 4 ml: 8 ml: 1.1 g





Styrene:DVB-80:water:Span-80 – 6 ml: 6 ml: 12 ml: 1.6 g

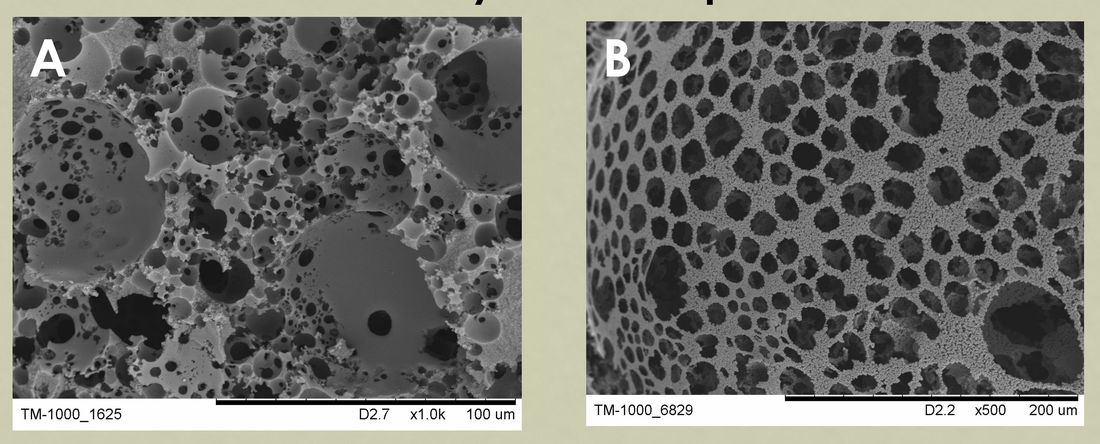




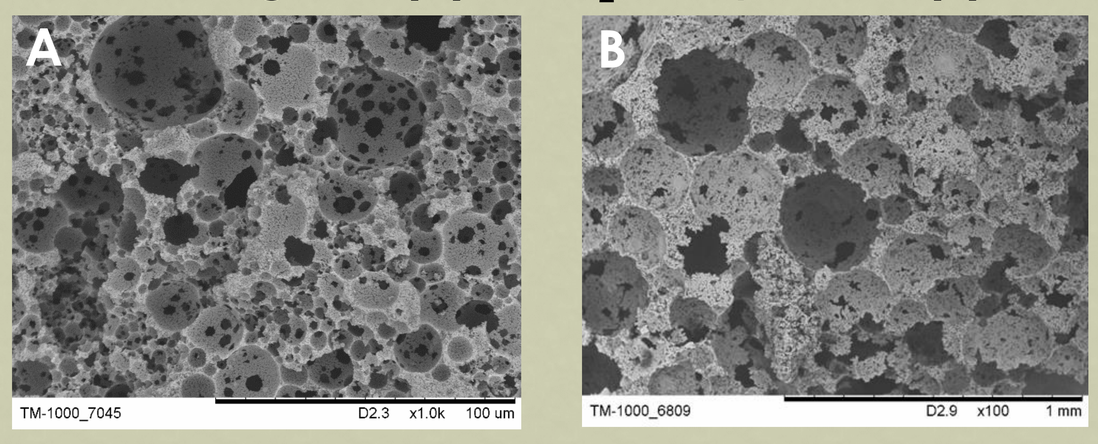
Results of Hg porosimetry mesurments for polyMIPE samples

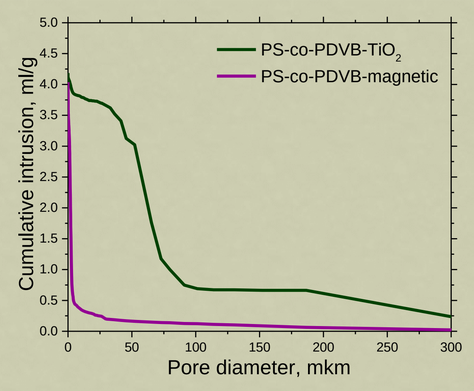
Sample	S_{Hg}, m^2/g	V_{Hg}, cm^3/g	Porosity, %
PS-co-PDVB	3	1.52	40
PS-co-PDVB-carboxylated	114	0.78	32

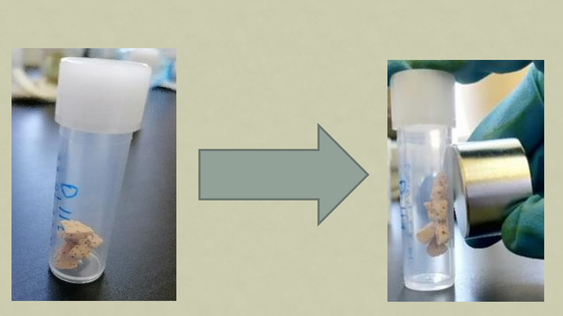
SEM images of polyMIPE (A) and polyHIPE (B) carboxylated samples



SEM images of polyHIPEs, based on PS-co-PDVB with magnetic (A) or TiO_2 nanoparticles (B)







Results of Hg porosimetry mesurments for polyHIPE samples

Sample	S_{Hg}, m^2/g	S_{BET}, m^2/g	V_{Hg}, cm^3/g	Porosity, %
PS-co-PDVB-magnetic	56.3	25	4.04	83
PS-co-PDVB-TiO_2	49.9	1	4.18	92

Conclusions

Polymerized medium-internal phase emulsions (polyMIPEs) and high internal phase emulsions (polyHIPEs) were synthesized and modified with functional groups or with metal nanoparticles (TiO_2 or magnetic). The study was focused on investigating the influence of the emulsion composition on the pore size of the resulting materials. The results revealed that incorporation of unsaturated fatty acid or metal nanoparticles (below 10 vol%) led to a narrower pore size distribution compared to samples prepared only with styrene and DVB. The textural characteristics of the materials were analyzed using mercury porosimetry and BET methods. The morphology of samples was examined through SEM and optical microscopy.

Acknowledgments
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