Synthesis and Properties of Polyelectrolyte Hydrogels

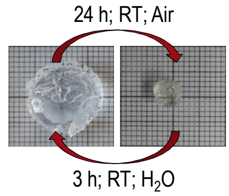
Johanna Claus[1,2], C. Lehnert[1,2], U. Kragl[1,2]

[1] University of Rostock, Department Life, Light & Matter, Albert-Einstein-Straße 25, 18059 Rostock, Germany

[2] University of Rostock, Institute of Chemistry, Albert-Einstein-Straße 3A, 18059 Rostock, Germany

Introduction

Polymeric materials such as hydrogels are used in pharmaceutical and medical applications like implants for enzyme immobilization and materials for contact lenses.[1] Hydrogels are build up by 3D-crosslinked polymeric structures, which have the ability to absorb significant amount of water. Their insolubility in most common solvents is caused



by chemical (ionic and covalent) and/or physical crosslinking. By polymerization of monomers in the presence of a small amount of crosslinker (CL) (e.g., *N,N'*- methylenebisacrylamide (MBis)), covalently crosslinked networks with permanent shapes are obtained and the mechanical properties as well as the swelling degree can be investigated.[2,3]

Results and Discussion

Synthesis

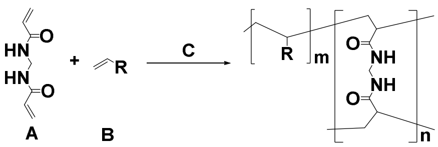


Fig. 1. Radical polymerization for the synthesis of hydrogels (**A** CL/MBis; **B** monomer; **C** polymerization reactants ammonium persulfate (APS) and N,N,N',N'-Tetramethylethane-1,2-diamine (TEMED).

The highly functionalized polymeric materials can be easily synthesized from a vast selection of monomers (Fig. 2) and the crosslinker MBis. To facilitate a wide range of properties and applications kationic, neutral, anionic as well as zwitterionic monomers were chosen.

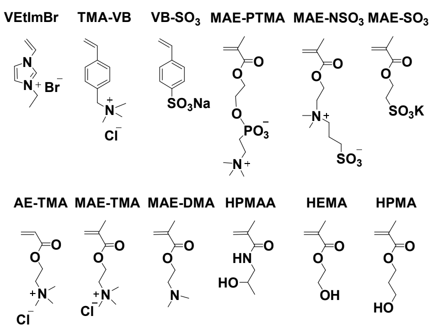


Fig. 2: Overview of the monomers used within this study.

Mechanical Properties

Compression tests were performed to investigate the mechanical behavior of synthesized hydrogels. Deformation can be used to characterize the mechanical stability of a material, which is essential for different applications, e. g. implants or various immobilization methods.

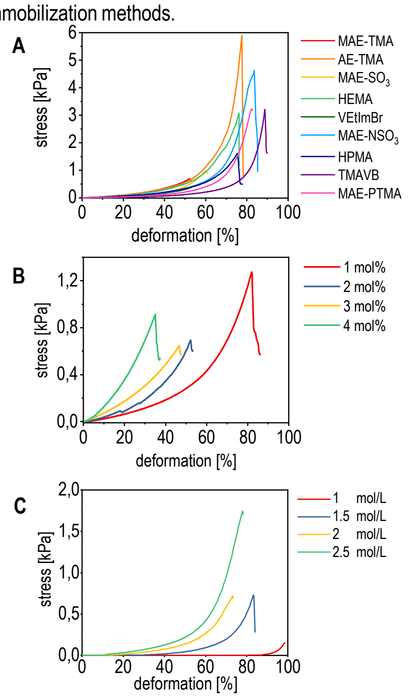


Fig. 3: Compression curves of various Hydrogels dependend on **A** monomer and MAE-TMA dependend on **B** crosslinker concentration or **C** monomer concentration.

Swelling Degree Properties

The swelling degree is an important parameter to characterize the behavior in aqueous media. This information can give a hint towards their usability in various fields.

$$qm = m_t / m_0$$

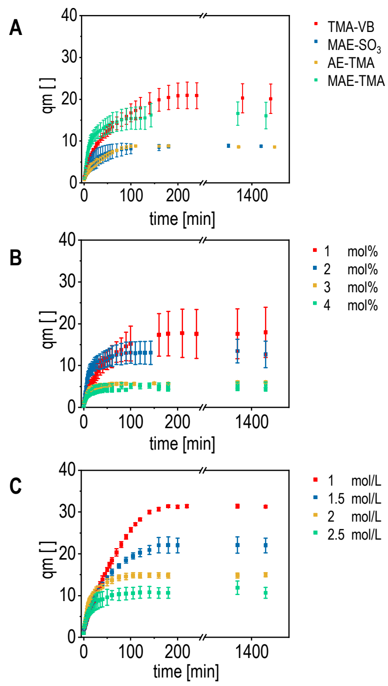
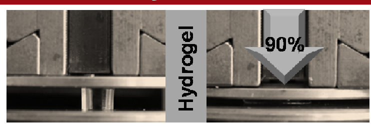


Fig. 4: Swelling degree (qm) in dest. water of various hydrogels dependend on **A** monomer and MAE-TMA dependend on **B** crosslinker concentration or **C** monomer concentration.

Summary and Outlook

- Simple synthesis
- Compressability from 50 to 90% and swelling degrees from 5 to 20 due to different monomer structures



- Wide range of mechanical properties and swelling behavior
- Designable hydrogels for a specific application

References

[1] Claus, J., Sommer, F. O., *Solid State Ionics* 314 (2018): 119-128.

[2] Deshayes , S., Kasko, A. M., *Journal of Polymer Science A: Polymer Chemistry* 51 (2013): 3531.

[3] Bandomir, J., *Macromolecular Chemistry and Physics* 215.8 (2014): 716-724.

Acknowledgements:
Financial support by Bundesministerium für Bildung und Forschung, Germany (project number: 032091 0 B) is gratefully acknowledged.

Scan this for PDF