# Environmentally Sensitive Polymer Materials and Composites



## HEAD:

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## GROUP MEMBERS:

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## RESEARCH PROFILE:

The main trend of research carried out in the group is to obtain new, structurally advanced and multi-functional polymeric materials.

## CURRENT RESEARCH ACTIVITIES:

The research aims at modifying the polymer gels to give them the desired properties. We want them to undergo the phenomenon of volume phase transition under given conditions *(Fig. 1)*, to degrade as external conditions change appropriately and in the presence of specific substances, to become sensitive to new environmental factors, to self- assemble and be capable of self-healing *(Fig. 2)*. We use them also as drug carriers enabling controlled release of active substances *(Fig. 3)*. It is important to obtain these gels in micro- and nano-size in order to reduce phase transition times as much as possible and to achieve a rapid balance with the environment, and to use them in biology and medicine. Thin gel membranes will also be produced on conductive surfaces as the starting substrates for the construction of advanced bioanalytical sensors.



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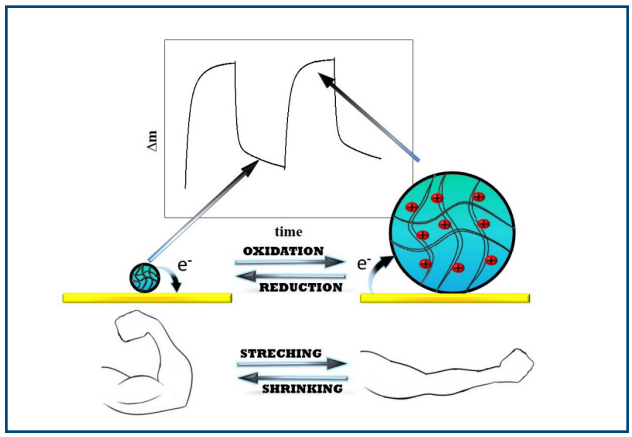


Fig. 1. Potential-triggered microgel volume phase transition, that can mimic muscle activity (monitored with quartz crystal microbalance QCM).

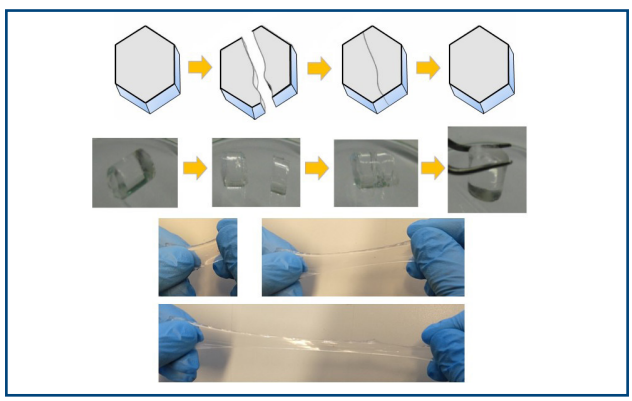

Fig. 2. Scheme and photos of self-healing process of hydrogel material and photos of hydrogels during elongation tests.

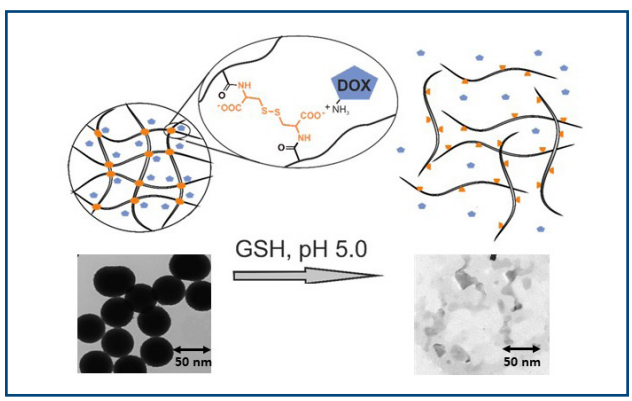


Fig. 3. Degradable micro and nano-gels crosslinked with cystin-derivative as systems for delivery and controlled release of active substances in cancer cells.

## SELECTED PUBLICATIONS:

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3. K. Kaniewska, W. Hyk, Z. Stojek, M.Karbarz, Diffusional and migrational transport of ionic species affected by electrostatic interactions with an oppositely charged hydrogel layer attached to an electrode surface, Electrochemistry Communications. 88 (2018) 97.

4. M. Maćkiewicz, K. Marcisz, M. Strawski, J. Romański, Z. Stojek, M. Karbarz, Modification of gold electrode with a monolayer of self-assembled microgels, Electrochimica Acta. 268 (2018) 531.
5. M. Karbarz, M. Maćkiewicz, K. Kaniewska, K. Marcisz, Z. Stojek, Recent developments in design and functionalization of micro- andnanostructural environmentally-sensitive hydrogels based on N-isopropylacrylamide, Applied Materials Today. 9 (2017) 1516.
6. M. Maćkiewicz, K. Kaniewska, J. Romański, E. Drozd, B. Gruber-Bzura, P. Fiedor, Z. Stojek, M. Karbarz, Nanohydrogel with N,N′-bis(acryloyl)cystine crosslinker for high drug loading, International Journal of Pharmaceutics. 15 (2017) 336.
7. M. Karbarz, J. Romański, Dual Sensing by Simple Heteroditopic Salt Receptors Containing an Anthraquinone Unit, Inorganic Chemistry. 55 (2016) 3616.
8. M. Maćkiewicz, K. Kaniewska, J. Romański, E. Augustin, Z. Stojek, M. Karbarz, Stable and degradable microgels linked with cystine for storing and environmentally triggered release of drugs, Journal of Materials Chemistry B. 3 (2015) 7262.
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10. M. Maćkiewicz, T. Rapecki, Z. Stojek, M. Karbarz, Environmentally sensitive, quickly responding microgels with lattice channels filled with polyaniline, Journal of Materials Chemistry B. 2 (2014) 1483.