Alternative Nanoreactor Design for Polyolefin Recycling

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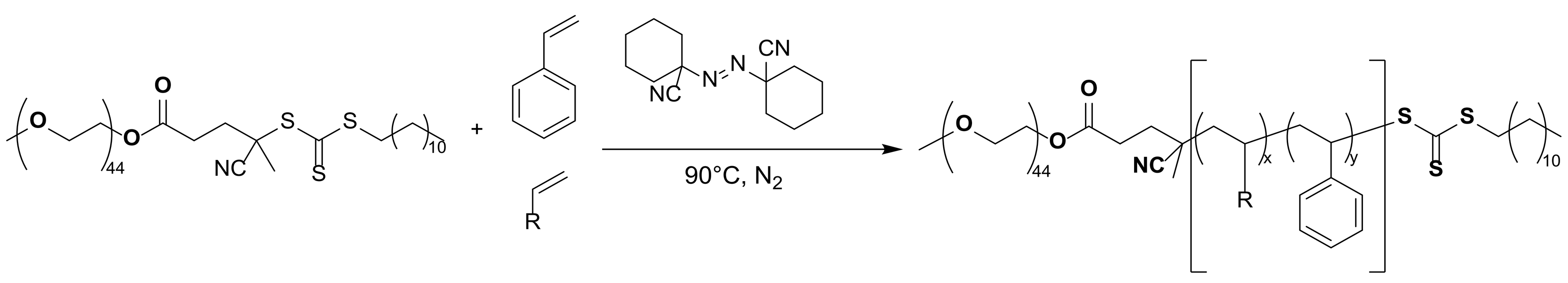
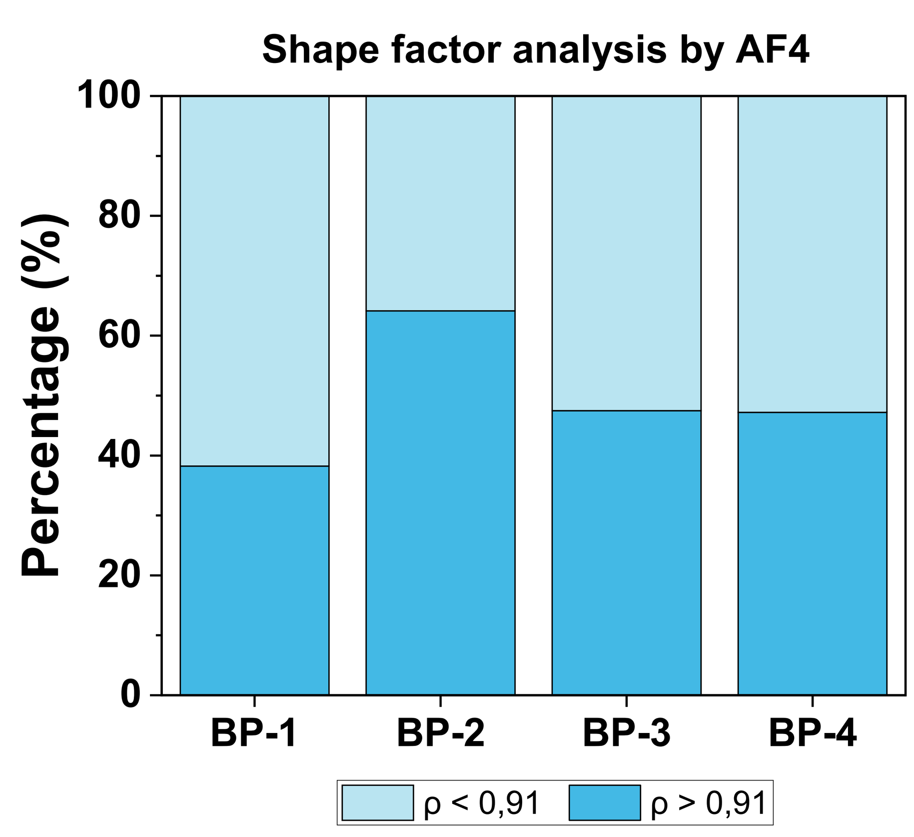
Introduction & Objective

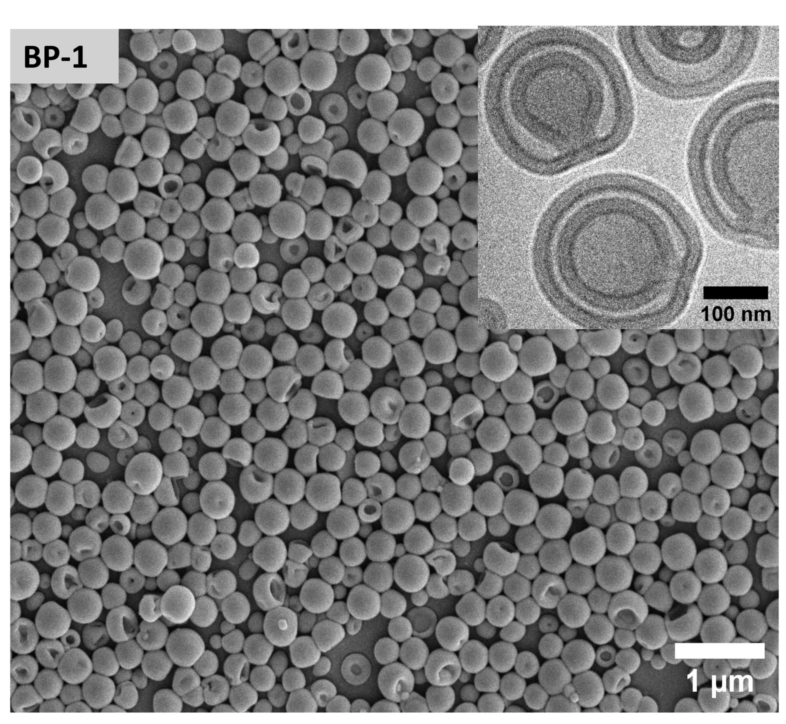
Polyolefins constitute almost half of the global polymer production and consequently represent the vast majority of all plastic wastes [1]. Chemical recycling which aims to convert waste plastics into hydrocarbon and other chemical feedstocks provides a potential solution to this waste problem. The control over depolymerization can be achieved by nanostructured catalysts and specially designed nanoreactors [2]. Here we chose bowl-shaped vesicles, stomatocytes, as nanoreactor templates which were used as potential carriers for specific catalysts that can participate in polyolefin degradation. In order to get control over the final degradation products, template characteristics were investigated, and platinum nanoparticles were chosen as model catalyst.

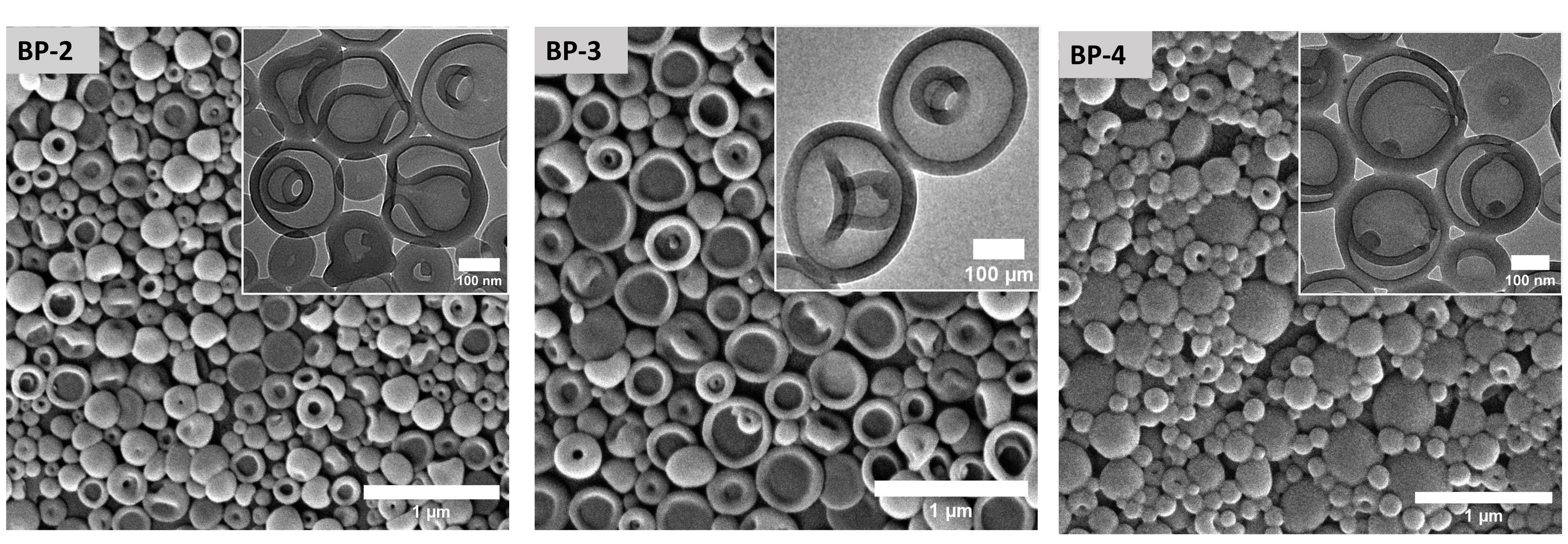
Template Preparation



	M_n (kg/mol) (NMR)	*Đ* (GPC)	Z-average (d.nm)	PDI
BP-1 PEG_{44}-*b*-(PS_{180}-*co*-X_{10})	22	1.07	230	0.08
BP-2 PEG_{44}-*b*-(PS_{155}-*co*-X_{22})	21	1.10	200	0.06
BP-3 PEG_{44}-*b*-(PS_{190}-*co*-X_{33})	25	1.11	240	0.12
BP-4 PEG_{44}-*b*-PS_{155}-*b*-X_{10}	19	1.10	190	0.14

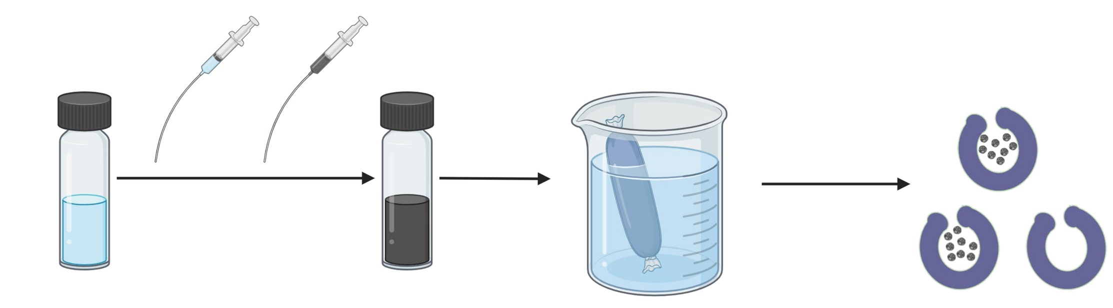


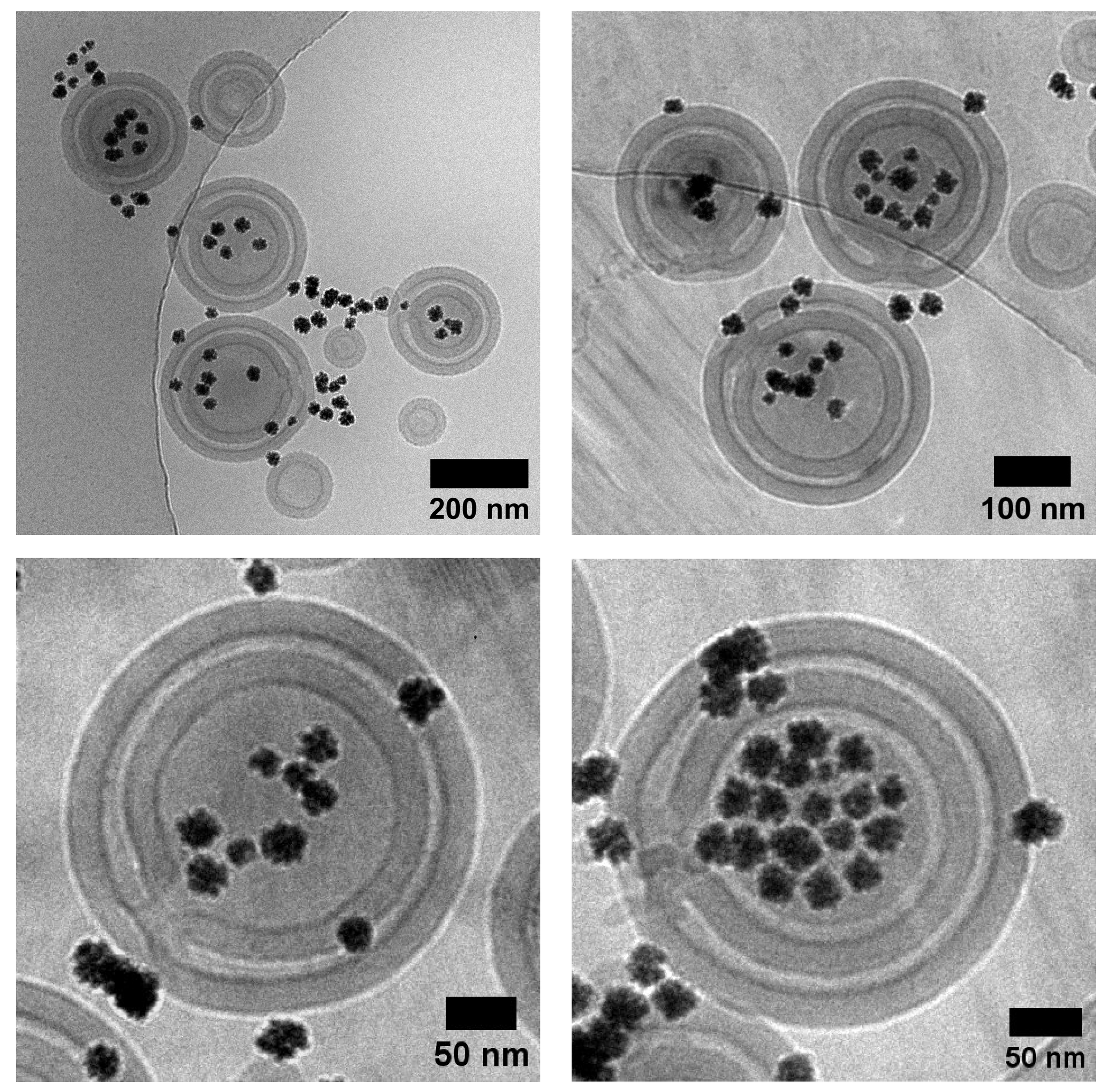




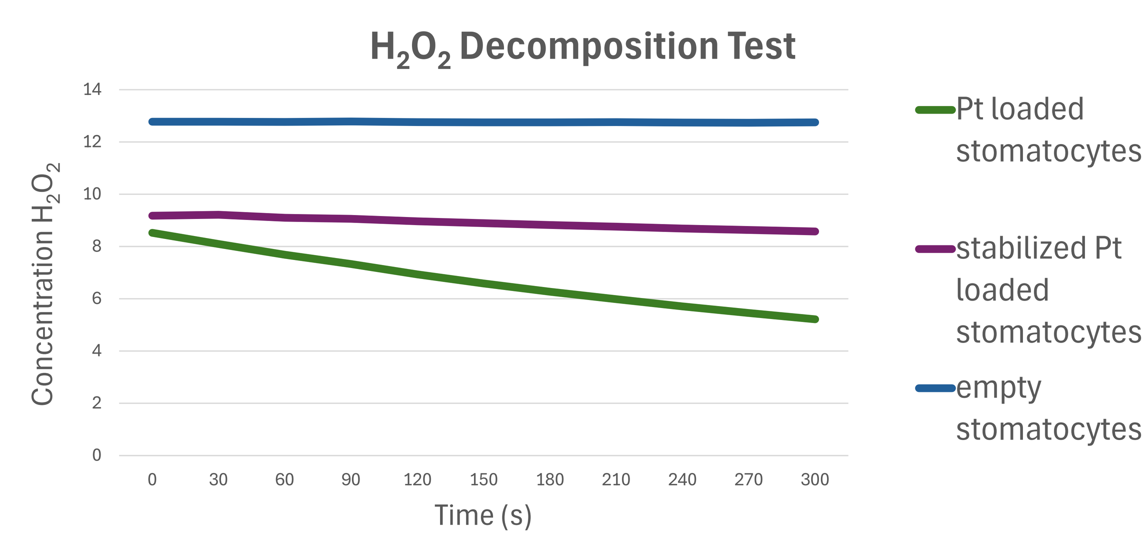
EM images of the stomatocytes prepared with different amphiphilic polymers.

Nanoreactor

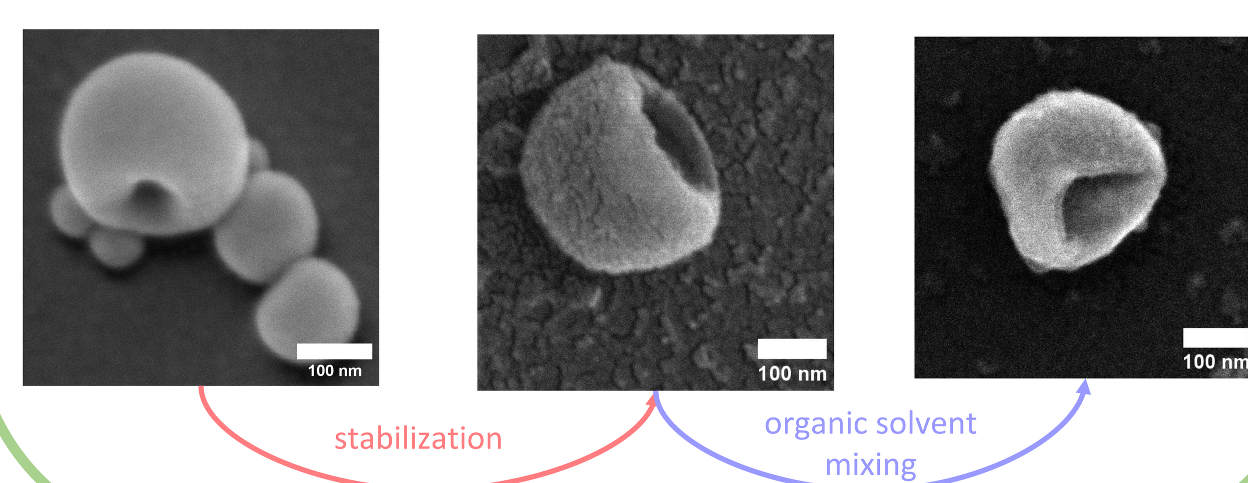




TEM image of the PtNP encapsulation in the stomatocytes.



H_2O_2 decomposition by Pt was checked by UV-Vis.
The decrease in [H_2O_2] indicates Pt catalytic activity.



Conclusion

- ✓ The amphiphilic polymer building blocks were synthesized successfully.
- ✓ Solvent switch method was used to produce stomatocytes.
- ✓ The effect of the different polymers on morphology was investigated.
- ✓ Platinum nanoparticles were encapsulated efficiently.
- ✓ Bowl-shaped vesicles were stabilized to retain their morphology.

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References:
1) Plastics – the fast Facts 2023.
2) Coordination Chemistry Reviews 458, 2022, 214422.
*Figures created with BioRender.com.

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