Surfactant-free Microemulsion Polymerization

Surfactant-free microemulsions (SFMEs) are at least ternary mixtures consisting of water, oil, and a hydrotrope. In contrast to surfactants, hydrotropes are amphiphiles with a shorter chain length, e.g., simple alcohols like propanols or tert-butanol. The inventors from the University could show that it is possible to control the polymerization kinetics, mean molar mass, conversion, and polymer morphology by choosing a suitable SFME system.

IP RIGHTS
EP application from
2021

Ideal for defined-property polymer particles

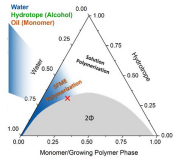
SFMEs have a less defined interface but can have oil-in-water, bicontinuous, or inverse structures, similar to conventional microemulsions. Figure 1 shows a typical ternary phase diagram for SFME systems, the region where SFMEs can be expected, and a molecular dynamics snapshot of the mesostructuring in the monophasic region.

01 Based on simple, low-cost, non-toxic substances. Very pure polymer particles can be obtained by removing the hydrotrope.

02 Ideal for producers of polymer particles, e.g. for cosmetics, pharma, adhesives and paints

03 Avoid problems due to surfactant residues in the final product (e.g. foaming, harmful substances)

04 Possible access to hard-to-synthesize co-polymers by tuning the monomer reactivity



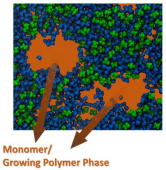


Figure 1, top: Ternary phase diagram of an SFME system with the region marked where SFMEs can be expected. bottom: molecular dynamics snapshots of SFME aggregates, in which the polymerization takes place.

REFERENCES:

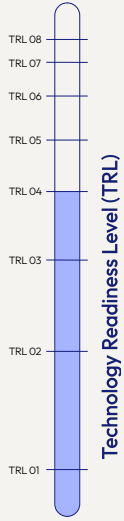
Blahnik et al., J Colloid Interface Sci (2023) DOI: 10.1016/j.jcis.2023.06.025.

CHALLENGE

Microemulsions are widely used as a reaction medium for free-radical polymerization in industry. Using surfactants or similar auxiliaries helps to gain control over the reaction process and the resulting polymer properties. However, the surfactants or auxiliaries will remain in the final product and can negatively impact its properties. For example, unwanted foaming can occur or hydrophilicity can be altered. Especially in cosmetics/pharma, unwanted additive residues can be avoided.

INNOVATION

The innovative SFME system comprises just the monomers, initiators, water, and a simple alcohol as the hydrotrope.
Several vinylic monomers, such as different acrylates, methacrylates, styrene, acrylonitrile, or vinyl acetate, were tested and were found suitable for polymerizations in SFME. The existence of mesostructuring could also be proven for dichloroethane, the industrial precursor of vinyl chloride. Acrylic acid, methacrylic acid, or hydroxyethyl methacrylate can be added to the system and act as additional hydrotropes. The invention is ideal for products based on defined polymer particles, such as special pharma and cosmetics products, adhesives and paints.



01 Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstrated in operational environment · **08** System complete and qualified

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