Synthesis, self-organization and emulsifying/foaming capability of 2-acrylamido-2-methyl-1-propanesulfonic acid (AMPSA)-based amphiphilic copolymers

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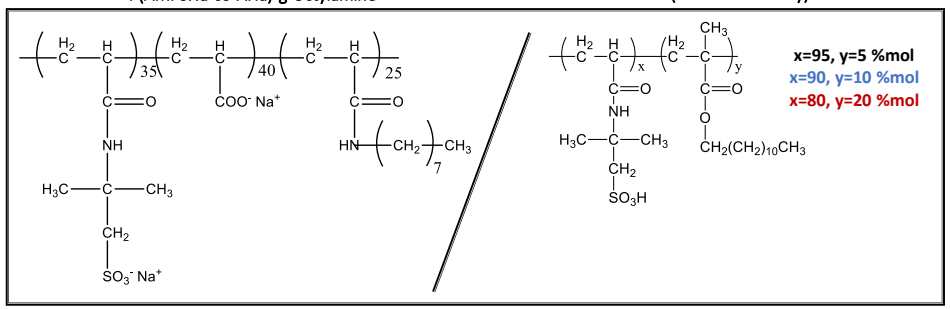
Introduction

Amphiphilic water-soluble polymers are a class of polymers that have attracted great scientific interest during the last decades. Their ability to self-organize into various structures in solution allows them to be used as nanocarriers, emulsifiers or rheology modifiers, and can find application in several fields like nanomedicine, sensing, etc [1,2]. In the present work, amphiphilic polyelectrolytes of the hydrophilic, anionic unit 2-acrylamido-2-methyl-1-propanesulfonic acid (AMPSA), with hydrophobic units bearing alkyl groups such as dodecyl or octyl chains, were synthesized through free radical polymerization (FRP) or grafting reaction. Their self-organization behavior was explored in aqueous media while their capability to be used as emulsifying agents for the stabilization of oil-in-water emulsions was investigated through optical observation. Such systems could be promising candidates for applications like enhanced oil recovery [3,4].

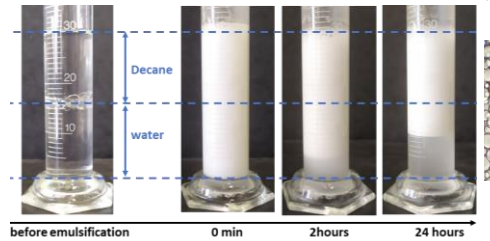
P(AMPSNa-co-ANa)-g-Octylamine



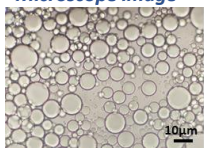
P(AMPSA-co-DMAy)

x=95, y=5 %mol
x=90, y=10 %mol
x=80, y=20 %mol

Visual appearance of P(AMPSA-co-DMA) emulsions

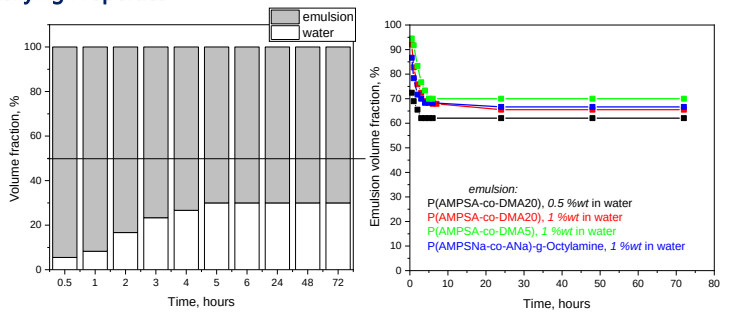


Microscope image



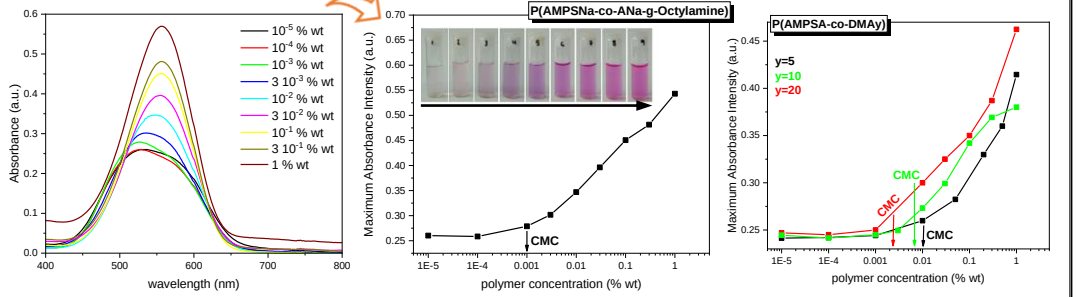
Photographs of the time-dependent phase separation of the decane/water emulsion in the presence of the P(AMPSA-co-DMA5) copolymer (15 ml/15 ml decane/water, initial polymer concentration in water : 1 %wt)

Emulsifying Properties

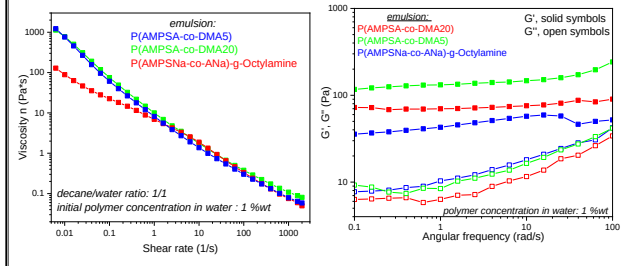


Self-organization in aqueous media

Nile Red probing *for the determination of the Critical Micelle Concentration (CMC)*



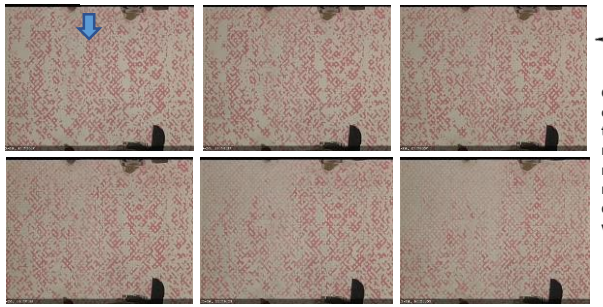
Rheology



Non-Newtonian fluid type Shear-thinning

✓ **G' > G" : solid-like behavior**

Displacement (secondary imbibition) of oil by emulsion



Gradual creation of a frontal drive that progressively mobilizes the majority of residual oil due to the high viscosity ratio [5]

Successive snap-shots of the displacement of dodecane by emulsion prepared by mixing equal volumes (20mL:20mL) of decane with aq. dispersion of 1%wt P(AMPSA-co-DMA20)

Conclusions

- ✓ Successful synthesis of amphiphilic AMPSA-based copolymers.
- ✓ The copolymers self-associate at polymer concentrations above the CMC.
- ✓ The stability of water/decane emulsions depends on the hydrophobic content.
- ✓ Promising displacement (secondary imbibition) of oil by emulsion.

References

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Acknowledgements

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