One-step formation of stable multiple emulsions

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Stimuli-responsive multiple emulsions formed in a one-step mechanical emulsification process are shown to be stable for months. These emulsions are stabilized by amphiphilic copolymers synthesized by atom transfer radical polymerization (ATRP). Depending on pH, ionic strength and temperature, different emulsion types are obtained, including water-continuous (W/O/W) and oil-continuous (O/W/O) multiple emulsions.
In particular W/O/W emulsions can be formed with biocompatible molecules like poly(dimethylsiloxane)-*b*-poly(dimethylaminoethyl methacrylate) copolymer and Miglyol® 812 as an oil phase. These emulsions enable the encapsulation and controlled release of hydrophilic species with the three stimuli: pH, ionic strength and temperature.
Furthermore, we studied the formation conditions of multiple water – toluene – polystyrene-*b*-poly(styrene-*st*-dimethylaminoethyl methacrylate) emulsions. The conformation of the polymer adsorbed at the water – oil interface was probed using an original neutron reflectivity set-up. Our results evidence a correlation between emulsion type and polymer conformation. More precisely, the formation of multiple emulsions is promoted by a decrease in the curvature of the microemulsions formed in water, in agreement with cryo-transmission electron microscopy and small angle neutron scattering. Finally, we exhibit predictive criteria for the formation of multiple emulsions based on interfacial tension and polymer partitioning measurements.

Ref. : M. Protat, N. Bodin, F. Gobeaux, F. Malloggi, J. Daillant, N. Pantoustier, P. Guenoun and P. Perrin, Langmuir (2016), **32**, 10912.