Viscosity and morphology of water-in-water emulsions stabilized by polyelectrolyte under shear

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Résumé

Water-in-water (W/W) emulsions are formed when two aqueous solutions of incompatible polymers are mixed. It is challenging to stabilize this emulsion because of its very low interfacial tension (10-6N/m) and the size of the interface (dozens of nm). It has been shown that water-in-water emulsions formed by polyethylene oxide (PEO) and dextran can be stabilized by polyelectrolyte with some hydrophobic fragments like chitosan, diethylaminoethyl dextran or propylene glycol alginate (1). To obtain a better understanding of the stabilization mechanism, rheology and shearing during acquisition of confocal images was performed on the emulsions. W/W emulsions show a characteristic decrease of the viscosity with increasing shear rate that is well described by equations proposed in the literature (2-3). Confocal laser scanning microscopy images showed that the decrease of the viscosity was caused by deformation and alignment of the dispersed droplets followed by string formation (4). W/W emulsions stabilized by addition of polysaccharides or protein microgels (used to visualize the stabilizing agent) still form strings when sheared with the particles remaining at the interface (figure 1.). After cessation of the flow the strings break up into small droplets and the presence of stabilizing particles inhibits their coalescence. It is shown how the viscosity and the microstructure depend on the initial droplet size, the interfacial tension, the viscosity of the two phases and the concentration of the stabilizing polymers (5).

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