Toward a new route for water remediation via microgel stabilized emulsions

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Microgels are soft and deformable colloidal particles, capable of irreversibly adsorbing at liquid-liquid and liquid-gas interfaces thereby stabilizing Pickering foams and emulsions [1-2]. The microgels undergo conformational changes from a flattened shape to a more compressed state depending on their concentration and processing history, which impact the interfacial properties [3]. Thanks to their porous structure, microgels also have excellent sorbent properties, making them ideal candidates for payload entrapment and delivery. A key feature of microgels is their stimuli-responsiveness. An interesting consequence is the possibility to destabilize emulsions / foams on demand, upon application of a stimulus.
Here, we investigate the potential of microgels as sorbents for small molecular contaminants in water, followed by interfacial adsorption of the loaded microgels to enable extraction from the medium. In particular, we evaluate the ability of microgel-stabilized emulsions to physically separate the contaminant from the medium by skimming the droplets, by analogy with the flotation process [4]. Emulsion destruction on demand allows collecting the concentrated dye and the recovery of oil and microgels.
In the present study, we select methylene blue, a cationic dye as a model contaminant. Using poly(N-isopropylacrylamide) (PNIPAM) microgels incorporating negatively charged carboxylate groups, we obtained up to 90% removal of MB from aqueous solution. These microgels were used to stabilize emulsions in the limited coalescence regime, *i.e.* the regime where all microgels are adsorbed at the oil-water interface, thereby concentrating the dye at the surface. Thanks to droplets creaming, a concentrated emulsion layer is created, which concentrates the contaminants, offering its rapid and easy extraction by skimming. Emulsion destruction on demand allows collecting the concentrated dye and the recovery of the microgels. This concept could bring interesting perspectives for the decontamination of water with a good recovery of the extracted species and sorbents.

Keywords:
Emulsion, responsive microgel, water remediation.

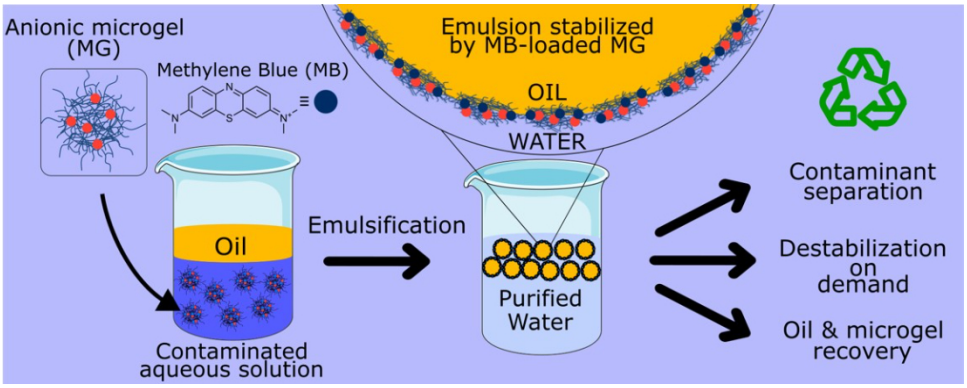

Fig. 1: pNIPAM-stabilized emulsion to extract contaminant from aqueous phase.

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