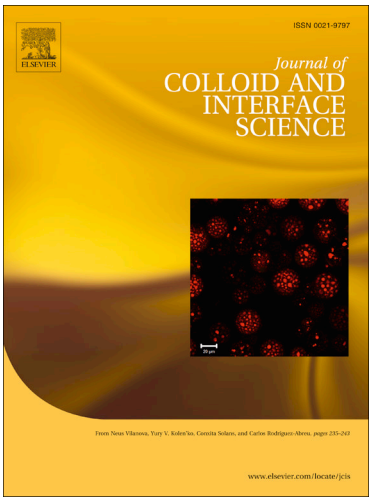

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Keywords

Waterless emulsions, carbon dioxide in oil emulsions, carbon dioxide – oil interface, emulsion stability, silicone, PDMS, non-fluorous, comb polymers.

Abstract

The design of surfactants for CO_2/oil emulsions has been elusive given the low CO_2-oil interfacial tension, and consequently, low driving force for surfactant adsorption. Our hypothesis is that waterless, high pressure CO_2/oil emulsions can be stabilized by hydrophobic comb polymer surfactants that adsorb at the interface and sterically stabilize the CO_2 droplets. The emulsions were formed by mixing with an impeller or by co-injecting CO_2 and oil through a beadpack (CO_2 volume fractions (ϕ) of 0.50 to 0.90). Emulsions were generated with comb polymer surfactants with a polydimethylsiloxane (PDMS) backbone and pendant linear alkyl chains. The C_{30} alkyl chains are CO_2-insoluble but oil soluble (oleophilic), whereas PDMS with more than 50 repeat units is CO_2-philic but only partially oleophilic. The adsorbed surfactants sterically stabilized CO_2 droplets against Ostwald ripening and coalescence. The optimum surfactant adsorption was obtained with a PDMS degree of polymerization of ~88 and seven C_{30} side chains. The emulsion apparent viscosity reached 18 cP at a ϕ of 0.70, several orders of magnitude higher than the viscosity of pure CO_2, with CO_2 droplets in the 10 – 150 μm range. These