Novel Pickering-stabilized Water-in-oil emulsions

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Confined gap cooling was used to generate novel lipid microstructures and water droplet encapsulation matrices. Hydrogenated canola oil (HCO) in canola oil with or without the presence of surfactants [glycerol monooleate (GMO), polyglycerol polyricinoleate (PGPR)] was cooled from 70º to 25ºC at a constant shear rate (400 s^{-1}) in the parallel plate geometry (500 µm gap) of a controlled-shear rheometer. Different-sized and shaped HCO crystal aggregates were observed depending on the distance from the parallel plate centreline. The lowest linear shear velocity (nearest the centerline) promoted spherulite-spherulite clustering into spheroidal aggregated masses with rough surfaces ~150 µm in length. Under mid and high-shear conditions, crystal-crystal clustering was observed around a central spherulite. The resulting spheroids had a smoothened surface and became smaller with gradually higher shear (down to ~40 µm in length at high shear). Freshly-prepared 20 wt% water-in-oil emulsions consisting of the same oil phases as above and cooled under the same shear/temperature conditions were tested for their capacity to encapsulate the dispersed phase. HCO crystal spheroids made with GMO-stabilized emulsions encapsulated nearly all dispersed water droplets whereas with PGPR-stabilized emulsions, no droplets were incorporated as all droplets remained in the continuous oil phase. Comparative bulk-cooling with an impeller-type mixer did not lead to the development of such microstructures nor any water droplet encapsulation. This demonstrated the vital requirement of a confined gap for the development of these shear-induced microstructures.