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Exotic shapes and microscale structure of a bubble rising in hydrophobically modified alkali-soluble emulsion polymer solutions

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The motion of single air bubbles rising through 1.3 and 2.1 wt% hydrophobically modified alkali-soluble emulsion polymer (HASE) solutions are experimentally examined. As reported in past research (Ohta et. al, 2015), a bubble rising in a HASE solution will have a shape that is distinct from a bubble rising in a typical non-Newtonian fluid. A bubble rising in a HASE solution can attain a shape with a very long thin trailing edge, long branched trailing edges, blade-shaped (two-dimensional thin plate shape) trailing edges, and more. By intuition, it is predicted that these distinct bubble shapes are formed due to the contribution of the elastic effect of HASE solutions. It has been discovered experimentally that the microstructure at the trailing edge of a rising bubble is intimately related to the concentration of HASE material in the liquid surrounding a bubble and the bubble size. The various HASE induced microstructures observed are categorized: (1) herring bone, (2) fish backbone, and (3) dendritically-expanded. It is hypothesized that the determination of one of these 3 shapes cannot be explained by straightforward surface tension considerations, and instead one must investigate localized interactions between the individual polymers in a HASE solution and the gas phase in the bubble.