Abstract Submitted
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Liquid stresses associated with a bubble pinch-off event[1] OLIVER MCRAE, PETER WALLS, Boston University, VENKATESH NATARAJAN, CHRIS JOHNSON, CHRIS ANTONIOU, Biogen, JAMES BIRD, Boston University — The interface between two fluids can quickly change shape when subjected to various forces. For example, capillary forces can rapidly deform a liquid-air interface during bubble coalescence or pinch-off events. This process can lead to significant stresses in the nearby fluid, stresses which can be quantified and presented in terms of an energy dissipation rate (EDR). The EDR surrounding bubbles as they change shape is particularly relevant to the efficiency of bioreactors, as a large EDR can damage or kill suspended cells. Here we investigate numerically the magnitude and extent of stresses that develop around spontaneous bubble breakup, geometrically similar to bubble formation at a sparger used in aeration. We present the EDR levels experienced by a particular volume of liquid surrounding the original bubble to illustrate the potential for these bubble formation events to damage or kill surrounding cells. We also compare these results to stresses associated with bubbles bursting at a free surface, and relate our findings to experiments of bubbles breaking up surrounded by cells in a microfluidic device. We believe this work will be pertinent in sparger design with a goal of understanding and mitigating the damaging effect bubble formation can have on cells undergoing aeration.

[1]Biogen

Oliver McRae
Boston University

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