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The Pressure Drop along Rectangular Microchannels Containing Bubbles ANN LAI, MICHAEL FUERSTMAN, MEGHAN THURLOW, SERGEY SHEVKOPLYAS, HOWARD STONE, GEORGE WHITESIDES, Harvard University — We derive the drop in pressure along a rectangular microchannel through which a flowing liquid (water, with or without surfactant, and mixtures of water and glycerol) carries bubbles. We use an indirect method to derive the pressure in the channel. At both low and high concentrations of surfactant, the pressure drop depends predominantly on the number of bubbles in the channel. At intermediate concentrations of surfactant, the total, aggregated length of the bubbles in the channel is the dominant contributor to the pressure drop. The difference between these two cases stems from the flow of liquid through the "gutters" – the regions of the system bounded by the curved body of the bubble and the corners of the channel – in the presence of intermediate concentrations of surfactant. We present a systematic and quantitative investigation of the influence of surfactants on such multiphase flows in rectangular microchannels. We surmise that the contributions to the overall pressure drop stem from three regions: i) the slugs of liquid, where the liquid flows as if no bubbles were present; ii) the "gutters" running alongside the body of the bubble; and iii) the curved caps at the ends of the bubble.

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