Electronic Supplementary Material (ESI) for Lab on a Chip

Derivation of the cross-sectional area of the virtual channel

Cross-section of the virtual channel can be divided into a trapezoid and two segments, one on each side. The width of the channel at the top w_t changes with bulging and can be expressed as a function of the sidewall radius of curvature R_S and the bottom contact angle θ_S. This is illustrated in Fig. A1.

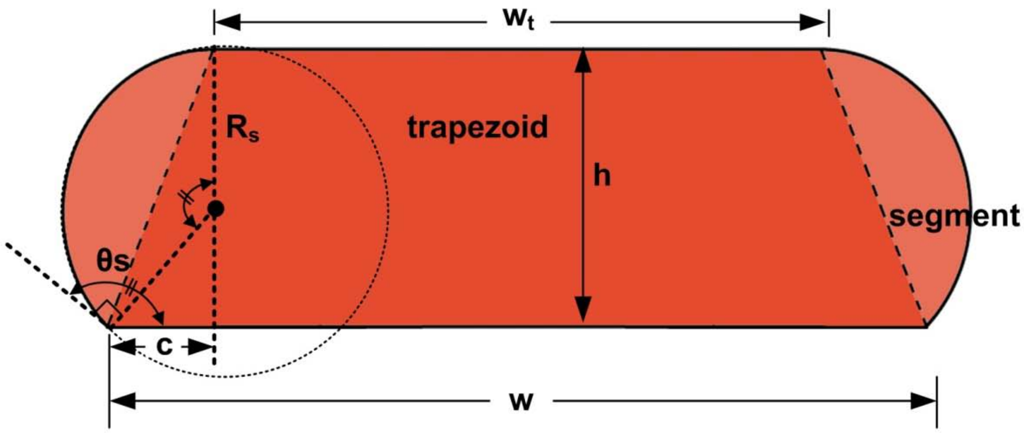

Fig. A1: Cross-section of the virtual channel.

The total cross-sectional area A is given then by

$$A = A_T + 2A_S \tag{A1}$$

where A_T is the trapezoid area and A_S is the segment area.
The area of a trapezoid is defined as

$$A_T = h(w_t + w)/2 \tag{A2}$$

The width at the top is defined as

$$w_t = w - 2c \tag{A3}$$

where $c = R_S \sin\,\theta_S$. Substituting A3 into A2 and simplifying leads to the trapezoid area

$$A_T = h(w - R_S\, sin\, \theta_S) \tag{A4}$$

The area of a circular segment is defined as

$$A_S = \frac{{R_S}^2}{2}\left(\frac{\theta_S \pi}{180} - \sin\theta s\right) \tag{A5}$$

Substituting A4 and A5 into A1 yields the cross-sectional area of a virtual channel as:

$$\begin{aligned} A =\ & h(w - R_S\, sin\, \theta_S) + \frac{{R_S}^2}{2}\left(\frac{\theta_S \pi}{180} - \sin\theta s\right) \\ =\ & hw - R_s \sin\theta s(h + R_s) + \frac{\theta_s}{180}\pi {R_s}^2 \end{aligned} \tag{A6}$$