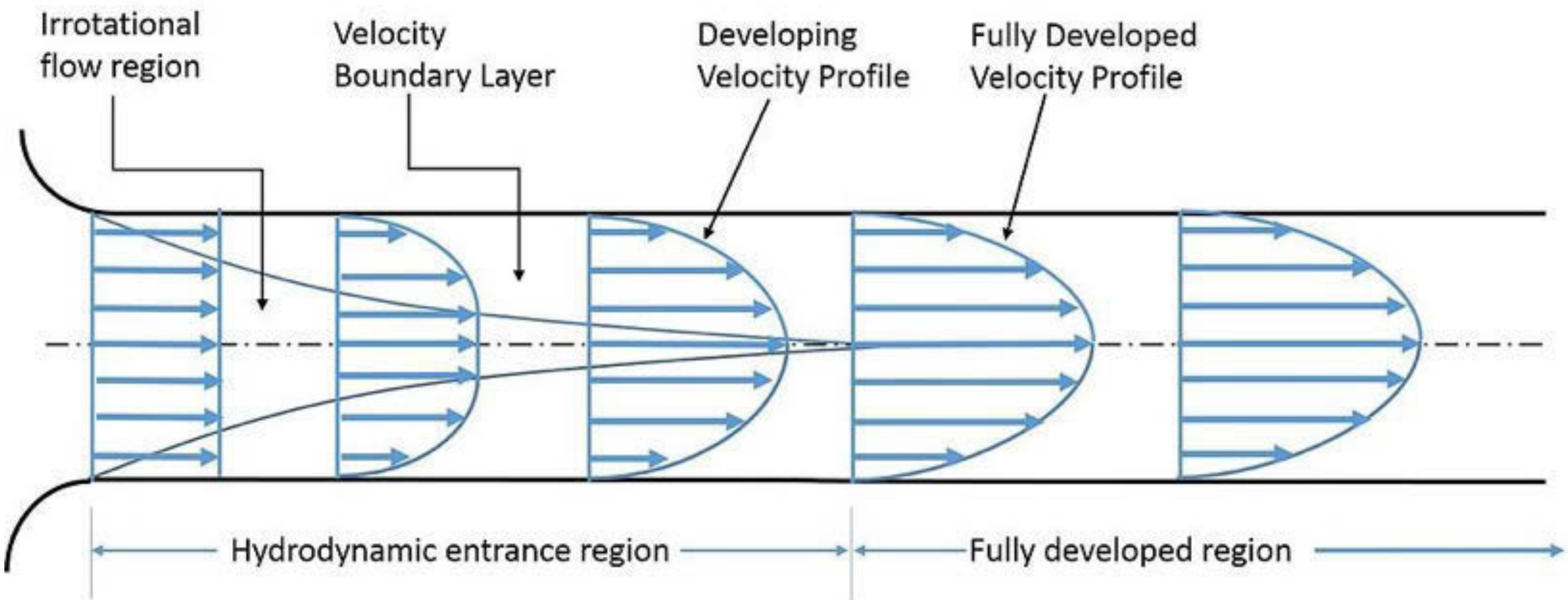
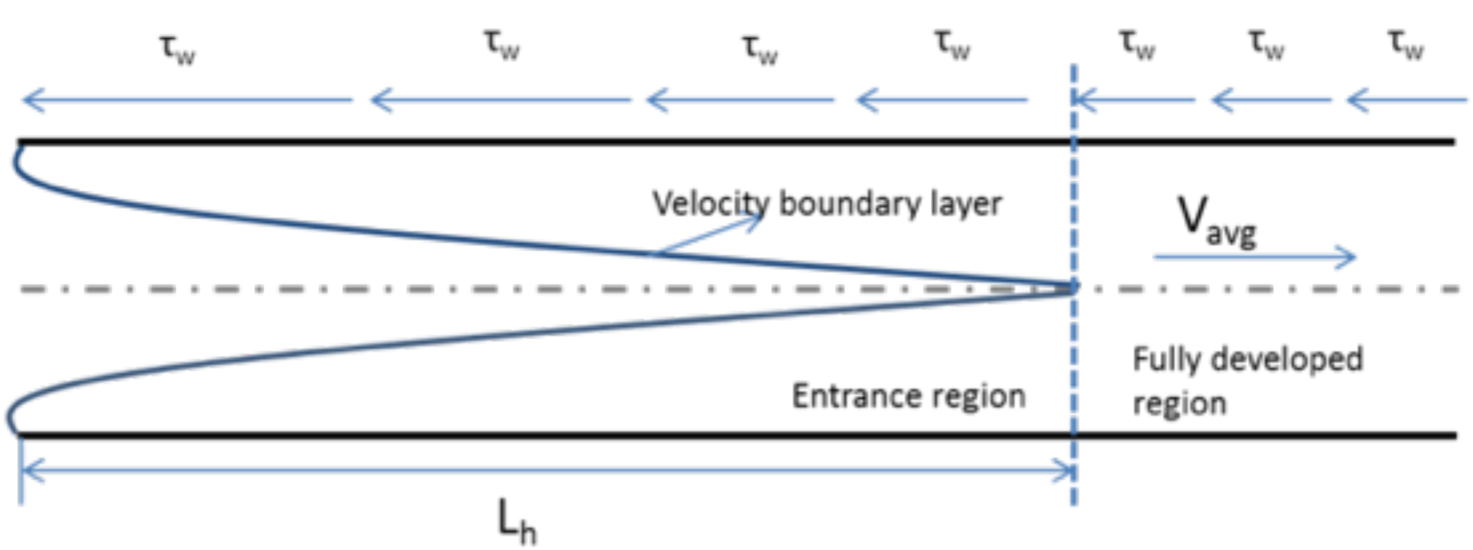
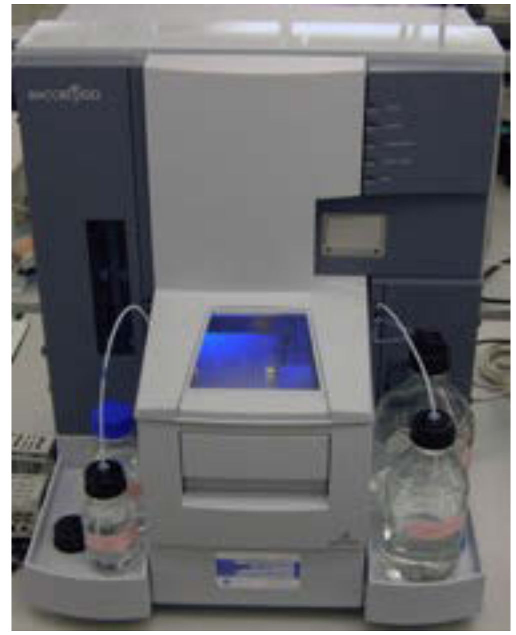
Entrance region for developing flow

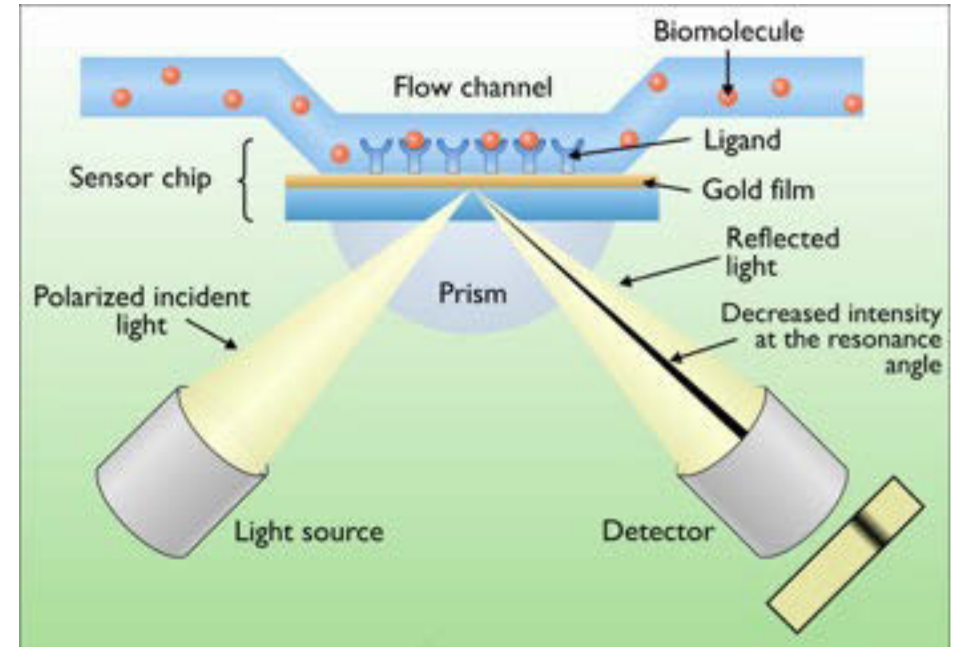


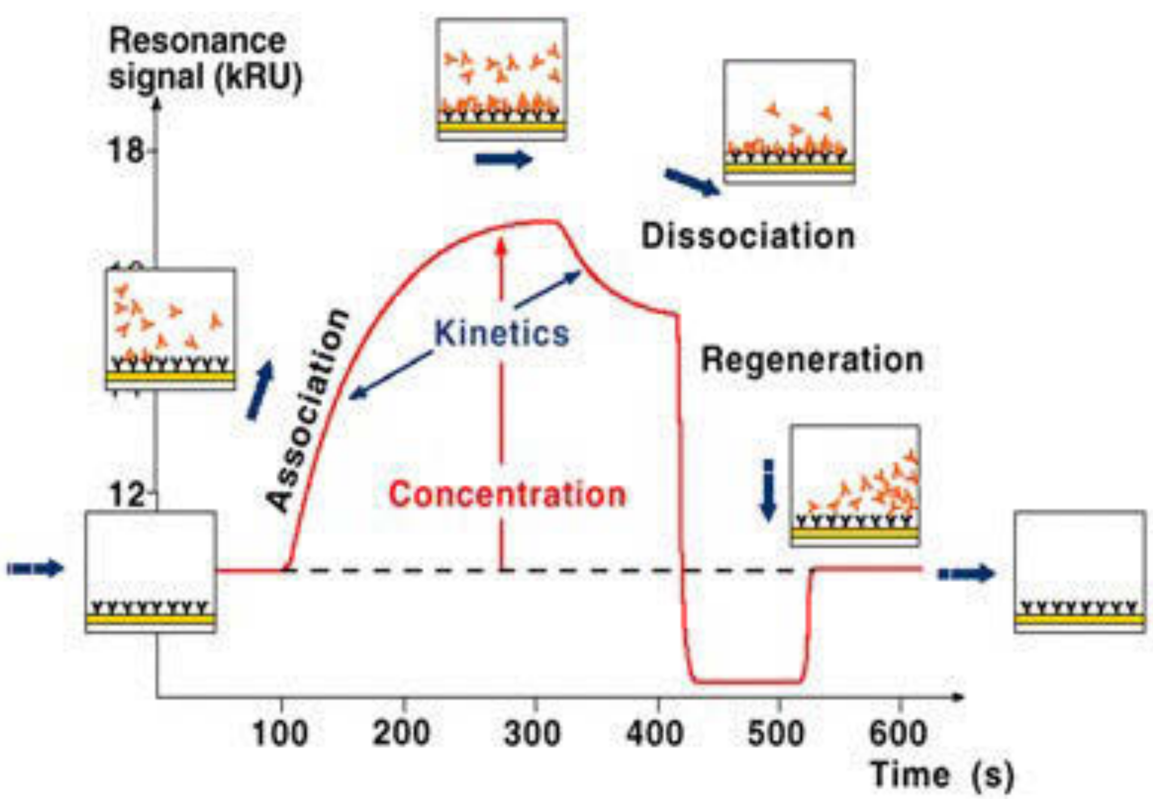


Biacore (GE)

Measure on/off kinetics and concentration in a label-free manner







The *analyte* is the interaction partner that is passed in solution over the ligand (Figure 1-1).

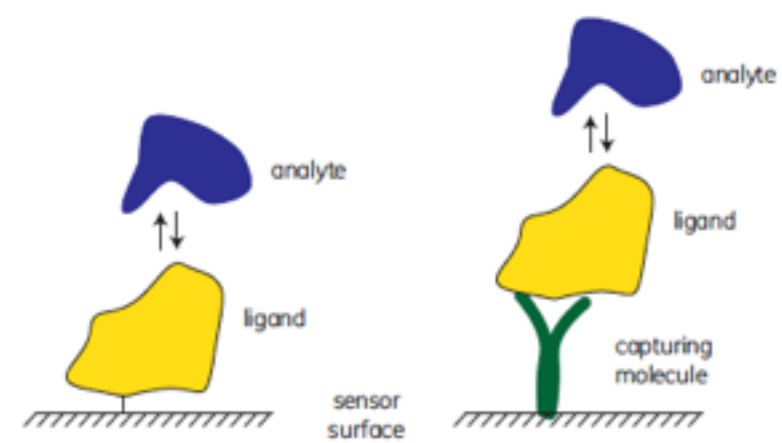


Figure 1-1. The ligand is the interaction partner that is attached to the sensor surface. The ligand may be immobilized directly on the surface (left) or attached through binding to an immobilized capturing molecule (right). The analyte is free in solution and binds to the immobilized ligand.

Making it stick: convection, reaction and diffusion in surface-based biosensors

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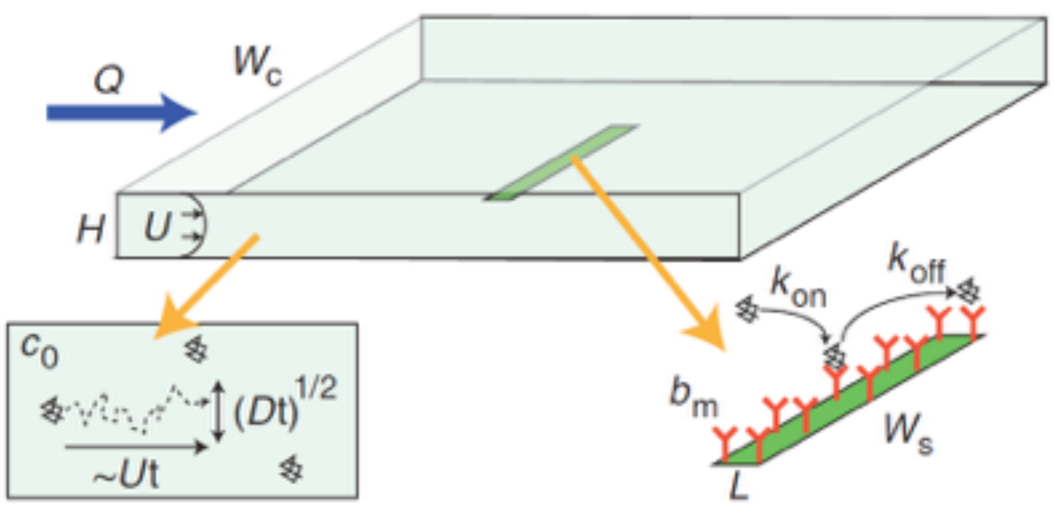

Figure 1 Model system studied here. Solution with target concentration c_0 flows with velocity U and volumetric flow rate $Q \sim HW_cU$ through a channel of height H and width W_c over a sensor of length L and width W_s that is functionalized with b_m receptors per unit area.The kinetic rate constants for the (first-order) binding reaction are k_{on} and k_{off}, and the diffusivity of the target molecules is D.

Source: Squires, Todd M. et al. "Making it stick: convection, reaction and diffusion in surface-based biosensors." Nature Biotechnology 26, no. 4 (2008): 417-426.

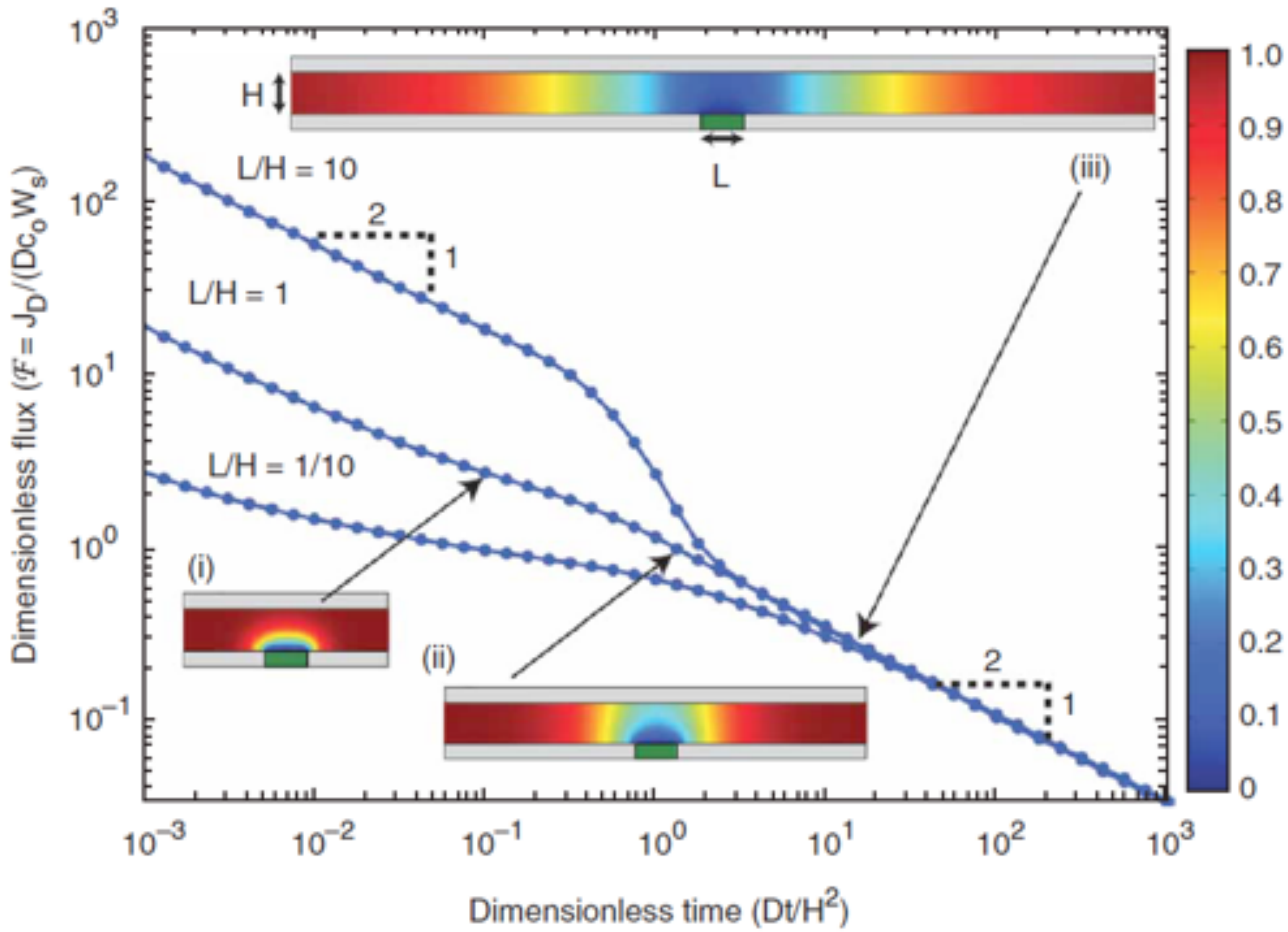

Figure 2 Purely diffusive flux to sensors of three different sizes ($\lambda = L/H$): $\lambda = 10$ (top), $\lambda = 1$ (middle), and $\lambda = 1/10$ (bottom), computed using COMSOL. We plot a dimensionless flux $\mathcal{F} = J_D/(Dc_0 W_s)$ as a function of dimensionless time $\tilde{t} = Dt/H^2$, assuming for simplicity the sensor is as wide as the channel. Inset plots i–iii show the depletion zones for various relevant times for a sensor with $\lambda = 1$: (i) $t \ll L^2/D$, where the depletion zone is essentially planar; (ii) $t \sim H^2/D$, when it 'feels' the finite channel height, and (iii) $t \gg H^2/D$, where it extends far into the channels and is essentially uniform across the channel. At these long times, the collection flux $\mathcal{F}$ is independent of sensor size. Note that no steady state is ever reached.

Source: Squires, Todd M. et al. "Making it stick: convection, reaction and diffusion in surface-based biosensors." Nature Biotechnology 26, no. 4 (2008): 417-426.

Figure 2 shows the behavior of this ideal sensor. As target molecules are collected by the sensor, a depleted zone forms with 'size' $\delta \sim \sqrt{Dt}$. The depletion zone starts relatively flat (**Fig. 2a**), until its thickness δ becomes comparable to the sensor size L (after time L^2/D). It then grows radially for a time scale $\tau_D = H^2/D$ until it spans the channel (**Fig. 2b**), after which it extends into the channels, with a length $\delta \sim \sqrt{Dt}$ that grows indefinitely (**Fig. 2c**).

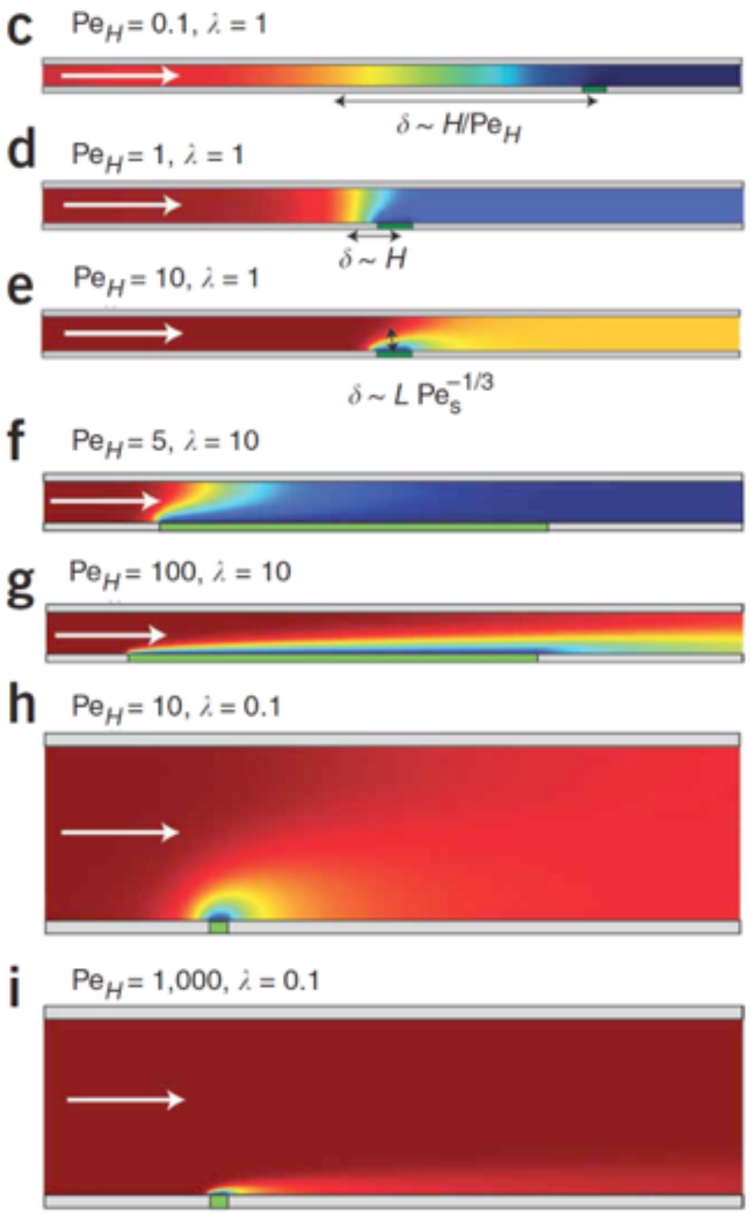

Figure 3 Mass transport and steady-state flux. (**a**) 'Phase diagram' for mass transport in our model sensing system. 'Full collection' occurs at sufficiently low Pe_H (and large enough sensor λ), corresponding to region i. In region ii, a depletion zone ($\delta_s \sim LPe_s^{-1/3}$) forms that is thin compared to both the sensor length L and the channel height H, with collection flux given by equation 7 in main text. In region iii, the depletion zone ($\delta_s \sim L/Pe_s^{1/2}$) is thinner than the channel, but thicker than the sensor, with flux given by equation 8. Region iv has not, to our knowledge, been studied thus far. The boundaries between these regions are described in **Supplementary**