

SESSION 5: ANALYSIS OF SAMPLES WITH LOW NUMBER OF MOLECULES

Exercise 1.

We target the detection of a cancer marker M (a small protein, $D=10^{-7} \text{ cm}^2/\text{s}$). In the aim to avoid amplification of the analyte, we will develop a biosensor that is collecting as much of the analyte as possible. A hospital provides the company with samples. Each sample contains 5ml of volume.

A sensing surface with $100 \mu\text{m}$ width and 10 mm length is placed on the bottom of a channel with height $1 \mu\text{m}$. The channel itself has the same size as the sensor. Anti-M antibodies are immobilized in excess (compared to the number of analytes) on the surface of the sensor. We are in the hypothesis of perfect collection.

A microfluidics system is used to push the sample volume through the channel at a flow rate of $6 \cdot 10^{-13} \text{ m}^3/\text{s}$.

1.a Describe the general approach to make a sensor that collects most of the analytes. Which parameter would you calculate to ensure high collection rate in this sensor?

1.b How big is the depletion zone? Is it large enough to ensure collection of all analytes?

1.c How long will it take for the provided sample (entire volume) to be analyzed?

1.d What is the problem with such a design? How could you improve it?