

## Supporting Information

### A PDMS Viscometer for Assaying Endoglucanase Activity

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**Model Construction:** The cross section of the PDMS pump was used as the model geometry (Figure s1). Domain r1 (30 mm× 6 mm) was the bulk PDMS and domain r2 (20 mm × 0.1 mm) was the chamber of the PDMS pump. We assumed that  $c_A$  (mol/m<sup>3</sup>) was the air concentration in domain r1 and  $c_B$  (mol/m<sup>3</sup>) was the air concentration in domain r2. Air was considered a pure ideal gas since oxygen and nitrogen had the same diffusion coefficient in PDMS and air.<sup>1</sup> The PDMS pump was placed in a Petri dish in the experiment. Consequently, there was no air flux from the surface of the PDMS pump contacting with Petri dish.

Air diffusion in the two domains was controlled by Fick's second law,

$$\frac{\partial c_A}{\partial t} = D_A \cdot \nabla^2 c_A$$

$$\frac{\partial c_B}{\partial t} = D_B \cdot \nabla^2 c_B$$

Initial conditions: at  $t = 0$ ,  $c_A = c_{A,0}$ ,  $c_B = c_{B,0}$ ;

External Boundary conditions of r1:

Boundary condition 1: no flux;

Boundary condition 2, 3, 4:  $c_A = c_E$ ;

Internal Boundary condition of r1:  $c_A = \frac{1}{k} c_B$

Here,  $D_B/D_A = 10^4$ , which means mass diffusion in r2 was the rate limiting step

compared with mass transport from r1 to r2. In this case, PDMS was always saturated with air of r1 at the internal boundary of r1.  $k = c_{B,0}/c_E$  due to Henry's law.

We assumed  $c'_A = kc_A$ ,  $c'_{A,0} = kc_{A,0}$ ,  $c'_E = kc_E$  and substituted this equation to the above diffusion equations, initial conditions and boundary conditions. We obtained:

$$\frac{\partial c'_A}{\partial t} = D_A \cdot \nabla^2 c'_A$$

$$\frac{\partial c_B}{\partial t} = D_B \cdot \nabla^2 c_B$$

Initial conditions: at  $t = 0$ ,  $c'_A = c'_{A,0}$ ,  $c_B = c_{B,0}$ ;

External Boundary conditions of r1:

Boundary condition 1: no flux;

Boundary condition 2, 3, 4:  $c'_A = c'_E$ ;

Internal Boundary condition of r1:  $c'_A = c_B$

To simplify the simulation, we obtained  $c'_A$  and  $c_B$  from the following simulation by COMSOL. The real air distribution  $c_A$  in PDMS can be obtained by dividing  $c'_A$  by  $k$ .

$c_{B,0}$  was the air concentration in atmosphere and  $c_E$  is the saturated air concentration in PDMS,  $c_{B,0} = 44 \text{ mol/m}^3$ ,  $c_E = 4.89 \text{ mol/m}^3$  and  $k = c_{B,0}/c_E = 9$ .<sup>2</sup>

From our simulation, after degassing in vacuum desiccator for 15 min, about 20% air remained in PDMS, so  $c_{A,0} = 0.2c_E = 0.98 \text{ mol/m}^3$ .  $D_A$  and  $D_B$  were diffusion coefficients of air in PDMS and air,  $D_A = 3.4 \times 10^{-9} \text{ m}^2/\text{s}$ ,  $D_B = 2.0 \times 10^{-5} \text{ m}^2/\text{s}$ .<sup>1</sup>

**Reference:**

- 1 T. C. Merkel, V. I. Bondar, K. Nagai, B. D. Freeman and I. Pinnau, *J. Polym. Sci. Pt. B-Polym. Phys.*, 2000, **38**, 415.
- 2 K. Hosokawa, K. Sato, N. Ichikawa and M. Maeda, *Lab Chip*, 2004, **4**, 181.

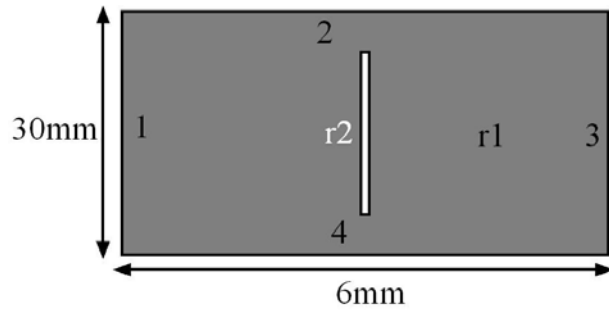


Figure S1. The geometry of the cross section of the PDMS pump.

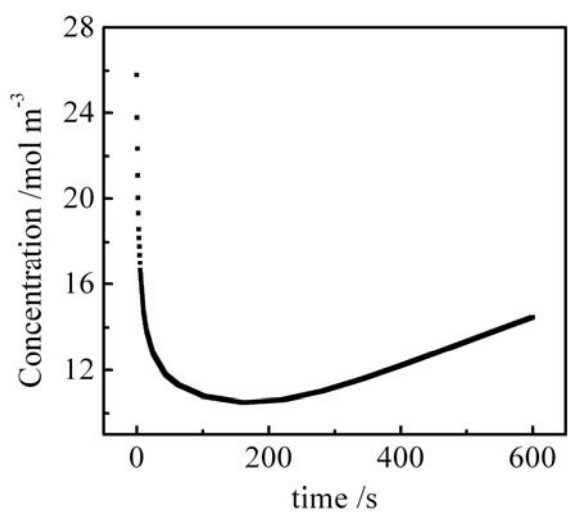
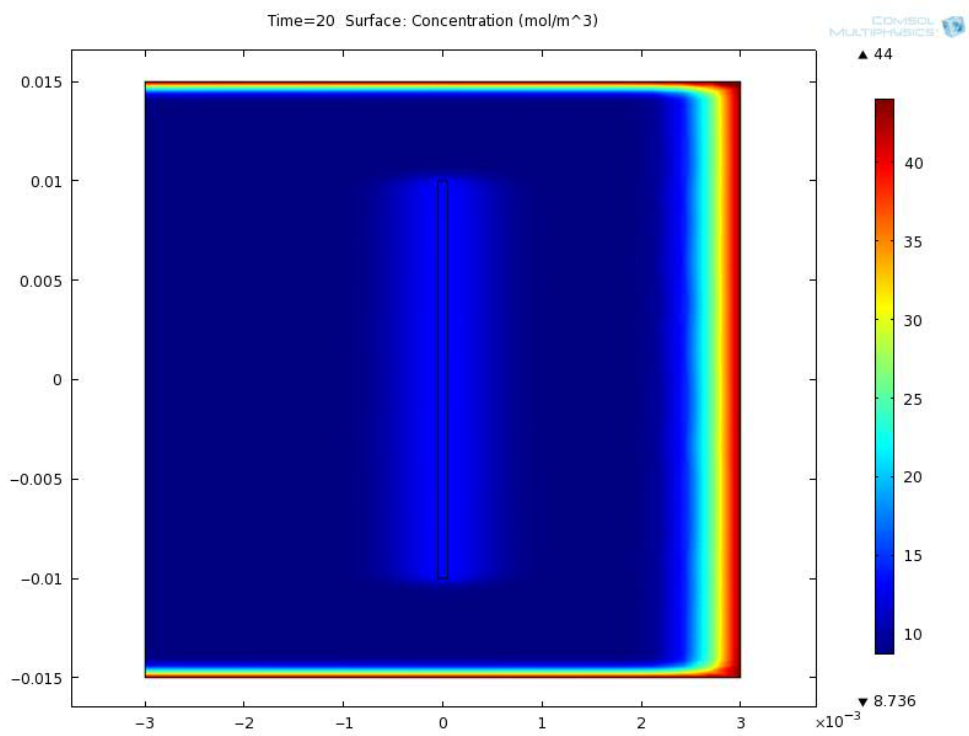
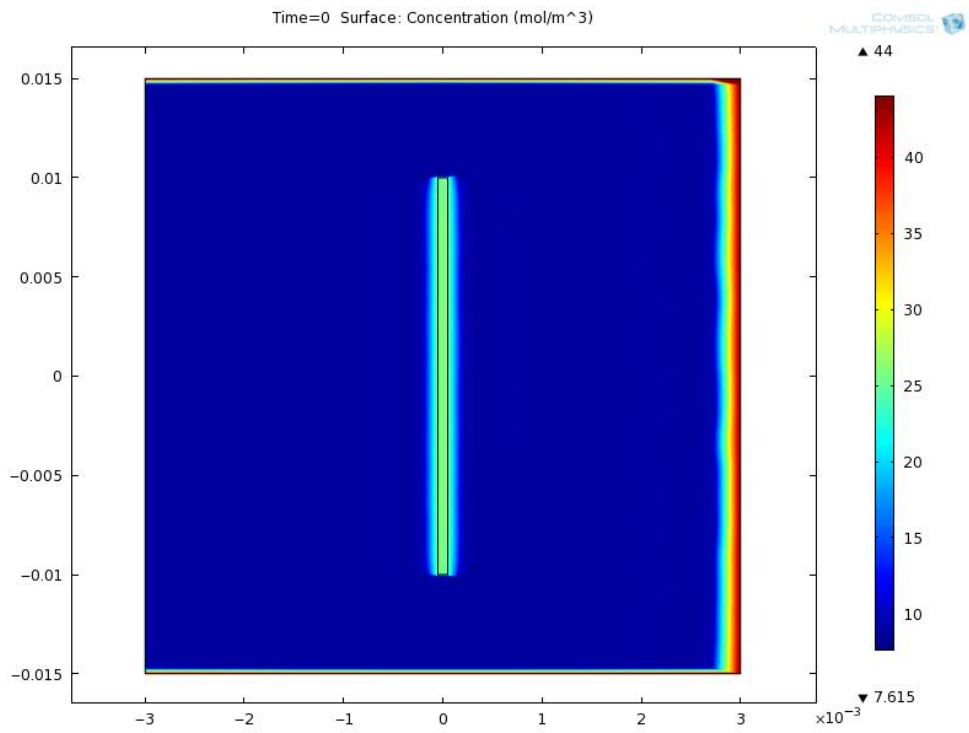


Figure S2. Plot of air concentration in the chamber of PDMS pump vs. time ( $c_B$  vs. time). Time zero was the moment when the PDMS pump was connected with the PDMS viscometer. Air concentration in the chamber decreased in the initial 160s and then increased.



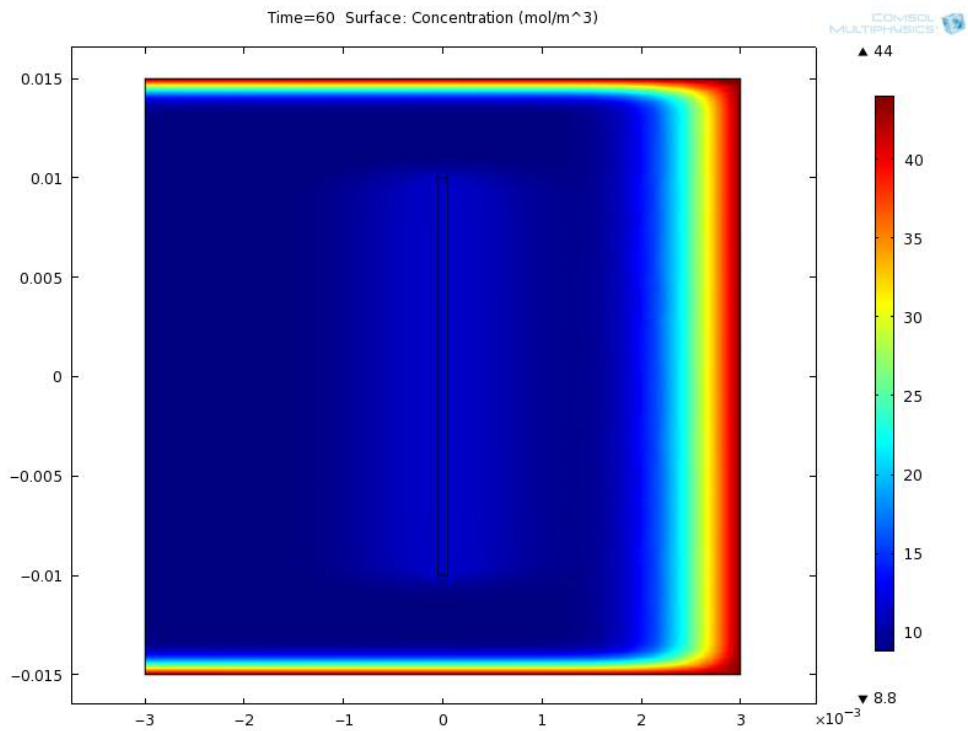
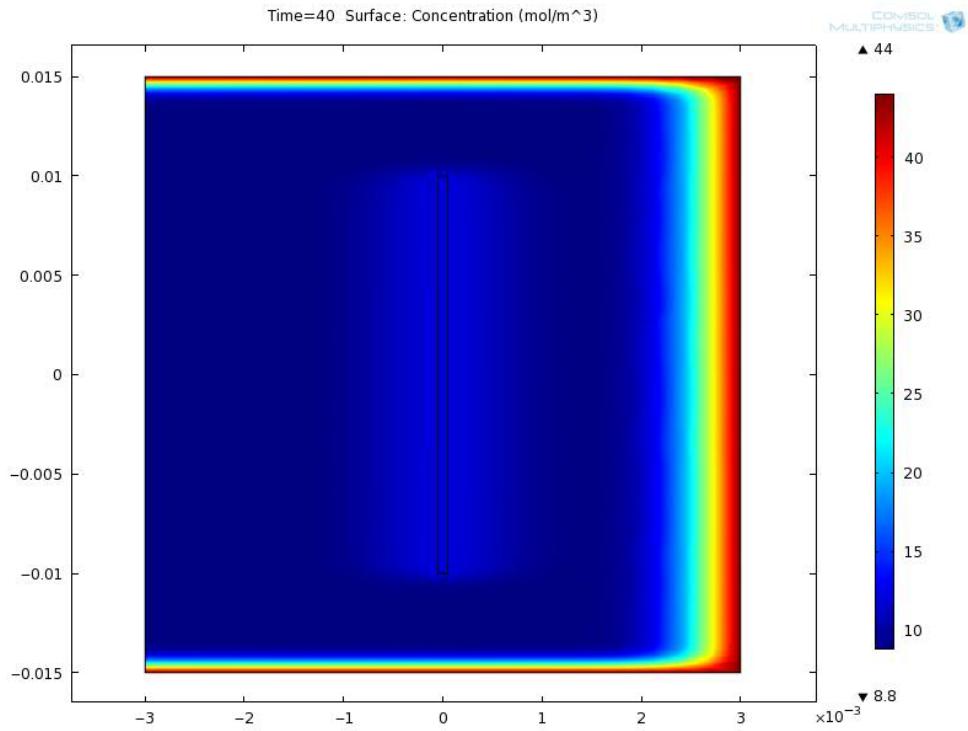


Figure S3. The distribution of the air concentration on the cross section of the PDMS pump at 0, 20, 40 and 60 s after the PDMS pump was connected with the PDMS viscometer.