Photobleaching test of FSS in the pores and selection of the concentration range

In order to study the multicomponent diffusion experimentally, we chose fluorescein sodium salt (FSS) as a marker electrolyte. Fluorescent intensity (gray value) is a direct measure of fluorescein concentration in the pores, under appropriate illumination conditions. We performed experiments on an inverted microscope (Leica DMI4000B, FITC) with fixed imaging parameters. By setting exposure, gain, and intensity values, respectively, 7 ms, 3, and 1, we set the laser intensity to be \( \approx 350 \text{ W/m}^2 \). The laser power is measured with an optical power meter (Thorlabs PM100D) and a standard photodiode power sensor (Thorlabs S120VC). Then with 1-minute-interval imaging, we observed that the fluorescein in these channel is not photobleached (Figure S1 (a,b)) for 7 minutes. Also, the averaged gray values over 7 minutes (Figure S1 (c)) show that the intensity increases linearly with the concentration of FSS up to 2 mM. Therefore, to use the normalized gray values in the pores as a direct measure of normalized FSS concentration, we conduct experiments with 2 mM FSS as the initial concentration in the pores. We note that the FSS concentration monotonically decreases once the experiment starts, and thus we never exceed the experimentally set maximum (2 mM FSS).

Comparison between experiments and the coupled model with modified boundary condition

We performed the simulation of Eq. (3) by assuming that \( c_2(0, \tau) = 0.06 \) to quantitatively capture the effect of the concentration boundary condition at \( \chi = 0 \).
The results in Fig. 2 show that the quantitative agreement improves. To further improve the prediction, a full 3-dimensional model needs to be considered.

Figure 2 Comparison between experiments and the coupled with modified boundary conditions. Fluoroscein concentration $c_2(X, \tau)$ for $\beta = 1$, where $\beta = 1$ corresponds to the concentration of 4 mM NaCl in the main channel. The solid lines are results for the coupled electrolyte model (Eq. (3)), and the data points are obtained from experiments.