Electronic supplementary information

ESI Table Commercially available membrane materials with nominal molecular cut-offs in the range of 1-200 KDa. Wavelength retardation of membranes as measured with a Berek compensator. Examined membranes were polyethersulfone (PES) (Biomax PB Membranes, Millipore); polyvinylidene difluoride (PVDF) (Viresolve Membranes, Millipore); regenerated cellulose (RC) (FisherBrand, Cellu Sep, Thermo and Ultracel Plc, Millipore); cellulose ester (CE) (Float-A-Lyzer G2, G235058, Spectrum Labs)

Membrane	Retardation [nm]	Membrane thickness [μm]
PES	Opaque	280
PVDF	Opaque	150
RC	~240	20-30 (FisherBrand) 280 (Millipore)
CE	17-25	60

Sample Loading

Prior to sample loading, the reservoir channel was filled with buffer to prevent sample dehydration. We connected both reservoir inlet and outlet to vials that were open to atmospheric pressure on the top (Fig 1c). Both vials were mounted onto a vertical rail to allow for precise control of reservoir flow rates through hydrostatic pressure driven flow by adjusting absolute and relative heights of the vials.

Sample was loaded using a mechanical syringe pump (OEM, Harvard Apparatus) and Hamilton gas tight glass syringe (Fig. ESI1). All outlets were open during loading. To minimize *fd* virus consumption per experiment we primed the storage layer with fluorinated oil (FC-43, Fluorinert™, 3M) and used an injection loop[1] carrying ~3 µL virus followed by more FC-43 oil. Fluorinated oil is immiscible with both water and hydrocarbon oils and therefore does not interact with biological samples[2]. After virus loading was completed, we carefully blocked the virus storage layer outlet. The mechanical syringe pump was left connected to the inlet throughout the experiment.

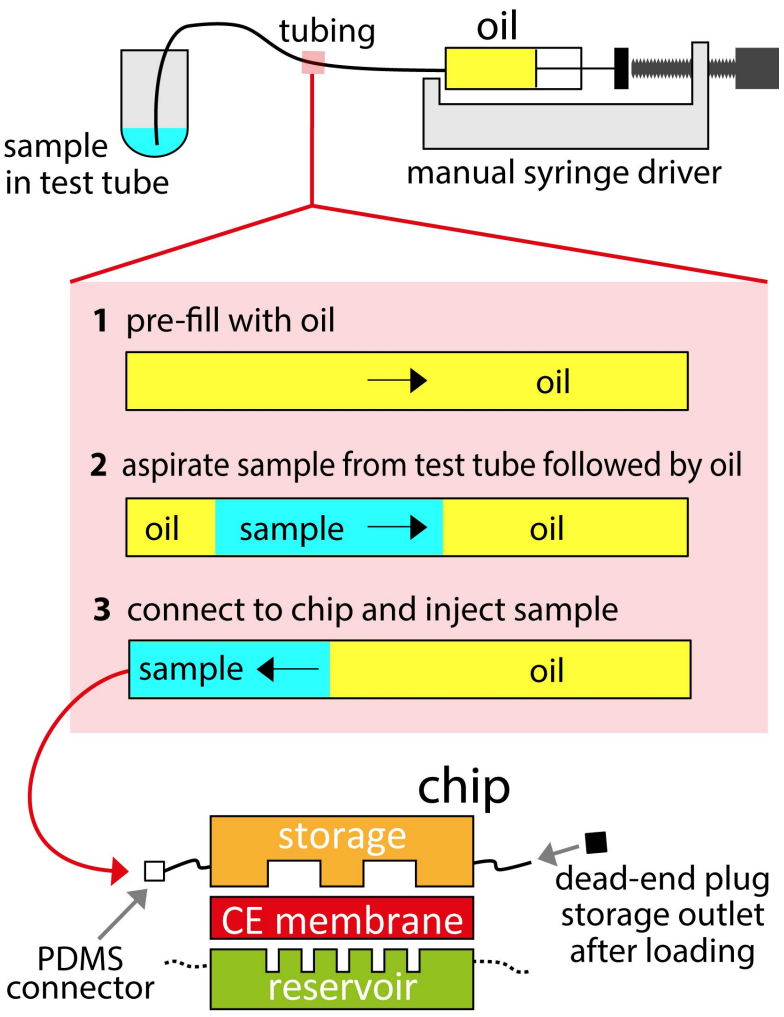

Fig. ESI1 Sample injection proceeded using FC-43 fluorinated oil as a hydraulic fluid to minimize sample consumption. A manual syringe driver was used to aspirate a few μL of sample spaced in immiscible oil. The sample was then carefully injected into the storage channel. After injection had been completed, the storage channel outlet was dead-end sealed.

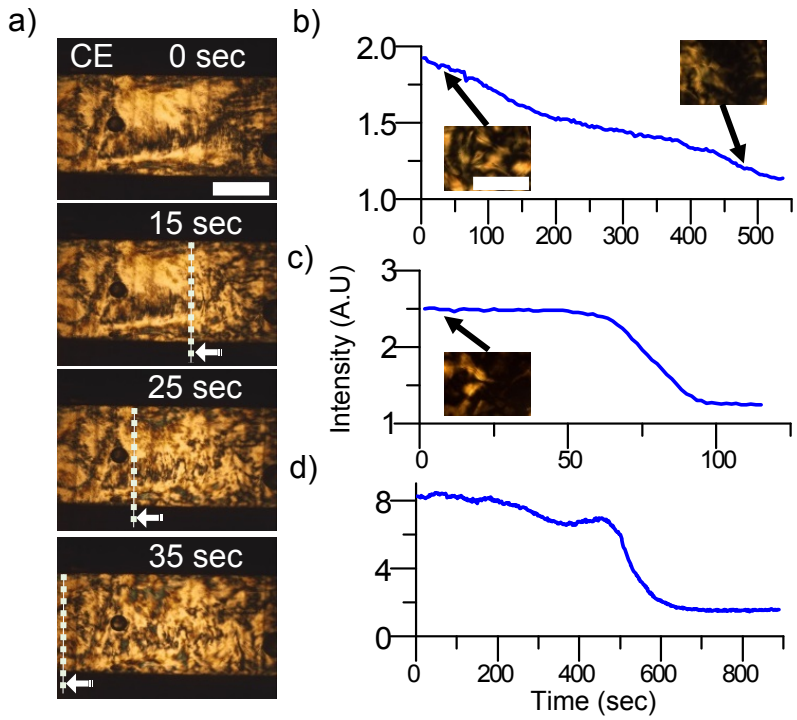

Fig. ESI2 (a) Image time series of the immediate reaction following a buffer exchange from 0 mM NaCl to 40 mM NaCl. CE membrane positioned alongside the sample channel appeared dark under cross polarizers. Sample was in equilibrium at *t=0*, when the 40 mM NaCl solution, flowing from right to left, reached underneath reservoir channels. The dotted line marks the front of the transition. Reoriented nematic were observed on the left hand side of the line. The line moved at approximately 65 μm/s while several more minutes were required for the sample to reach equilibrium. The integrated intensity of light during buffer exchanges to higher salt concentrations are presented for 0 to 80 mM (b) 100 to 120 mM (c) and 0 to 280mM (d) NaCl. Inset pictures in (b) and (c) show cross polarized images of at different stages before and during transition. Scale bar 500 μm.

ESI Text for Fig. 2

Phase transitions were induced through dialysis of NaCl into and out of the storage compartment, while leaving all other experimental parameters constant. A nematic order was observed for 0 to 100 mM NaCl (Fig 2a-d), where transition times were of the order of few minutes and images were taken at equilibrium. The 120 mM image (Fig. 2e) shows an intermediate, non-equilibrated state, where some ~100 μm long nematic domains still existed but gradually transformed within hours into granular smaller nematic tactoids.

In the 280 mM image (Fig. 2f), nematic tactoids, such as the one circled by a dashed line in the Fig 2f inset, dot the isotropic phase. This state was obtained only hours after the buffer exchange to the high NaCl concentration. Finally, a 0 mM NaCl solution was reintroduced and the nematic phase was restored (Fig. 2g), several hours after the NaCl concentration change. The asterisk marks the isotropic membrane next to the sample channel.

At the initial 0 mM NaCl concentration, the director was mostly in-plane with the membrane (Fig. 2h). At 100 mM NaCl, many domains had their optical axis pointing out-of-plane (Fig. 2i). The restored nematic phase (Fig. 2g,j) was characterized by two groups of large domains. One was formed in the middle of the channel with the optical axis parallel to the channel's length. The other group was close to the channel side faces with the optical axis of pointing towards the faces.

References

1. Q.-F. Li, A. M. Spinelli, R. Wang, Y. Anfinogenova, H. A. Singer, and D. D. Tang, *J. Biol. Chem.*, 2006, **281**, 34716–24.

2. L. S. Roach, H. Song, and R. F. Ismagilov, *Anal. Chem.*, 2005, **77**, 785–96.