Externally directed self assembly of disk-shaped zeolite particles: Supplementary information

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For SDS concentrations less than 0.1 mM the particles aggregate since sufficient surfactant is not available to the particle surface. For SDS concentrations greater than 100 mM, the high ionic strength of the solution screens the electrostatic repulsion and the particles aggregate. This is illustrated in the sequence of three microscopy images, shown in figure 1, observed on an inverted Zeiss microscope using a 63X water immersion objective. In a 0.01 mM SDS solution (figure 1b) aggregates of few particles are observed, at 1 mM (figure 1c) the suspension is stable and at 100 mM (figure 1d) the particles again aggregate. It should be noted under these conditions the pH of the suspension is not controlled.
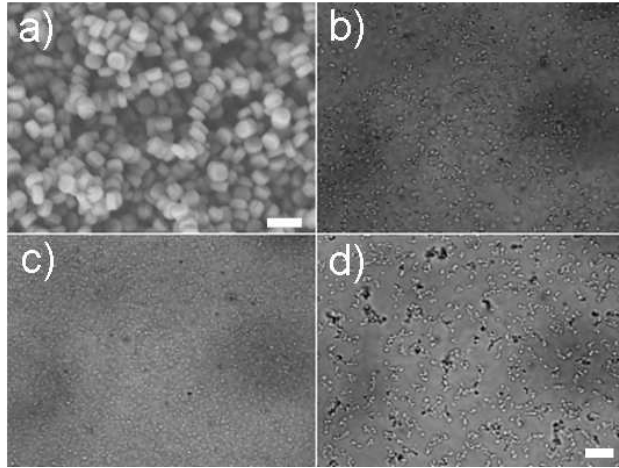

FIG. 1. (a) Scanning electron microscopy image (Scale bar: 1 μm) of ZSM-5 zeolite particles used in this work. The particles are disk shaped with a diameter of 453$\pm$11 nm and a thickness 209$\pm$10. Optical microscopy images (Scalebar: 10 μm) of zeolite particles in (b) 0.01 mM SDS, (c) 1 mM SDS and (d) 100 mM SDS solution.

We measured the electrophoretic mobility of the particles using a commercial dynamic light scattering instrument (Brookhaven Instrument Corp. ZETA-PALS). As seen in figure 2, the particles are negatively charged and the mobility increases upon increasing the SDS
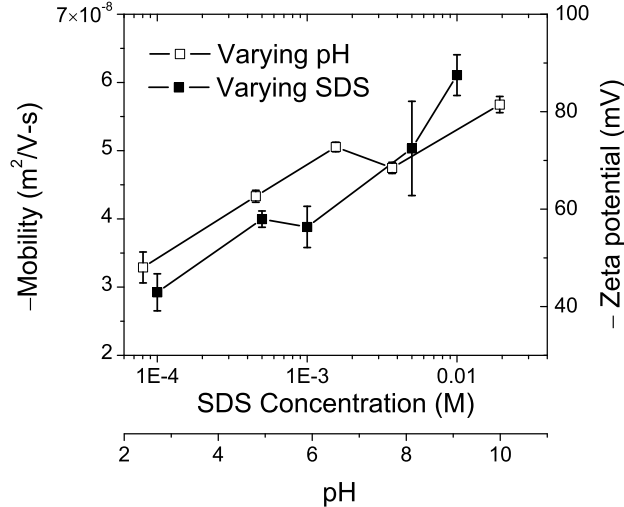
FIG. 2. Electrophoretic mobility and the zeta potential of particles as a function of SDS concentration (solid symbols) and as a function of pH (open symbols). The SDS concentration was fixed at 1 mM when the pH was varied. The error bars correspond to the mobility measurements. Lines are guides to the eye.

concentration. For the curve with filled symbols the SDS concentration is varied from 0.1 mM to 10 mM and the pH of the solution is not controlled. We also fixed the SDS concentration to 1 mM and adjusted the pH by adding a buffer solution of known pH. On increasing pH, the mobility of the particles increases (open symbols, figure 2). This indicates that the silica surface of the zeolite particles is also charged due to dissociation of the surface -OH groups and adsorption of H^+ ions.

Figure 3 is a vector plot of the electric field at a field strength of 500 V/cm. The plot represents a section along the thickness of the cell. The distance along the y-axis in the plot corresponds to the thickness of the cell. The electrode is along the negative x direction and the edge is located at the coordinates (0,0). The plain glass slide extends along the positive x-direction.

The flow velocity at six different separations from the electrode as a function of E^2 are shown in figure 3b of the article. The least squared fits for the linear dependence are shown in black lines and are summarized in table I below.
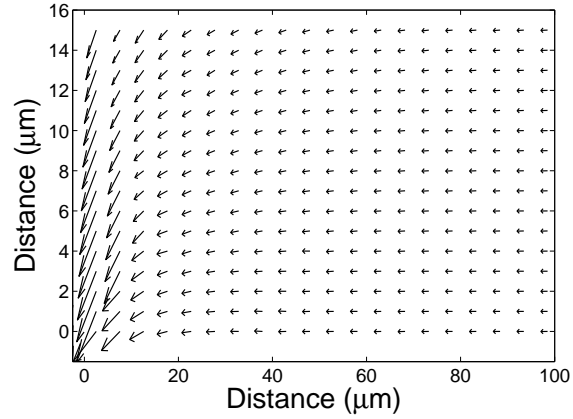
FIG. 3. Vector plot for the electric field near the electrode edge at a field strength of 500 V/cm. The electrode edge is located at coordinates (0,0) along the negative x-axis. The distance along x-axis is the distance from the electrode edge and the y-axis corresponds to the thickness of the cell.

TABLE I. Table summarizing the linear fits shown in figure 3b of the article.

Distance (μm)	Slope $\times 10^5$	Intercept	R^2
89.5	7.87±1.1	1.0±1.7	0.85
74.3	10.6±1.1	1.2±1.7	0.92
59.0	11.8±1.4	2.5±2.3	0.90
43.7	15.0±1.9	2.4±3.2	0.88
28.5	19.8±1.8	3.5±3.0	0.94
13.2	28.8±4.9	0.3±8.1	0.82