Supplemental Figures

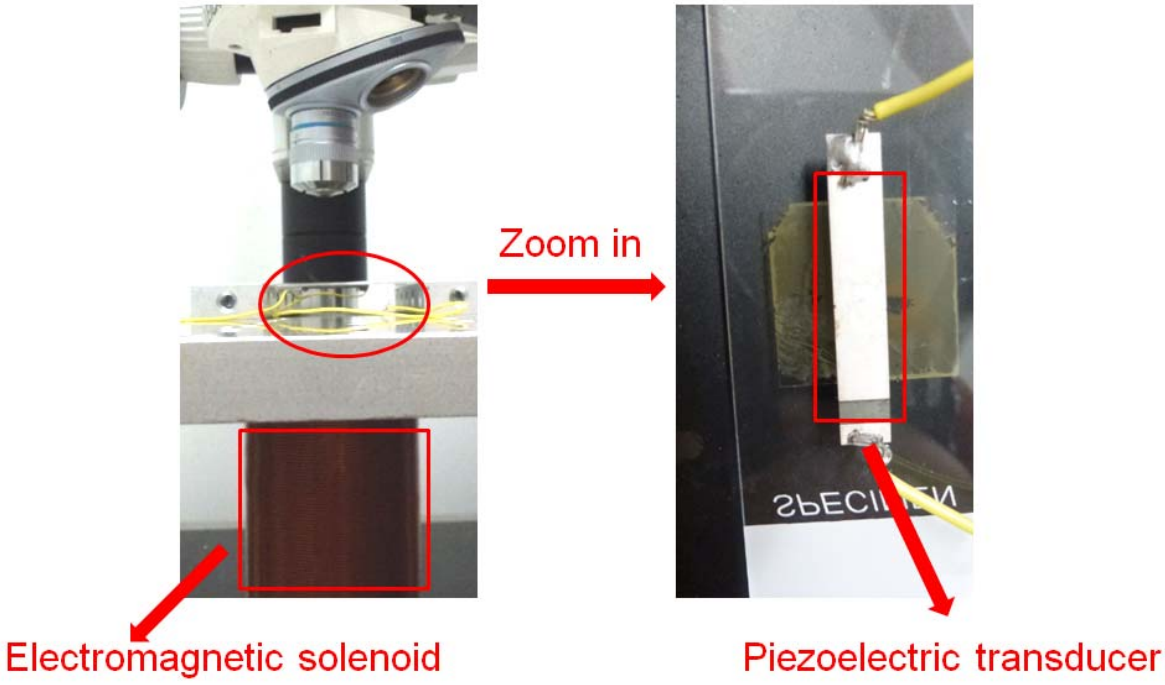

Figure S1. A photograph of our experimental setup: the sample was observed under an upright microscope, with the solenoid underneath the sample. For the experiments with acoustic concentration, a piezoelectric transducer is attached to the back of the slide to generate acoustic field.

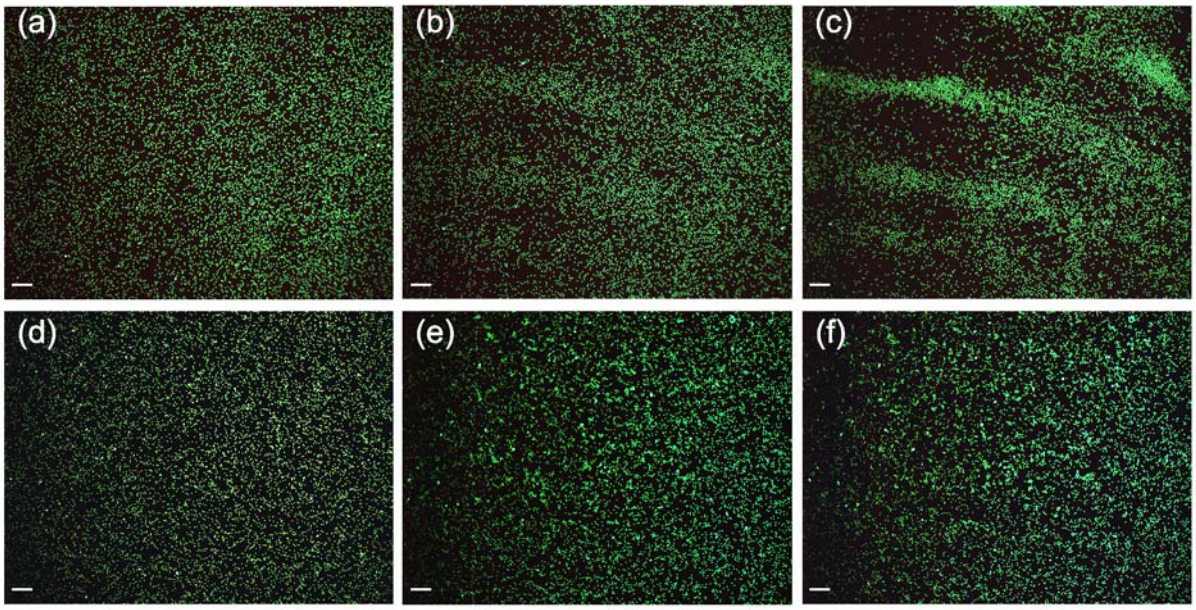

Figure S2. Illustration of acoustic concentration effects. A 1V, 2.93 MHz sine wave was used to drive PZT to generate acoustic field and concentrate the particles in local regions for: (a) 1 hour; (b) 2 hours; (c) 3 hours. Control experiments without acoustic field were conducted for: (a) 1 hour; (b) 2 hours; (c) 3 hours. The particles begin to locally concentrate in certain regions after applying the acoustic field for 2 hours. All the scale bars are 50μm.

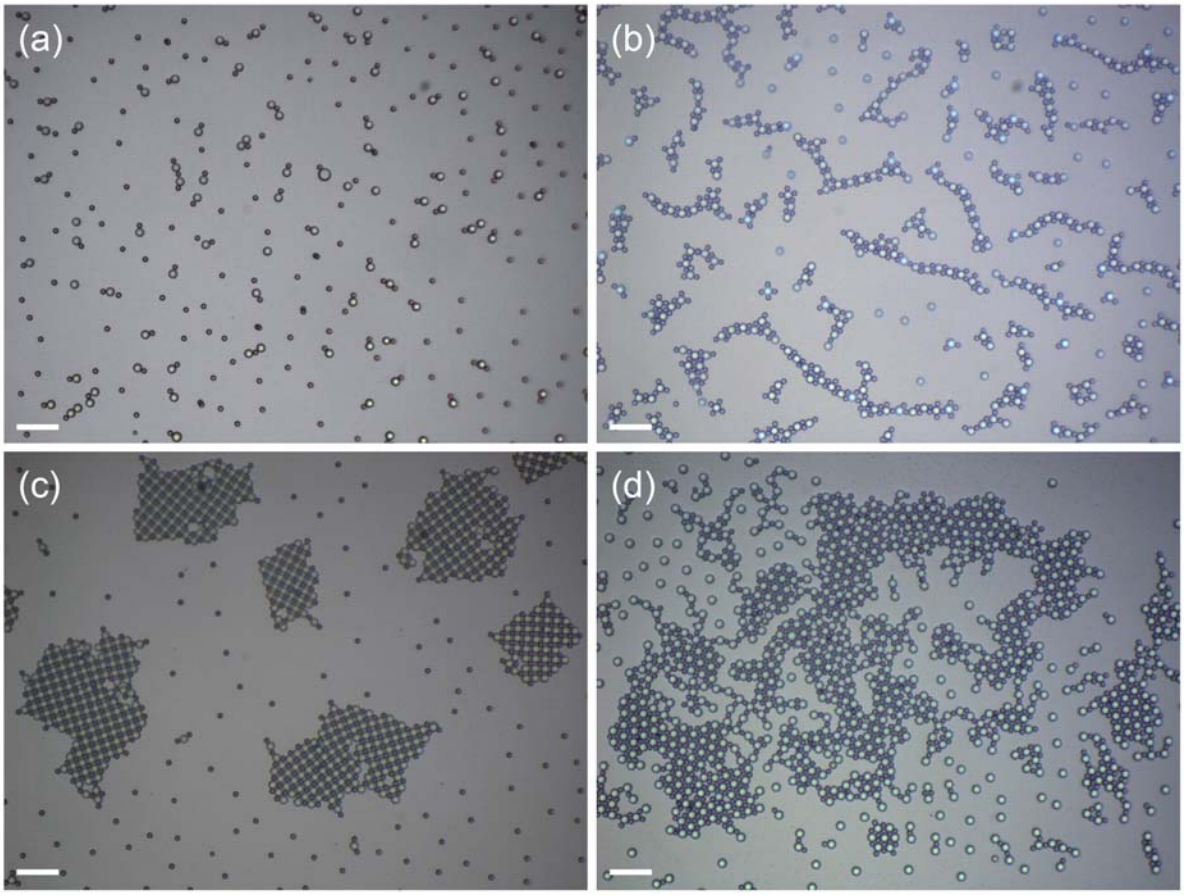

Figure S3. Wide field images of examples for different structures are illustrated: (a) *MN* ring at φ=0.1%; (b) M_2N chains at φ=0.8%; (c) square lattice at φ=0.5%; (d) honeycomb lattice at φ=0.8%. Although there are sometimes multiple different types of structures present within each image, we chose to plot the dominant phase in the phase diagram. The scale bars are 25μm.

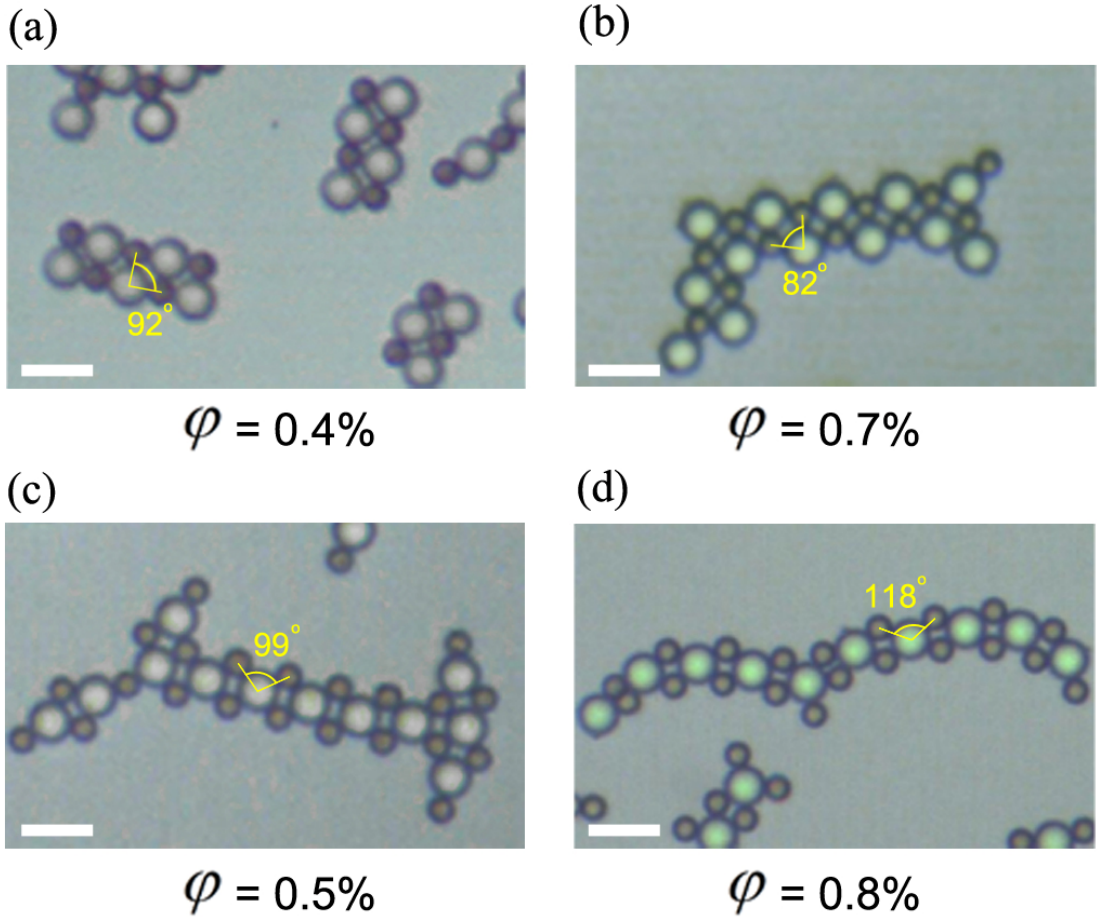

Figure S4. In the 2-particle system, the particle sized difference introduces variations for the 1D chain structures in their way of packing. At slightly different ferrofluid concentrations, two different M_2N_2 chain structures (a)(b), and two different M_2N structures (c)(d) can be observed. And the difference between (a) and (b), (c) and (d) can be observed through measurement angle measurement. The scale bars are 10μm.

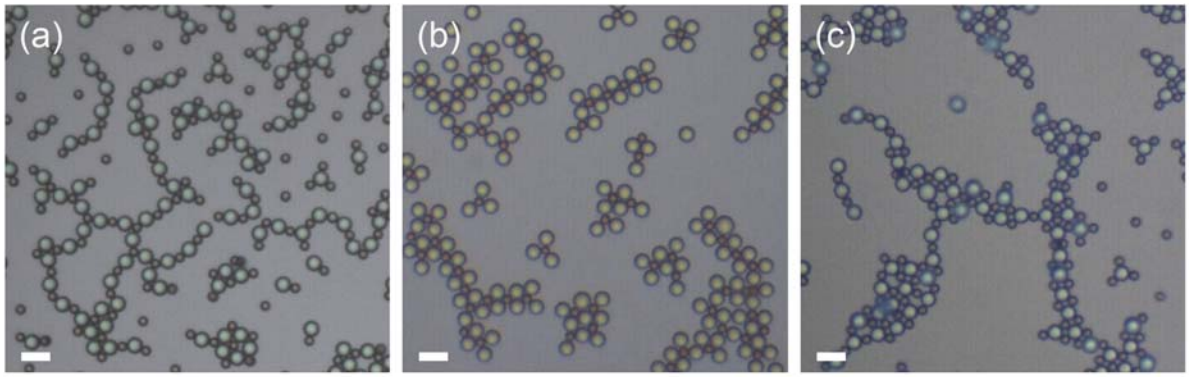

Figure S5. For certain ferrofluid concentrations at the border between two different equilibrium phases, a percolating network of chains was sometimes observed, such as those shown in (a) a network of *MN* chains at φ=0.2%; (b) a network of MN_2 chains at φ=0.3%; (c) a network of MN_2 chains at φ=0.5%. The scale bars are 10μm.