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Driving morphological changes in magnetic nanoparticle structures through the application of acoustic waves and magnetic fields[1] ANN HUANG, MORTEZA MIANSARI, JAMES FRIEND, University of California, San Diego — The growing interest in acoustic manipulation of particles in micro to nanofluidics using surface acoustic waves (SAW), together with the many applications of magnetic nanoparticles—whether individual or in arrays—underpins our discovery of how these forces can be used to rapidly, easily, and irreversibly form 1D chains and 2D films. These films and chains are currently difficult to produce yet offer many advantages over individual nanoparticles in suspension. Making use of the scale of the structures formed, 10^{-9} to 10^{-5} m, and by taking a balance of the relevant external and interparticle forces, the underlying mechanisms responsible for the phenomena become apparent. For 1D chains, the magnetic field alone is sufficient, though applying an acoustic field drives a topology change from loosely connected chains to loops of $\sim$ 10–100 particles. Adding the acoustic field drives a transition from these looped structures to dense 2D arrays via interparticle Bjerknes forces. Inter-particle drainage of the surrounding fluid leaves these structures intact after removal of the externally applied forces. Clear morphology transitions are present and depend on the relative amplitude of the incident Brownian, Bjerknes, and magnetic forces.

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