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Magnetic Bubbles XUE ZHAO, PEDRO QUINTO-SU, CLAUS-DIETER OHL, Division of Physics and Applied Physics, SPMS, NTU, Singapore — Bubbles in liquids driven by a sound field are used in many disciplines: for example bubbles clean surfaces in ultrasonic water bathes, they catalyze unique chemical reactions in sonochemistry, and under special conditions even create light. However, conventional bubbles have a major limitation when placed in an acoustic field: it is extremely hard to control their position. Here we present a new type of bubble that has permanent magnetization originating from a shell of self-assembled nanoparticles, so that magnetic fields can be used to control the bubble's position independently. We will report on the recipe and the experiment to study bubble oscillations in weak magnetic fields. The magnetic susceptibility of the bubbles is proportional to their surface area,$\chi = (9 \pm 3 \times 10^{-6} m) r^2$, where r is the radius. Also they are compressible in moderate acoustic fields and induce a microstreaming flow with a toroidal vortex at the upper pole of the bubble. Similar microstreaming flows have been used to transport and rupture cells at small scales. Thus we envision applications in manipulation of biological materials and in microfluidic devices using acoustic and magnetic forces.

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