SUPPLEMENTARY MATERIALS:

Fig. S1: Calibration curve of the magnetic device representing the magnetic field gradient as a function of the distance between the tip of the needle and the particle.
Fig. S2: Histogram of the maximal deformations of magnetic pillars (diameter = 10 μm) obtained by incorporating ferromagnetic black iron oxide particles with an average size of around 200 nm. The distance between the tip of the needle and the pillar, $D$, is 50 μm.
Movie 1: Pillars with a 10 µm diameter and 20 µm height filled with ferromagnetic black iron oxide particles.

Movie 2: Pillars of 5 µm diameter and 15 µm height with magnetic spherical aggregates of around 250 nm.

Movie 3: Pillars of 5 µm diameter and 15 µm height with embedded magnetic nanorods.