Domain wall movement assisted transport of magnetic particles on surfaces

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Superparamagnetic nanoparticle remote control by magnetic gradient fields holds promise for applications like biological cargo transport, particle sorting, or in mixers for smallest amounts of chemicals. However, long range attractive forces between their induced magnetic moments and short range unspecific interparticle interactions enhances agglomeration and poses together with an increasing ratio between particle-substrate sticking and magnetic driving forces for decreasing particle size severe problems for applications and miniaturization. Here we show that these obstacles may be dramatically reduced using exchange bias bilayers with designed magnetic domain patterns for particle transport in the stray fields of moving domain walls. Two unique characteristics of the bilayers are exploited, their asymmetric magnetization reversal and the possibility to pattern them into designed domains. Particle clustering is dramatically reduced. Magnetic fields in this scheme are considerably smaller as gradient fields necessary for conventional transport showing a route towards controlled transport of nanoparticles.

9.7 cm

13.4 cm

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