Supporting Information

Label-free microRNA detection based on exchange-induced remnant magnetization

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1. Experimental details

The thiol-modified DNA or biotinylated RNA strands as Strand 1 were immobilized on the bottom surface of sample wells coated with gold or streptavidin, respectively. The concentrations of the DNA and RNA strands were 10 μM. After hybridization with their corresponding biotinylated DNA/RNA strands (10 μM) with one mismatched base (Strand 2), the duplexes were incubated with streptavidin-conjugated magnetic particles (M280 or T1 beads, both from Invitrogen) at room temperature in tris-buffered saline (TBS) solution with 1% (w/v) bovine serum albumin (BSA) and 0.05% detergent Tween 20. The magnetic particles were then magnetized by approaching the pole face of a permanent magnet perpendicularly. The magnetization time was 2 min. The magnetic field at the surface of the magnet was approximately 0.5 T.

To start the exchange reaction, the label-free target DNA or miRNA (Strand 3) with complementary sequence to the immobilized Strand 1 was added in the sample well and incubated in TE buffer (10 mM tris, 1 mM EDTA, 1 M NaCl, pH 8.0) at 37 ºC or room temperature. The magnetic measurements of the samples were obtained using an atomic magnetometer after applying a weak centrifugal force at 1000 rpm to eliminate physisorption of the magnetic particles. The home-built atomic magnetometer has been described previously (N. C. Garcia, D. Yu, L. Yao and S.-J. Xu, *Opt. Lett.*, 2010, **35**, 661-663.). The sensitivity of the atomic magnetometer was 150 fT/(Hz)$^{1/2}$.

For the detection of miRNAs let-7a and let-7c, the two sample wells were mounted on a plastic sample holder with center-to-center distance of 14 mm. The reaction temperature was 37 ºC. The melting point (Tm) of the target DNA binding its complementary sequence was estimated to be 60.1 °C. The melting points of the let-7a and let-7c duplexes were estimated

to be 68.2 °C and 70.8 °C, respectively, under our experimental conditions. (Integrated DNA Technologies, http://www.idtdna.com/analyzer/Applications/OligoAnalyzer/)

2. Signal of DNA exchange using M280 magnetic particles

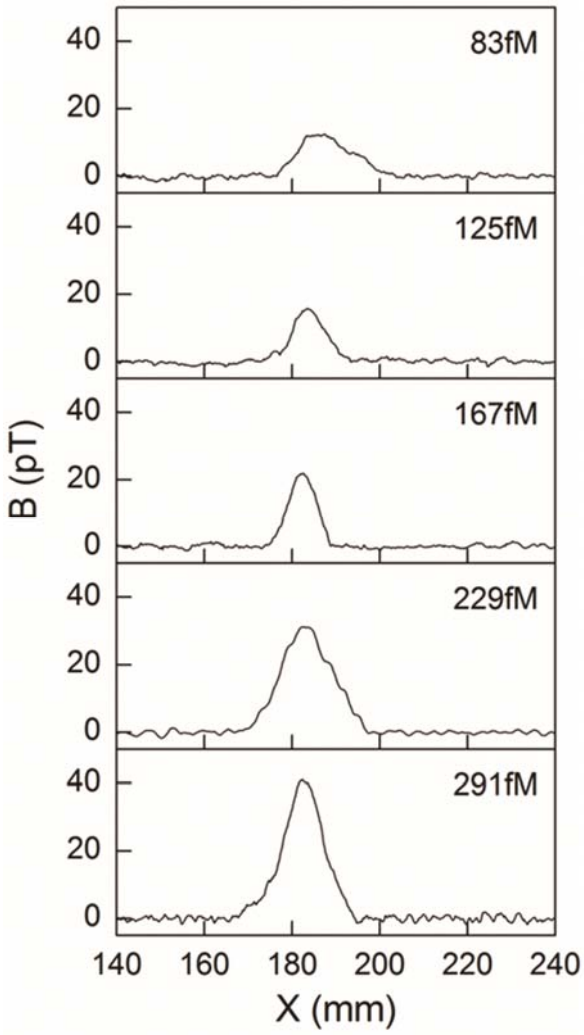

Fig. S1 *Magnetic field measurements for the exchange reactions involving 12-base DNA strands at five different concentrations. Magnetic particles M280 (~2.8-μm diameter) were used. Each point on the profile has 1 s signal averaging time, obtained by averaging 33 adjacent data points in the raw data, where each data point was measured for 30 ms.*

3. Signal of DNA exchange using T1 magnetic particles

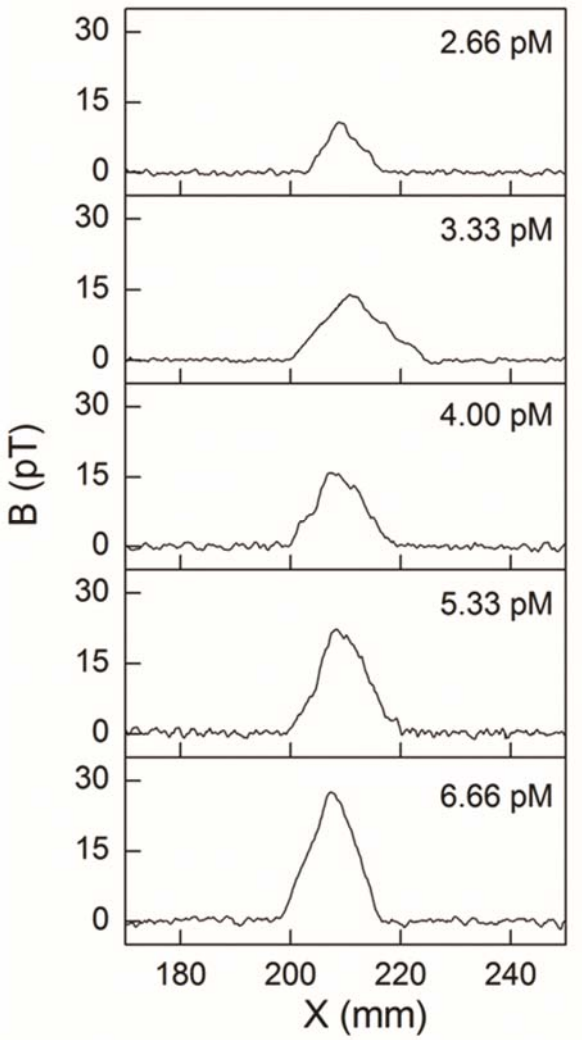

Fig. S2 *Magnetic field measurements for the exchange reactions involving 12-base DNA strands at five different concentrations. Magnetic particles T1 (~1-μm diameter) were used. Each point on the profile has 1 s signal averaging time, obtained by averaging 33 adjacent data points in the raw data, where each data point was measured for 30 ms.*