Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information (ESI)

Diamagnetic repulsion of particles for multilaminar flow assays

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1. Fluorescently labelled biotin in ferrofluid

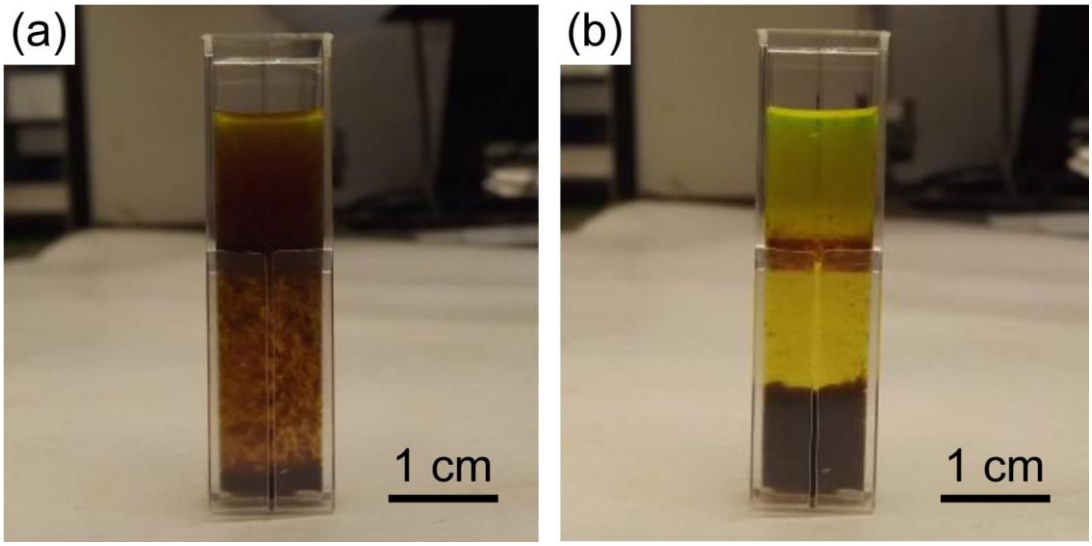

Fig. S1 Addition of biotin-4-fluorescein solution to 0.01x diluted aqueous-based EMG 507 ferrofluid. (a) Immediately following addition, showing agglomeration of the magnetic nanoparticles in the solution. (b) Several minutes after addition, with the magnetic nanoparticle agglomerates having dropped out of suspension, leaving the fluorescently labelled biotin solution clearly visible.

2. Laminar flow in the microfluidic device

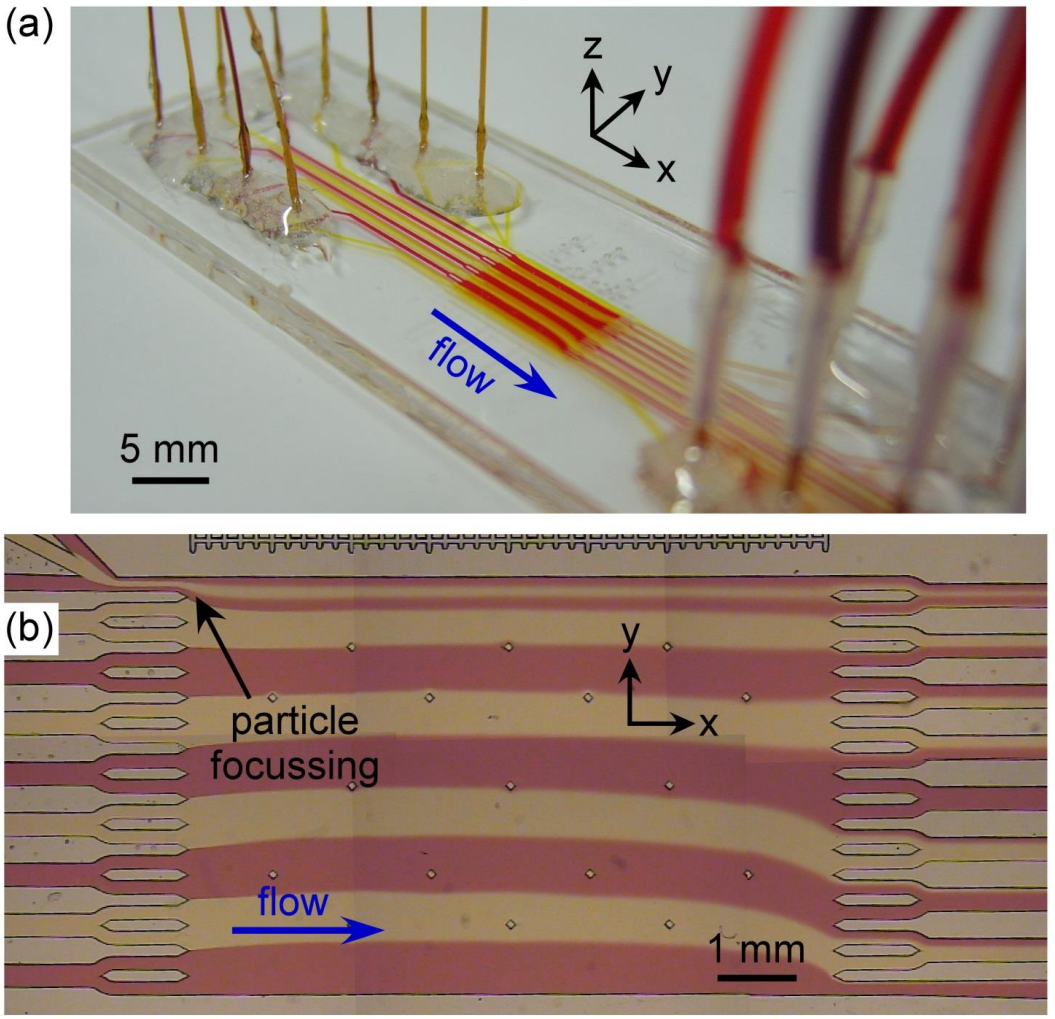

Fig. S2 Laminar flow regime in the 10-inlet microfluidic chip, visualised with red and yellow inks. (a) Photograph of the device with inlet and outlet tubing. (b) Superimposed images of the reaction chamber with laminar flow of red and yellow inks, taken with a 10x objective on a microscope. Although the flow near the bottom of the chamber is diverted downwards slightly due to a region of low pressure caused by a short outlet channel, the region at the top of the chamber through which the particles passed did not experience this effect.

3. Finite Element Method Magnetics (FEMM) simulations

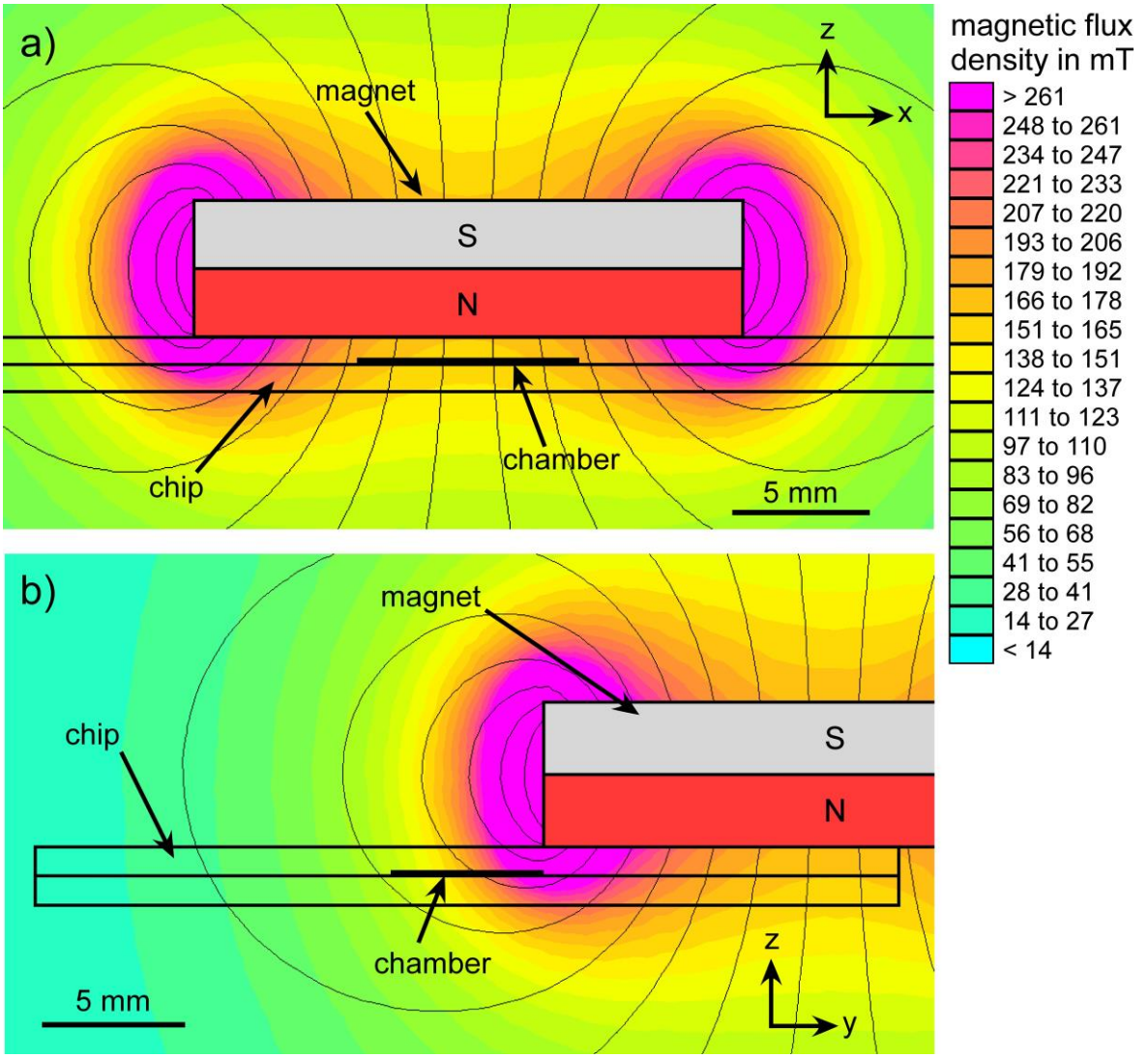

Fig. S3 FEMM simulations of the magnetic field across the chip from a 20 mm Ø x 5 mm NdFeB magnet. (a) Front view of the device. (b) Side-on view of the chip. Due to software limitations, a view could not be achieved from above the microfluidic chip. The cylindrical shape of the magnet could also not be taken into account, thus the simulations show a cross-section of the centre of the magnet and the chip/chamber in relation to this. The magnetic flux density (**B**) at the surface of the magnet was calculated to be approximately 275 mT, and the FEMM simulations were plotted from this. From the simulation, the average value of **B** in the region of the chamber through which the particles passed was estimated to be 307 mT, with a gradient (∇**B**) of 48 mT mm^{-1} and a (**B**·∇)**B** value of 14.7 T^2 m^{-1}.

4. Concept of multilaminar flow reactions via diamagnetic repulsion

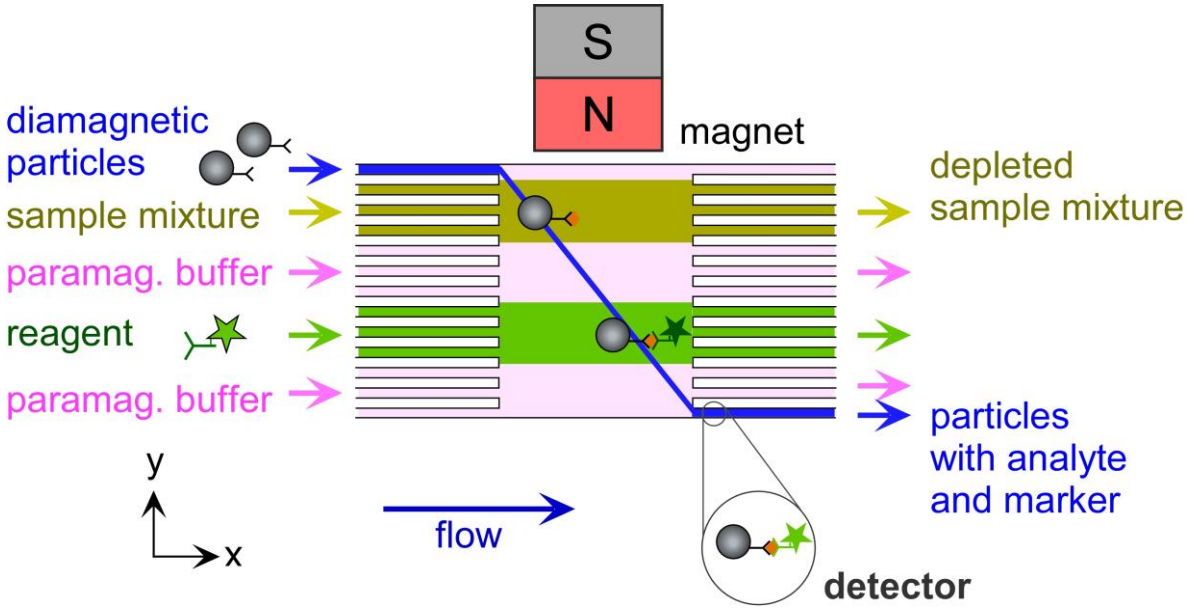

Fig. S4 Schematic showing a future concept of two-step multilaminar flow assays via diamagnetic repulsion of functionalised polymer particles, e.g. for sandwich immunoassays.