malloy ($Ni_{80}Fe_{20}$) or a switchable multilayer spin valve element. The membrane **2** can be a fluid impermeable membrane that acts as a barrier between the traps **1** and a fluid containing magnetic particles. The membrane **2** can be transparent or opaque and made from a material that provides a fluid barrier. According to one embodiment of the present invention a silicon nitride membrane was determined to be suitable for use with biological samples. Transparent membranes were determined to be particularly useful because they allow for the simultaneous incorporation and application of optical techniques. For example, a transparent membrane would allow for the micromachined magnetic trap platform that supports the magnetic traps **1** to be placed on an inverted optical microscope for observation of translocation events. The optical microscope can be equipped with a charge-coupled device (CCD) camera and imaging software. The images obtained by the CCD camera could provide information on the location of the magnetic particles with respect to the magnetic traps. By interfacing the CCD image with the magnetic force microscope (MFM) software, a program can be implemented to sort particles, based on size, color, chemical functionality, and magnetic susceptibility, into their respective positions in an array.

[0056] A liquid sample solution can be injected beneath the membrane **2**, opposite the magnetic traps **1**, or on the same side of the membrane **2** as the magnetic traps **1**.

[0057] When the micromachined magnetic trap platform of FIG. **1** is placed in an applied magnetic field, the trap arrays are induced to create local magnetic fields that are localized about each individual trap **1**. As depicted in FIG. **2**, magnetic particles **3** or magnetically tagged or labeled particles become attracted and trapped in the individual magnetic fields that are localized about the magnetic traps **1**.

[0058] FIGS. **3**A-**3**E depict on manner of fabricating the micromachined magnetic trap platform of FIG. **1**.

[0059] According to one embodiment of the present invention the micromachined magnetic trap platform (also referred to as a microfluidic platform) can be fabricated as depicted in FIGS. **3**A-**3**E by depositing a 0.2-1 μm low stress silicon nitride **5** on opposite sides of a polished 350 μm Si (100) wafer **6** as depicted in FIG. **3**A. Next, an array of 0.014 mm^2 squares **7** are etched in the nitride film **5** on the back side of the wafer **6** as depicted in FIG. **3**B followed by anisotropically etching wells **8** in the underlying silicon to the nitride film **5** on the opposite side of the wafer **6** as depicted in FIGS. **3**C using, for example, aqueous potassium hydroxide. After wells **8** are formed, fluid channels **9** can be formed in the silicon wafer **6** as depicted in FIG. **3**E. Next, the magnetic traps **1** were formed using a photoresist and sputter depositing a tantalum adhesive layer of 5 μm and a Permalloy layer of 30 μm as depicted in FIG. **3**F. The arrays of traps **1** etched across each portion of the nitride membrane that extends across the bottoms of each of the wells **8** is referred to herein as the magnetic trap arrays. The individual traps **1** are referred herein to as traps. From FIGS. **3**A-**3**E it can be understood that a single chip or micromachined magnetic trap platform can include a plurality of membranes (arranged in an array) each or which includes a plurality of traps **1** that are also arranged in an array.

[0060] According to the present invention micromachined magnetic trap platforms can have a plurality of magnetic trap arrays each of which can have 50 to 200 traps with each trap being 1.2 μm×3.6 μm, it being understood that these dimensions and number or traps are non-limiting examples only and that the dimensions and number or traps can easily be varied as desired.

[0061] The single layered traps of FIGS. **1**-**3** (not counting the tantalum adhesive layer, can be activated (stitched "ON" or "OFF") by application of an applied magnetic field. According to further embodiments of the present invention multilayered spin-valve traps are provided which can be switched "ON" and "OFF" in groups or individually by application of an auxiliary magnetic field that can be applied selectively and as a short pulse as discussed below.

[0062] FIG. **4** is a schematic side view of a magnetic element according to one embodiment of the present invention. The magnetic element depicted in FIG. **4** includes two layers of magnetic permeable or ferric material exemplified as Permalloy **10**, **11** which are separated by an intermediate layer of copper **12**. Note shown in FIG. **4** is a lower layer of tantalum which would normally be provided as an adhesive layer to secure the multilayered magnetiv element to a membrane.

[0063] FIG. **5** is a schematic side view of a spin-valve element according to another embodiment of the present invention. The spin-valve element depicted in FIG. **5** includes a layer of tantalum **13**, a layer of Permalloy ($Ni_{80}Fe_{20}$) **14**, a layer of cobalt **15**, a layer of copper **16**, a layer of cobalt **17**, a layer of Permalloy ($Ni_{80}Fe_{20}$) **18**, a layer of IrMn **19**,and a layer of tantalum **20** as shown. According to one embodiment the layer **13** of tantalum was 5 nm, the layer **14** of Permalloy ($Ni_{80}Fe_{20}$) was 15 nm, the layer **15** of cobalt 5 nm, the layer **16** of copper was 10 nm, the layer **17** of cobalt was 5 nm, the layer **18** of Permalloy ($Ni_{80}Fe_{20}$) was 15 nm, the layer **19** of IrMn was 5 nm and the layer **20** of tantalum was 5 nm. The lower layer of tantalum **20** functions as an adhesive between the spin-valve element and the membrane to which is attached and the top layer of tantalum **13** acts as a barrier to oxidation. The cobalt layers **15** and **17** act as diffusion barriers between the Permalloy ($Ni_{80}Fe_{20}$) layers **14** and **18** and the Cu spacer layer **16**. The IrMn layer serves to pin the adjacent magnetic layer. The magnetic layer thicknesses are chosen to give small magnetic field gradients in the antiparallel state. According to one embodiment, a spin-valve element as illustrated in FIG. **5** was fabricated having a width of 1 micrometer in width and a length of 4 micrometers. It is to be understood that the dimensions of the elements discussed herein including the spin-valve arrays and spin-valve elements and the thickness of the various layers of the spin-valve elements and membrane are not limited to the specific examples given and could be varied as desired.

[0064] FIG. **6** is an M-H curve of a spin-valve element that depicts the bistable state at H=0 Oe. As shown in FIG. **6**, the spin-valve elements exhibit a bistable magnetic structure that encompasses a ferromagnetic "ON" and antiferromagnetic "OFF" state in the absence of an applied magnetic or current-induced magnetic field. Since the spin-valve arrays and spin-valve elements are arrayed, the location of the traped particle can be specified by a matrix position with respect to all other spin-valve arrays and spin-valve elements in the arrays. The magnetization of the spin-valve elements can be macroscopically turned "ON" and "OFF" by applying an applied magnetic field of the appropriate