consideration the dimensions of the magnetic particle and the other dimensions of the islands and gap regions.

[0086] The vertical profile of the islands (i.e., their profile in the z-dimension) is also a significant design consideration, particularly at the edges of the gap where the magnetic particles are trapped. **FIG. 7** shows a schematic cross-sectional view of several islands with different vertical profiles, where the angle between the island wall at the gap and the substrate is indicated as α. In certain embodiments of the invention the wall is substantially vertical (i.e., perpendicular to the plane of the substrate), while in other embodiments of the invention the wall forms an angle α of greater than 90° with the substrate. The angle may be between 90 and 100 degrees, between 100 and 110 degrees, between 110 and 120 degrees, between 120 and 130 degrees, between 130 and 140 degrees, between 140 and 150 degrees, etc. Of course the angle a may also be less than 90°. In addition, the angle may vary in the vertical dimension. The walls may not meet to form an angle with straight edges but rather may form a curve, in which case the angle will be approximate. A substantially vertical wall may result in better particle trapping than an angled wall. The angle of the wall may vary depending on the etching technique. One of ordinary skill in the art will be able to vary the etching parameters and technique to generate a substantially vertical or angled wall as desired.

[0087] The length l_{is} of the magnetic islands may also be varied. It will be appreciated that the length may be selected in conjunction with the width of the islands and the gap length in order to minimize fringing fields. In certain embodiments of the invention the islands are substantially rectangular, and the length l is approximately equal to the width w_{is}. In certain embodiments of the invention the islands are substantially rectangular, and the length l_{is} is greater than the width w_{is} by a factor of between 1 and 2. In certain embodiments of the invention the islands are substantially rectangular, and the length l_{is} is greater than the width w_{is} by a factor of between 2 and 3. In certain embodiments of the invention the islands are substantially rectangular, and the length l_{is} is greater than the width w_{is} by a factor of between 3 and 5. In certain embodiments of the invention the islands are substantially rectangular, and the length l_{is} is greater than the width w_{is} by a factor of between 5 and 10. These relative dimensions are merely exemplary and are not intended to limit the invention in any way.

[0088] Where the island is not rectangular, there may be a minimum and a maximum width and/or length, depending on the points at which the measurement is made. For example, in **FIG. 3**, the minimum length of an island is indicated by l_{min} while the maximum length is indicated by l_{max}. In certain embodiments of the invention the maximum length of the island is approximately equal to the maximum width of the island. In certain embodiments of the invention the maximum length of the island is greater than the maximum width of the island. The relative length and width may have any of the relationship listed above for the case of rectangular islands.

[0089] It will be appreciated that island length and also the spacing between rows of islands in the y-dimension (indicated as s in **FIG. 3**) influence the array density (i.e., the density of attachment locations). For example, if an island row spacing (i.e., the distance between the center in the y-dimension of islands in adjacent rows) of approximately 20 μm and an island length of approximately 17 μm are selected, the array density will be approximately 2500 sites/mm^2 (assuming a gap of 3 μm, which results in a site-to-site spacing of 20 μm in the x-dimension). If an island length and row spacing of approximately 10 μm is selected the array density will be approximately 10,000 sites/mm^2. These dimensions are readily achievable. In certain embodiments of the invention the island length is between 30 and 100 nm. In certain embodiments of the invention the island length is between 100 and 500 nm. In certain embodiments of the invention the island length is between 500 nm and 1000 nm. In certain embodiments of the invention the island length is between 1 and 5 μm. In certain embodiments of the invention the island length is between 5 and 10 μm. In certain embodiments of the invention the island length is between 10 and 20 μm. In certain embodiments of the invention the island length is between 20 and 30 μm. In certain embodiments of the invention the island length is between 30 and 50 μm. The distance between rows of islands may fall within any of the foregoing dimensions. It will be appreciated that the island length and spacing may be appropriately selected based upon the dimensions of the magnetic particle to be used. For example, where a 2.8 μm bead is used and a gap length and island width of approximately 3 μm are selected, an island length of less than 3 μm may lead to undesirably large fringing fields.

[0090] (2) Gap Length and Width

[0091] The trapping of the magnetic beads on the chip can be optimized by choosing appropriate island geometries and appropriate spacing between adjacent islands in both an x and y dimension. The spacing, shape, and size of the islands and gaps between them can be selected to strongly attract (and ultimately trap) a single magnetic bead. It will be appreciated from the above discussion that the selection of appropriate island and gap dimensions is interdependent. In general, the optimum spacing and size of the islands and gaps depends on the size of the beads to be used. Using 2.8 μm diameter beads and chips created with gap spacing varying from approximately 1 μm to approximately 5 μm, it has been found that if the gap is too small the efficiency of trapping is reduced. If the gap is too large, multiple beads may be trapped at each site. Experiments have suggested that a gap length slightly larger (in the x-dimension) than the bead diameter provides good results. In certain embodiments of the invention the minimum spacing between adjacent islands (indicated with the symbol g for gap) is between 1 and 5 microns. In certain embodiments of the invention the minimum spacing between ends of adjacent islands is between 1 and 10 microns. In certain embodiments of the invention the spacing between ends of adjacent islands is between 5 and 15 microns. In certain embodiments of the invention the minimum spacing between ends of adjacent islands is approximately 3 microns. One of ordinary skill in the art will appreciate that smaller or larger gap spacings may be appropriate for smaller or larger diameter beads. In certain embodiments of the invention the maximum dimension of the gap is approximately equal to the maximum dimension of a magnetic particle (e.g., the diameter of a spherical particle). The maximum dimension of the gap may be, for example, within 1%, within 5%, within 10%, within 20%, within 30%, within 50%, within 75%, within 100% greater than the maximum dimension of a particle. Other dimensions may also vary and may be approximately the