FIG. **4** illustrates the same experimental set up as FIG. **2**C, with the electroosmotic flowrate of 0.81 cm/s.

FIG. **5** illustrates the same experimental set up of FIGS. **3** and **4**, with a pressure driven flow.

FIG. **6** illustrates a second preferred embodiment of the present invention.

FIG. **7** is a white light microscopy image of the embodiment of FIG. **6**.

FIG. **8** illustrates experimental results of the degree of mixing of two reagents using embodiment of FIG. **7** and an embodiment similar to embodiment of FIG. **7** but with three wells instead of four.

FIG. **9** illustrates the results of the same experimental set up as FIG. **8** with a higher electroosmotic flowrate of 0.81 cm/s.

FIG. **10** illustrates an embodiment of a stream splitter wherein two inlet ports form a confluent stream wherein the fluid on one half of the channel is split into two streams located on opposite sides of the channel that then exit through two outlets.

FIG. **11** illustrates an embodiment of a four-well mixer that was analyzed with computational fluid dynamics techniques for variations in the present invention.

FIG. **12** illustrates some computational analysis of the flow patterns for various depths of wells, based on the embodiment shown in FIG. **11**.

FIG. **13** illustrates some computational results of various angles of the walls, based on the embodiment of FIG. **11**.

FIG. **14**A illustrates a plan view of the flow pattern of an embodiment of the present invention of a mixer with quantity 4 wells oriented at 15 degrees off of the axis of flow.

FIG. **14**B illustrates a cross sectional view of the flow pattern of FIG. **14**A, as observed from the cross section E-E.

FIG. **15** illustrates some computational results of changes in the electroosmotic (EO) mobility of the surfaces of the wells.

FIG. **16**A illustrates a plug of fluid introduced to and transported by a channel.

FIG. **16**B illustrates an embodiment of the present invention wherein a plug of fluid is introduced into a channel in which four wells are disposed.

FIG. **17** illustrates some results of a computational analysis of the flow of the embodiments of FIGS. **16**A and **16**B.

FIG. **18** illustrates the laser apparatus used to manufacture the experimental devices referenced in the specification.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates an embodiment **100** of the present invention of a microfluidic mixer. Two inlet streams **102** and **104** are combined and mixed in the mixing region **106** to produce a mixed flow that exhausts out of the outlet **108**. The mixing region **106** comprises several wells **110**, **112**, **114**, **116**, **118**, **120**, **122**, **124**, **126**, and **128** that are recessed into the outlet **108**.

In a first embodiment, the channels have a uniform, trapezoidal cross section, with the width at the top being 72 μm, depth 31 μm, and the width at the bottom being 28 μm. The wells **110**, **112**, **114**, **116**, **118**, **120**, **122**, **124**, **126**, and **128** have a depth of 85 μm in the center of the well.

The wells **110**, **112**, **114**, and **116** are parallel to each other and uniform in size. The wells are angled approximately 45 degrees from the axis of the outlet **108**. The wells **118**, **120**, **122**, **124**, **126**, and **128** are perpendicular to each other and are approximately 45 degrees from the axis of the outlet **108**.

The flow of reagents through the embodiment **100** may be electrokinetic, electroosmotic, or pressure driven flow. Since the electroosmotic flow is a wall driven phenomenon based on the surface charge of the microchannel wall and on the local electric field, the fluid may enter and follow the contour of the wells, with the slanted well design used to induce lateral transport across the channel. In a pressure driven flow, the flow is not a wall driven phenomenon and therefore the fluid is not forced to enter the wells like electroosmotic flow. However, the presence of the wells induces some lateral transport across the channel in pressure driven flow, although not as effective as with electroosmotic flow. The presence of the wells under electrokinetic flow, being the combination of both electroosmotic flow and electrophoretic flow, will also enhance the mixing.

In an experiment with the present embodiment, a confluence of Rhodamine B in a carbonate buffer was introduced into inlet **102** and carbonate buffer was introduced into inlet **104**. The fluorescence of the Rhodamine B was measured to indicate the degree of mixing achieved by the embodiment **100**.

The method of manufacture of the embodiment used in the experiment, as well as the experimental setup and method of measurements, are given elsewhere in this specification.

For the experiments, the length of each channel arm was 0.8 cm long, and the dimensions of the channel are 72 μm wide at the top, 28 μm wide at the bottom, and 31 μm deep. The laser etched wells that spanned across the entire width of the channel had a depth of 85 μm in the center of the well relative to the bottom of the imprinted channel. The intensity measurement was taken at distance **130** or 443 μm from the beginning of the confluent region.

FIGS. **2**A-C illustrate the results of the experiments as detailed elsewhere in this specification. FIG. **2**A is a white light microscopy image of the embodiment of FIG. **1**. FIG. **2**B is an image of the fluorescence of Rhodamine B introduced in the first inlet **202** mixed with the buffer solution introduced in the second inlet **204**, producing a mixed stream **206**. The flowrate is 0.06 cm/s. FIG. **2**C is a similar image as FIG. **2**B, except the flow is 0.81 cm/s.

FIG. **3** illustrates the degree of mixing of the embodiment **100**, wherein an electroosmotic flow of 0.06 cm/s was achieved. The horizontal axis is the position across the width of the outlet **108** and the vertical axis is the normalized intensity of the fluorescence of the Rhodamine B. The curve **302** represents the results of the measurement taken with no mixing wells present. The curve **304** represents perfect mixing. Curve **304** is trapezoidal in shape, following the profile of the trapezoidal outlet **108**. The curve **306** represents the actual experimental results. The details concerning the experimental procedure and equipment used to perform all of the experiments referenced in this specification are given elsewhere in this specification.

FIG. **4** is a graph that illustrates the same experimental set up as FIG. **3**, with the electroosmotic flowrate of 0.81 cm/s. The line **402** represents the results of the measurement taken with no mixing wells present. The line **404** represents perfect mixing. The line **406** represents the actual experimental results.

From the results illustrated in FIGS. **2**B, **2**C, **3**, and **4**, the degree of mixing exiting the mixer was 87.2% and 80.5% respectively, for the flowrates of 0.06 cm/s and 0.81 cm/s. To achieve the same degree of mixing, theoretical predictions state that a channel length of 0.2 cm and 2.3 cm for electroosmotic flowrates would be required if no mixer were present and based on diffusional mixing, assuming that the diffusion coefficient of the fluorescent material, Rhodamine B, is 2.8×10^{-6} cm^2/s. These results indicate that the length of the