B, is 2.8×10^{-6} cm^2/s. These results indicate that the length of the present embodiment is 22% and 2% of the length of a comparable diffusive mixer for the present application.

FIG. **5** is a graph that illustrates the results of the same experimental set up of FIGS. **2**, **3**, and **4**, with a pressure driven flow. The measurements were taken at 443 μm from the beginning of the confluence region. The curve **502** represents the perfect mixing results. The curve **504** represents the experimental results with a pressure driven flow at 0.21 cm/s. The curve **506** represents the experimental results with a pressure driven flow at 1.25 cm/s. Since the pressure driven flow is not a wall driven phenomenon and therefore the fluid is not forced to enter the wells like electroosmotic flow, the effects of the mixing are not as great with pressure driven flow as with electroosmotic flow. However, the presence of the wells does introduce some lateral transport across the channel. This suggests that a series of wells could be optimized for mixing under pressure driven flow.

FIG. **6** illustrates a second embodiment **600** of the present invention. Two inlet streams **602** and **604** are combined and mixed in the mixing region **606** to produce a mixed flow that exhausts out of the outlet **608**. The mixing region **606** comprises several wells **610**, **612**, **614**, and **616** that are recessed into outlet **608**. The measurement region **618** is 183 μm from the point of confluence of the inlets **602** and **604**. The shape and dimensions of the channels and wells are the same as with embodiment **100** of FIG. **1**. The wells **610**, **612**, **614**, and **616** are parallel to each other.

FIG. **7** is a white light microscopy image of an example of embodiment **600**.

FIG. **8** is a graph that illustrates the degree of mixing of two reagents using embodiment **600** and an embodiment similar to embodiment **600** but with three wells instead of four. The experimental results of FIG. **8** show results for electroosmotic flow of 0.06 cm/s taken 183 μm from the point of confluence of the inlet flows. The horizontal axis is the position across the width of the outlet stream **608** and the vertical axis is the normalized intensity of Rhodamine B. The same experimental setup was used for the results of FIG. **3** as FIG. **8**, with the differences being the configuration of the mixing region and the position of the measurements.

The curve **802** represents the mixing profile of the two inlet streams when no mixing wells are present. The curve **804** represents the perfect mixing of the two streams. The curve **806** represents the mixing profile for the electroosmotic flowrate of 0.06 cm/s and a three well mixer. The curve **808** represents the mixing profile for the same flowrate and a four well mixer. The three well mixer is the embodiment **600** with well **616** removed.

FIG. **9** illustrates the results of the same experimental set up as FIG. **8** with a higher electroosmotic flowrate of 0.81 cm/s. The curve **902** represents the mixing profile of the two inlet streams when no mixing wells are present. The curve **904** represents the perfect mixing of the two streams. The curve **906** represents the mixing profile for a three well mixer. The curve **908** represents the mixing profile for a four well mixer. The three well mixer is the embodiment **600** with well **616** removed.

The curve **908** forms two distinct humps, **910** and **912**, indicating that the four well mixer may be able to split the incoming streams into two streams of similar concentrations. The number of wells, the shape, dimension, and placement of the wells may be adapted to provide different dilutions of the incoming fluid. Such adaptations may depend on the reagents and the diffusivity constants of the various components of the confluent streams. As such, the particular result desired, such as splitting a stream or mixing a pair of confluent streams may be obtained by adjusting the quantity and position of the various wells.

FIG. **10** illustrates an embodiment **1000** of a stream splitter wherein inlet port **1002** and inlet port **1003** form a confluent stream wherein the fluid that is on one half of the channel is split into two streams due to the presence of the slanted wells, where the split streams are located on opposite sides of the channel that then exit through outlet **1004** and outlet **1006**. The flow of the microfluidic stream passes over three wells **1008**, **1010**, and **1012** of similar design and construction as those of other embodiments described in the present specification.

In lab-on-a-chip or μ-TAS (micro Total Analysis Systems), the use of a series of wells within a microchannel may greatly enhance the effectiveness of the entire system, especially when the system is limited to the laminar flow regime. The present invention is effective for low flowrates (<1 cm/s) as well as high flowrates (>1 cm/s). The present invention is further able to effectively mix flows that are driven electrokinetically, electroosmotically, or by pressure.

Several embodiments of the present invention may be used in series, such that one stream is separated and split, then separated and split again, with the end result being several outlet streams with differing dilutions of the original incoming stream. Such a system is known as serial dilution.

FIG. **11** illustrates an embodiment **1100** of a four-well mixer that was analyzed with computational fluid dynamics techniques for variations in the present invention. The computational analyses were designed to correspond to the experimental results shown in the previous figures. The channel geometry and fluid properties were selected to closely match those of the experiments. The inlet **1102** contains a buffer fluid with Rhodamine B that is mixed with a second inlet **1104** that contains only the buffer fluid. The fluid exits the embodiment **1100** via the outlet **1105**. The four wells **1106**, **1108**, **1110**, and **1112** are located at an angle theta **1113** from the centerline axis of the mixer. The geometry of the embodiment **1100** is similar to the previous embodiments described herein. Cross-section line A **1114** will be used to illustrate the incoming streams prior to mixing. Cross-section line B **1116** will be used to illustrate the mixing of the streams while in the well **1112**, the last of the four wells. Cross-section line C **1118** will be used to illustrate the mixing of the streams 5 μm past the exit of the last well. Cross-section line D **1120** will be used to illustrate the mixing of the streams at a location of 420 μm past the point of confluence.

FIG. **12** illustrates some computational analyses of the flow patterns for various depths of wells, based on the embodiment **1100** shown in FIG. **11**, with a constant well angle of 45°. The results for cross section A **1202** illustrate the two incoming flows **1204** and **1206** prior to mixing. The results for cross section B **1208** illustrate the flow patterns for the flow within the last of the four wells. The 10 μm depth results **1210** show that very little of the mixing is occurring in the well. The 50 μm depth results **1212** show that a substantial portion of the mixing is occurring in the well. The 85 μm depth results **1214** show that a substantial portion of the mixing is occurring in the well, but that there is not much increase in the mixing due to the larger depth over the 50 μm results **1212**. These results indicate that there is a finite depth wherein increasing the depth does not increase the degree of mixing substantially. Further, these results illustrate that the wells greatly affect the mixing by forcing the fluids to fold over each other.