nels which form a cross-shaped design consisting of four arms. PEMs are formed on the surfaces of the microchannels **314**. The various arms have PEM derivatived surfaces with either a positively or negatively charged outermost layer as desired.

The cross designs were treated to have different charges on the various arms by treating the entire microchannel **314** first with a desired number of PEMs as previously described above with reference to microfluidic device **10**. Next, the desired charged polymer solution was applied into the selected arms. Care was taken such that the solution only entered the desired arm during the derivatization and rinsing processes.

The flow of fluid through the various microfluidic devices depicted in FIGS. **3**(*a*)–**3**(*e*) are indicated by the arrows. Voltage was applied to various arms of the microfluidic device as indicated. The bulk flow in the microchannels with a negatively charged PSS top layer (the outermost layer of the PEMs) was from anode to cathode while the bulk flow in microchannels with a positively charged PAH top layer was reversed and flowed from cathode to anode. Flow in the devices could be controlled by either grounding or applying a voltage to each of the individual arms.

FIGS. **3**(*a*)–**3**(*e*) diagram flow patterns achieved in five devices with different charges on various, selected microchannel surfaces but with the same applied voltages. As will become obvious to one of ordinary skill in the art, the use of oppositely charged channels simplifies the applied voltages needed to produce various complicated flow patterns.

Although the invention has been described above in relation to preferred embodiments thereof, it will be understood by those skilled in the art that variations and modifications can be effected in these preferred embodiments without departing from the scope and spirit of the invention.

What is claimed is:

1. A microchannel device, comprising:

a plastic substrate having a microchannel formed therein, said microchannel having a geometry with at least one spatial dimension on the order of micrometers and a longitudinal axis;

polyelectrolyte layers comprising alternating layers of at least one net positively charged layer and at least one net negatively charged layer, said polyelectrolyte layers disposed along at least a portion of a microchannel surface; and

a lid disposed over said microchannel and having a lid surface facing said microchannel.

2. The microchannel device of claim **1**, wherein said plastic is selected from the group consisting of polystyrene, poly(ethylene terephthalate glycol), poly(methyl methacrylate), and polycarbonate.

3. The microchannel device of claim **1**, wherein said net negative charged layer comprises poly(styrene sulfonate).

4. The microchannel device of claim **1**, wherein said net positive charged layer comprises poly(allylamine hydrochloride).

5. The microchannel device of claim **1**, wherein said lid is formed of one of an elastomeric polymer, a hard plastic and a laminating film.

6. The microchannel device of claim **1**, wherein further polyelectrolyte layers are disposed on said lid surface.

7. The microchannel device of claim **1**, wherein an outermost layer of said polyelectrolyte layers is a negatively charged layer.

8. The microchannel device of claim **1**, wherein an outermost layer of said polyelectrolyte layers is a positively charged layer.

9. The microchannel device of claim **1**, wherein an outermost layer of said polyelectrolyte layers disposed on a first longitudinally extending portion of said microchannel surface is negatively charged and an outermost layer of said polyelectrolyte layers disposed on a second adjacent longitudinally extending portion of said microchannel surface is positively charged.

10. The microchannel device of claim **9**, wherein an outermost layer of said polyelectrolyte layers disposed on said lid surface comprises a negatively charged longitudinally extending portion adjacent to said first portion of said microchannel surface and a positively charged longitudinally extending portion adjacent to the second portion of said microchannel surface.

11. The microchannel device of claim **1**, wherein said microchannel comprises at least two intersecting subchannels defining at least three arms, each of said arms having disposed along at least a portion thereof alternating polyelectrolyte layers comprising at least one net positively charged layer and at least one net negatively charged layer.

12. The microchannel device of claim **11**, wherein said at least two subchannels form a "T"-shaped pattern consisting of three arms.

13. The microchannel device of claim **11**, wherein said at least two subchannels form a cross-shaped consisting of four arms.

14. The microchannel device of claim **11**, wherein an outermost layer of said polyelectrolyte layers disposed on at least one arm has a first charge and an outermost layer of said polyelectrolyte layers disposed on at least one further arm has a second, opposite charge.

15. The microchannel device of claim **11**, wherein an outermost layer of said polyelectrolyte layers disposed on a first longitudinally extending part of one said arm is negatively charged and an outermost layer of said polyelectrolyte layers disposed on a second adjacent longitudinally extending part of said one arm is positively charged.

16. The microchannel device of claim **11**, wherein an outermost layer of said polyelectrolyte layers disposed on a bottom surface of at least one arm of said at least three arms comprises a longitudinally extending negatively charged portion and an adjacent longitudinally extending positively charged portion.

17. The microchannel device of claim **1**, further comprising one of the group consisting of proteins, antibodies, and DNA disposed on an outermost layer of said polyelectrolytic layers.

18. The microchannel device of claim **1**, further comprising one of the group consisting of proteins, antibodies, and DNA disposed within selected layers of said polyelectrolyte layers.

19. The microchannel device of claim **1**, wherein said microchannel has a cross sectional geometry selected from the group consisting of trapezoidal, semicircular, rectangular, and square.

20. A method of manufacturing a microchannel device, said method comprising the steps of:

providing a plastic substrate with a microchannel formed therein, the microchannel having at least one spatial dimension on the order of micrometers and a longitudinal axis;

exposing selected surfaces of the microchannel to a first solution comprising positively charged polyelectrolytes;

exposing the selected surfaces of the microchannel to a second solution comprising negatively charged polyelectrolytes; and