Claims:

1. A single pass electro-separation system for separating substantially all of a charged molecule from a fluid stream in a single pass, the system comprising an assembly adapted to be disposed between a cathode and an anode, wherein the assembly comprises:

a. at least a first, second, and third separation membrane each having defined pore sizes;

b. a first spacer disposed between the first and second separation membranes and having a void extending from an inlet to an outlet to define a first fluid flow path for a first fluid stream between the first and second separation membranes; and

c. a second spacer disposed between the second and third separation membranes and having a void extending from an inlet and an outlet to define a second fluid flow path for a second fluid stream between the second and third separation membranes, wherein the assembly comprises:

d. a molecular barrier between the anode and the first fluid stream to prevent molecules in the first fluid stream contacting the anode; and

wherein either or both of the first and second flow paths are a series of linear paths linked by turns, a zigzag, a spiral or other tortuous path.

2. The single pass electro-separation system of claim 1, wherein

each inlet is associated with sealing channels adapted to direct the fluid streams uniformly into the flow path;

each outlet is associated with sealing channels adapted to direct the fluid stream into the outlet.

3. The single pass electro-separation system of claim 2, wherein in use, the fluid streams travel along the flow paths and an electric field is applied to the fluid streams in the flow paths to cause negatively charged molecules in the fluid streams to move towards the anode and positively charged molecules in the fluid streams to move towards the cathode such that molecules with sizes less than the pore size of the separation membrane will pass across the separation membrane from one fluid path to the other fluid path.

4. The system of any one of claims 1 to 3, wherein at least a portion of the first molecular barrier defines a third fluid path between the anode and the first molecular barrier.

5. The system of claim 4, further comprising a molecular barrier between the cathode and the second fluid stream to prevent molecules in the second fluid stream contacting the cathode, preferably wherein at least a portion of the second molecular barrier defines a fourth fluid path between the cathode and the second molecular barrier.

6. The system of claim 5, wherein, in use, the third and fourth fluid paths contain an ionic solution to cause a current flow between the cathode and anode in order to maintain an electric field between the cathode and anode; preferably wherein:

i) the ionic solution comprises a buffer; and/or

ii) the ionic solution is a coolant.

7. The system of any one of claims 1 to 6, wherein either of the first or second fluid streams is a feed material and the other fluid of the first or second fluid streams contains a molecule or molecules separated from the feed material.

8. The system of any one of claims 1 to 7, further comprising at least one additional spacer and at least one additional separation membrane wherein the additional spacer is disposed between the third and the additional separation membranes and having a void extending from an inlet to an outlet and defining a fluid flow path in communication with the first or the second fluid flow paths.

9. The system of any one of claims 1 to 8, wherein the separation membranes have the same or different defined pore sizes, preferably the separation membranes have the gradient pore sizes.

10. The system of any one of claims 1 to 9, wherein the first fluid stream is in the same direction as the second fluid stream, or wherein the first fluid stream is in the opposite direction to the second fluid stream.

11. The system of any one of claims 1 to 10, wherein the sealing channels comprise a series of substantially parallel channels.

12. The system of any one of claims 1 to 11, wherein the void in the spacer defining at least the first flow path and the second flow path has parallel sides, preferably wherein the flow rate along the fluid stream path of each stream is the same.

13. The system of any one of claims 1 to 12, wherein the void in the spacer defining at least the first flow path and the second flow path has non-parallel sides, preferably wherein the flow rate along the fluid stream path of each stream varies.

14. The system of any one of claims 1 to 13, wherein the at least one membrane is integrated into the anode or the cathode.

15. The system of any one of claims 1 to 14, wherein the flow rate of any one of the fluid streams is between 5 and 100 mL/min, preferably between 5 and 50 mL/min, more preferably about 20 mL/min.