CLAIMS

What is claimed is:

1. An apparatus for fabricating one or more nanopores in a membrane, where the membrane defines opposing planar surfaces and is comprised of at least one dielectric layer, comprising:

a first substrate having a common microchannel formed in an exposed surface of the first substrate;

a support structure disposed onto the exposed surface of the first substrate and configured to host a membrane;

a second substrate having one or more microfluidic channels formed in an inner surface of the second substrate, the second substrate being disposed onto the support structure with the inner surface facing the support structure such that the one or more microfluidic channels are fluidly separated by the membrane from the common microchannel;

a set of electrodes including a reference electrode positioned on one side of the membrane and two or more additional electrodes positioned on an opposing side of the membrane, wherein the set of electrodes generate an electric potential across the membrane and the two or more additional electrodes are arranged in relation to the membrane such that the electric field across the membrane is uniform.

2. The apparatus of claim 1 wherein magnitude of the electric potential across the membrane results in the electric field having a value greater than 0.1 volt per nanometer.

3. The apparatus of claim 1 further comprises

a current sensor electrically coupled to one of the electrodes and operable to measure current flowing between one of the one or more microfluidic channels and the common microchannel; and

a controller interfaced with the current sensor, wherein the controller detects an abrupt increase in the measured current which indicates formation of a

pore through the membrane and, in response to detecting the abrupt increase in the measured current, removes the electric potential applied across the membrane.

4. The apparatus of claim 1 wherein the two or more additional electrodes include a first electrode disposed in the one or more microfluidic channels upstream from the membrane and a second electrode disposed in the one or more microfluidic channels downstream from the membrane.

5. The apparatus of claim 4 wherein the set of electrodes includes two reference electrodes disposed in the common microchannel, such that one of the reference electrodes is upstream from the membrane and the other reference electrode is downstream from the membrane.

6. The apparatus of claim 1 wherein the support structure further includes a tapered recess formed in an area adjacent to the membrane and fluidly coupled to the common microchannel in the first substrate.

7. The apparatus of claim 1 further comprises multiple sets of electrodes and a plurality of microfluidic channels formed in the inner surface of the second substrate, wherein each microchannel in the plurality of microfluidic channels has an associated set of electrodes.

8. The apparatus of claim 1 further comprises an intermediate layer disposed directly onto the support structure and disposed in between the support structure and the second substrate, the intermediate layer having at least one via formed therein and configured to create an electric field that is uniform proximate to the via.

9. The apparatus of claim 1 wherein the one or more microfluidic channels have dimension on the order of microns.

10. The apparatus of claim 1 wherein the one or more microfluidic channels have dimension on the order of nanometers.

11. An apparatus for fabricating one or more nanopores in a membrane, comprising:

a first substrate having a common microchannel formed in an exposed surface of the first substrate;

a membrane disposed onto the exposed surface of the first substrate, where the membrane defines opposing planar surfaces and is comprised of at least one dielectric layer;

a second substrate having one or more microfluidic channels formed in an inner surface of the second substrate, the second substrate being disposed onto the membrane with the inner surface facing the membrane such that the one or more microfluidic channels are fluidly separated by the membrane from the common microchannel;

a set of electrodes including two reference electrodes positioned on one side of the membrane and two additional electrodes positioned on an opposing side of the membrane, wherein the set of electrodes generate an electric potential across the membrane and are arranged in relation to the membrane such that the electric field across the membrane is uniform.

12. The apparatus of claim 11 wherein magnitude of the electric potential across the membrane results in the electric field having a value greater than 0.1 volt per nanometer.

13. The apparatus of claim 11 further comprises

a current sensor electrically coupled to one of the electrodes and operable to measure current flowing between one of the one or more microfluidic channels and the common microchannel; and

a controller interfaced with the current sensor, wherein the controller detects an abrupt increase in the measured current which indicates formation of a pore and, in response to detecting the abrupt increase in the measured current, removes the electric potential applied across the membrane.

14. The apparatus of claim 11 wherein the two additional electrodes include a first electrode disposed in the one or more microfluidic channels upstream from

the membrane and a second electrode disposed in the one or more microfluidic channels downstream from the membrane.

15. The apparatus of claim 14 wherein the two reference electrodes are disposed in the common microchannel, such that one of the reference electrodes is upstream from the membrane and the other reference electrode is downstream from the membrane.

16. The apparatus of claim 11 further comprises a plurality of microfluidic channels formed in the inner surface of the second substrate and multiple sets of electrodes, wherein each microchannel in the plurality of microfluidic channels has an associated set of electrodes.