Claims

1. A nanochannel device, comprising:
a substrate having at least one channel in the surface of the substrate, the at least one channel having a trench width and a trench depth suitable for transporting a macromolecule across a length of the at least one channel; and
wherein the at least one channel is surmounted by sealing material to render it at least substantially enclosed.

2. The nanochannel device of claim 1, wherein the sealing material provides an opening to the at least one channel.

3. The nanochannel device of claim 1, wherein the end of the at least one channel is in fluid communication with at least one reservoir.

4. The nanochannel device of claim 1, wherein each end of the at least one channel are in fluid communication with a reservoir.

5. A method of preparing a nanochannel device, comprising
providing a substrate having a surface;
forming at least one channel in the surface of the substrate;
depositing a sealing material on the at least one channel to render such channels at least substantially enclosed and suitable for transporting a macromolecule across a length of the at least one channel.

6. The method of claim 5, wherein the at least one channel is formed by: nanoimprint lithography, spin coating, electron beam lithography, focused ion beam milling, photolithography, reactive ion-etching, wet-etching, embossing, injection molding, material fracturing, plasma-enhanced chemical vapor deposition, electron beam evaporation, sputter deposition, and combinations thereof.

7. The method of claim 5, wherein the sealing material is deposited using electron beam evaporation or sputter deposition.

8. The method of claim 5, further comprising depositing at least one optically opaque layer adjacent to the sealing material.

9. The method of claim 5, further comprising providing at least one near field slit feature above the at least one channel.

10. The method of claim 5, further comprising treating the least one channel with a surface-modifying agent to alter the surfaces interior to the at least one channel.

11. The method of claim 5, further comprising removing a portion of the sealing material to reduce the thickness of the sealing material above the at least one channel.

12. A nanofluidic chip, comprising:
a nanochannel device according to claim 1, wherein the at least one channel is capable of admitting a fluid;
at least one sample reservoir in fluid communication with the at least one channel of the nanochannel device, the sample reservoir capable of releasing a fluid; and
at least one waste reservoir in fluid communication with the at least one channel of the nanochannel device, the waste reservoir capable of receiving a fluid.

13. The nanofluidic chip of claim 12, wherein the at least one sample reservoir is formed in the surface of the substrate.

14. The nanofluidic chip of claim 12, further comprising at least one pair of electrodes capable of applying an electric field across the at least one channel in at least one direction.

15. The nanofluidic chip of claim 14, wherein at least two pair of electrodes each provides an electric field in different directions.

16. A system, comprising:
a nanofluidic chip according to claim 12; and
an apparatus for detecting at least one signal transmitted from a fluid in the nanochannel device.

17. The system of claim 16, further comprising a transporting apparatus to transport a fluid through the at least one channel.

18. The system of claim 16, further comprising a sample loading apparatus for loading at least one fluid to the at least one sample reservoir.

19. The system of claim 16, further comprising a data processor.

20. A method of analyzing at least one macromolecule, comprising:
providing a nanofluidic chip according to claim 12:
depositing at least one fluid into the at least one sample reservoir, the fluid comprising at least one macromolecule;
transporting the at least one macromolecule into the at least one channel;
detecting at least one signal transmitted from the at least one macromolecule; and
correlating the detected signal to at least one property of the at least one macromolecule.

21. The method of claim 20, wherein a plurality of reservoirs provide a plurality of macromolecules into a plurality of channels for determining at least one characteristic of each macromolecule.

22. A cartridge, comprising:
at least one nanofluidic chip according to claim 12, the cartridge capable of being inserted and removed from a system for analyzing macromolecules.

Claims

1. A nanochannel device, comprising:
a substrate having at least one channel in the surface of the substrate, the at least one channel having a trench width and a trench depth suitable for transporting a macromolecule across a length of the at least one channel; and
wherein the at least one channel is surmounted by sealing material to render it at least substantially enclosed.

2. The nanochannel device of claim 1, wherein the end of the at least one channel is in fluid communication with at least one reservoir.

3. The nanochannel device of claim 1, wherein each end of the at least one channel are in fluid communication with a reservoir.

4. A method of preparing a nanochannel device, comprising
providing a substrate having a surface;
forming at least one channel in the surface of the substrate;
depositing a sealing material on the at least one channel to render such channels at least substantially enclosed and suitable for transporting a macromolecule across a length of the at least one channel.

5. The method of claim 4, wherein the at least one channel is formed by: nanoimprint lithography, spin coating, electron beam lithography, focused ion beam milling, photolithography, reactive ion-etching, wet-etching, embossing, injection molding, material fracturing, plasma-enhanced chemical vapor deposition, electron beam evaporation, sputter deposition, and combinations thereof.

6. The method of claim 4, wherein the sealing material is deposited using electron beam evaporation or sputter deposition.

7. The method of claim 4, further comprising depositing at least one optically opaque layer adjacent to the sealing material.

8. The method of claim 4, further comprising providing at least one near field slit feature above the at least one channel.

9. The method of claim 4, further comprising treating the least one channel with a surface-modifying agent to alter the surfaces interior to the at least one channel.

10. The method of claim 4, further comprising removing a portion of the sealing material to reduce the thickness of the sealing material above the at least one channel.

11. A nanofluidic chip, comprising:
a nanochannel device according to claim 1, wherein the at least one channel is capable of admitting a fluid;

at least one sample reservoir in fluid communication with the at least one channel of the nanochannel device, the sample reservoir capable of releasing a fluid; and

at least one waste reservoir in fluid communication with the at least one channel of the nanochannel device, the waste reservoir capable of receiving a fluid.

12. The nanofluidic chip of claim 11, wherein the at least one sample reservoir is formed in the surface of the substrate.

13. The nanofluidic chip of claim 11, further comprising at least one pair of electrodes capable of applying an electric field across the at least one channel in at least one direction.

14. The nanofluidic chip of claim 13, wherein at least two pair of electrodes each provides an electric field in different directions.

15. A system, comprising:

a nanofluidic chip according to claim 11; and

an apparatus for detecting at least one signal transmitted from a fluid in the nanochannel device.

16. The system of claim 15, further comprising a transporting apparatus to transport a fluid through the at least one channel.

17. The system of claim 15, further comprising a sample loading apparatus for loading at least one fluid to the at least one sample reservoir.

18. The system of claim 15, further comprising a data processor.

19. A method of analyzing at least one macromolecule, comprising:

providing a nanofluidic chip according to claim 11:

depositing at least one fluid into the at least one sample reservoir, the fluid comprising at least one macromolecule;

transporting the at least one macromolecule into the at least one channel;

detecting at least one signal transmitted from the at least one macromolecule; and

correlating the detected signal to at least one property of the at least one macromolecule.

20. The method of claim 19, wherein a plurality of reservoirs provide a plurality of macromolecules into a plurality of channels for determining at least one characteristic of each macromolecule.

21. A cartridge, comprising:

at least one nanofluidic chip according to claim 11, the cartridge capable of being inserted and removed from a system for analyzing macromolecules.