Claims

1. A flow cell, comprising:

a substrate including:

nano-depressions defined in a surface of the substrate; and

interstitial regions separating the nano-depressions; and

a barrier depression surrounding each of the respective sub-sets of the nano-depressions; and

a hydrophobic material layer i) having a surface that is at least substantially co-planar with the interstitial regions and ii) positioned to define a hydrophobic barrier around respective sub-sets of the nano-depressions; and

the hydrophobic material layer is positioned in the barrier depression.

2. The flow cell as defined in claim 1, wherein the hydrophobic material layer has a thickness ranging from 10 nm to 1 μm.

3. The flow cell as defined in claims 1 or 2, wherein the hydrophobic material is selected from the group consisting of a fluorinated polymer, a perfluorinated polymer, a silicon polymer, a silane, and a mixture thereof.

4. The flow cell as defined in any of claims 1, 2 or 3, further comprising:

a polymer layer in the nano-depressions; and

a primer attached to the polymer layer.

5. A method of forming the flow cell according to any one of claims 1-4, wherein the method comprises:

applying a hydrophobic material on a patterned substrate, including:

nano-depressions defined in a surface of the patterned substrate; and

interstitial regions separating the nano-depressions;

thereby forming a hydrophobic material layer i) in the nano-depressions and ii) on the interstitial regions, wherein the hydrophobic material layer on the interstitial regions has a thickness less than about 2 μm;

applying a mask material on a first portion of the hydrophobic material layer to define a pattern of a hydrophobic barrier around respective sub-sets of the nano-depressions and the interstitial regions, whereby a second portion of the hydrophobic material layer is exposed at the respective sub-sets;

removing the second portion of the hydrophobic material layer, thereby exposing the respective sub-sets of the nano-depressions and the interstitial regions;

attaching a gel material to the nano-depressions of the respective sub-sets; and

removing the mask material from the first portion of the hydrophobic material layer to reveal the hydrophobic barrier.

6. The method as defined in claim 5, wherein:

the patterned substrate further includes a barrier interstitial around the respective sub-sets of the nano-depressions and the interstitial regions; and

the hydrophobic barrier is formed on the barrier interstitial.

7. The method as defined in claim 5, wherein the hydrophobic barrier is formed in some of the nano-depressions and on some of the interstitial regions that are positioned between the respective sub-sets of the nano-depressions and the interstitial regions.

8. The method as defined in any of claims 5, 6, or 7, wherein:

the attaching of the gel material involves:

silanizing the nano-depressions and interstitial regions of the respective sub-sets; and

depositing the gel material on the nano-depressions and interstitial regions of the respective sub-sets and on the mask material; and

the method further comprises removing the gel material from the mask material and from the interstitial regions of the respective sub-sets.

9. The method as defined in any of claims 5, 6, 7, or 8, wherein the hydrophobic material is selected from the group consisting of a fluorinated polymer, a perfluorinated polymer, a silicon polymer, and a mixture thereof.

10. The method as defined in any of claims 5, 6, 7, 8, or 9, wherein prior to applying the hydrophobic material, the method further comprises forming the patterned substrate by patterning a non-patterned support to form the nano-depressions.

11. The method as defined in claim 10, wherein the patterning involves etching, nano-imprint lithography, or combinations thereof.

12. The method as defined in any of claims 5, 6, 7, 8, 9, 10, or 11, wherein:

the removing of the mask material from the first portion of the hydrophobic material layer to reveal the hydrophobic barrier occurs prior to attaching the gel material; and

attaching the gel material involves:

silanizing the nano-depressions and interstitial regions of the respective sub-sets; and

depositing the gel material on the nano-depressions and interstitial regions of the respective sub-sets and on the hydrophobic barrier; and

the method further comprises removing the gel material from the hydrophobic barrier and from the interstitial regions of the respective sub-sets.