nucleic acid concentration. Generally, increasing the number of replicates increases the accuracy and reproducibility of dPCR results.

[0005] The array format in most quantitative polymerase chain reaction (qPCR) platforms is designed for sample-by-assay experiments, in which PCR results need to be addressable for post-run analysis. For dPCR, however, the specific position or well of each PCR result may be immaterial and only the number of positive and negative replicates per sample may be analyzed.

[0006] The read-out of dPCR, that is, the number of positive reactions and the number of negative reactions, is linearly proportional to the template concentration, while the read-out of qPCR (signal vs. cycle) is proportional to the log of the template concentration. Thus, for dPCR, it is desirable to minimize sample volumes.

[0007] However, continuing to decrease reaction volumes may lead to challenges related to confidence in loading the array with sample volumes and maintaining the physical isolation of the sample volumes, for example. In other words, it is important to load the sample volume into as many wells or through-holes as possible and to reduce the cross-talk between the wells or through-holes.

SUMMARY

[0008] According to an aspect of the present invention, an apparatus for biological reactions is provided. The apparatus includes a substrate and a plurality of reaction sites within the substrate. A surface of the substrate ~~is~~ comprises a hydrophilic coating and each surface of the plurality of reaction sites ~~is~~ comprises a hydrophilic coating to load a substantial number of reaction sites with a sample volume. The sample volume of each loaded reaction site is substantially confined to its respective reaction site. The sample ~~volume~~ is configured to undergo a biological reaction within the reaction site.

[0008a] There is also disclosed a method for designing a substrate with a plurality of reaction sites, the method comprising:
determining an advancing water contact angle of a liquid sample with a first material;
determining a receding water contact angle for a liquid sample with the first material; and

CLAIMS

What is claimed is:

1. An apparatus for biological reactions, the apparatus comprising:

a substrate; and

a plurality of reaction sites within the substrate,

wherein a surface of the substrate ~~is~~ comprises a hydrophilic coating and each surface of the plurality of reaction sites ~~is~~ comprises a hydrophilic coating to load a substantial number of reaction sites with a sample volume,

wherein the sample volume of each loaded reaction site is substantially confined to its respective reaction site, and

wherein the sample ~~volume~~ is configured to undergo a biological reaction within the reaction site.

2. The apparatus of claim 1, wherein the surface of the substrate is configured to have an advancing water contact angle of 60 to 100 degrees.

3. The apparatus of claim 1, wherein the surface of the substrate is configured to have an advancing water contact angle of 75 to 90 degrees.

4. The apparatus of claim 1, wherein the surface of the substrate and each surface of the plurality of reaction sites have the same hydrophilicity.

5. The apparatus of claim 2, wherein the surface of the substrate is configured to have a receding water contact angle of 60-100 degrees.

6. The apparatus of claim 5, wherein the difference between the advancing water contact angle and the receding contact angle is 0 degrees.

7. The apparatus of claim 5, wherein the difference between the advancing water contact angle and the receding contact angle is 0 to 30 degrees.

8. The apparatus of claim 5, wherein the difference between the advancing water contact angle and the receding contact angle is 10-15 degrees.

9. The apparatus of claim 1, wherein the surface of the substrate and each surface of the plurality of reaction sites are coated with the same material.

~~10. The apparatus of claim 9, wherein the material is hexamethyldisilazane (HMDS).~~

~~11~~10. The apparatus of claim 9, wherein the surface of the substrate and each surface of the plurality of reaction sites are coated by a vapor deposition process.

~~12~~11. The apparatus of claim 1, wherein the substantial number of reaction sites is 90 to 100% of the plurality of reaction sites.

~~13~~12. The apparatus of claim 1, wherein the liquid sample volume loaded into the plurality of reaction sites is at most 1 nanoliter.

~~14~~13. The apparatus of claim 1, wherein the substrate is composed of one material of the following: silicon, silicon oxide, glass, and plastic.

~~15~~14. The apparatus of claim 1, wherein the plurality of reaction sites are through-holes.

~~16~~15. The apparatus of claim 1, wherein the biological reaction is an amplification reaction.

~~17~~16. The apparatus of claim 1, wherein the substrate and the plurality of reaction sites are configured to generate a sufficient surface tension force to substantially confine the sample volume within each loaded reaction site.

~~18~~17. The apparatus of claim 1, wherein capillary action determines a volume of liquid sample loaded into each reaction site, wherein the amount of capillary action is based on a dimension of each reaction site.