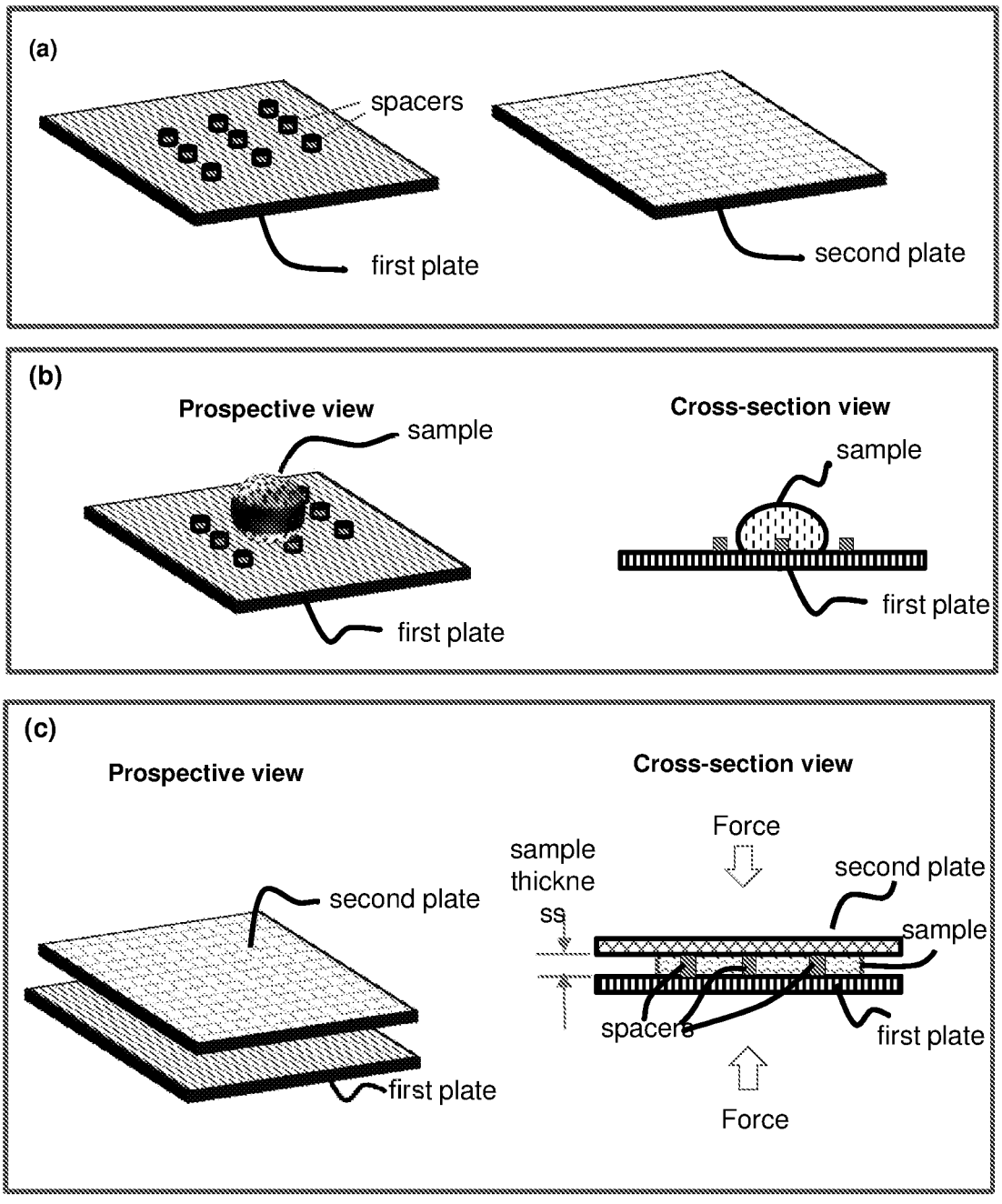

(a)
spacers
first plate
second plate
(b)
Prospective view
sample
first plate
Cross-section view
sample
first plate
(c)
Prospective view
second plate
first plate
Cross-section view
Force
sample thickness
second plate
sample
spacers
first plate
Force

FIG. 1

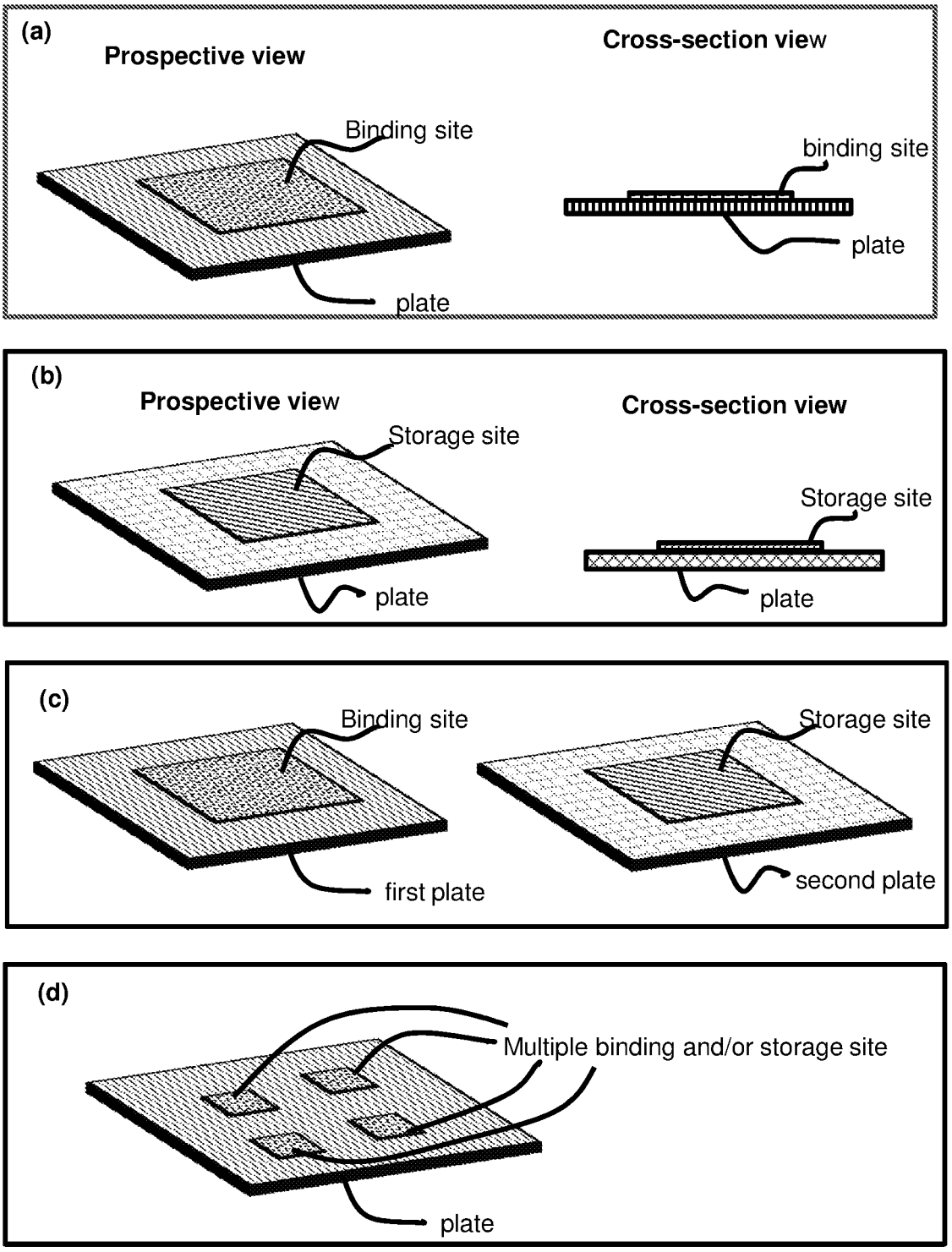

(a)
Prospective view
Cross-section view
Binding site
binding site
plate
plate
(b)
Prospective view
Cross-section view
Storage site
Storage site
plate
plate
(c)
Binding site
Storage site
first plate
second plate
(d)
Multiple binding and/or storage site
plate

FIG. 2

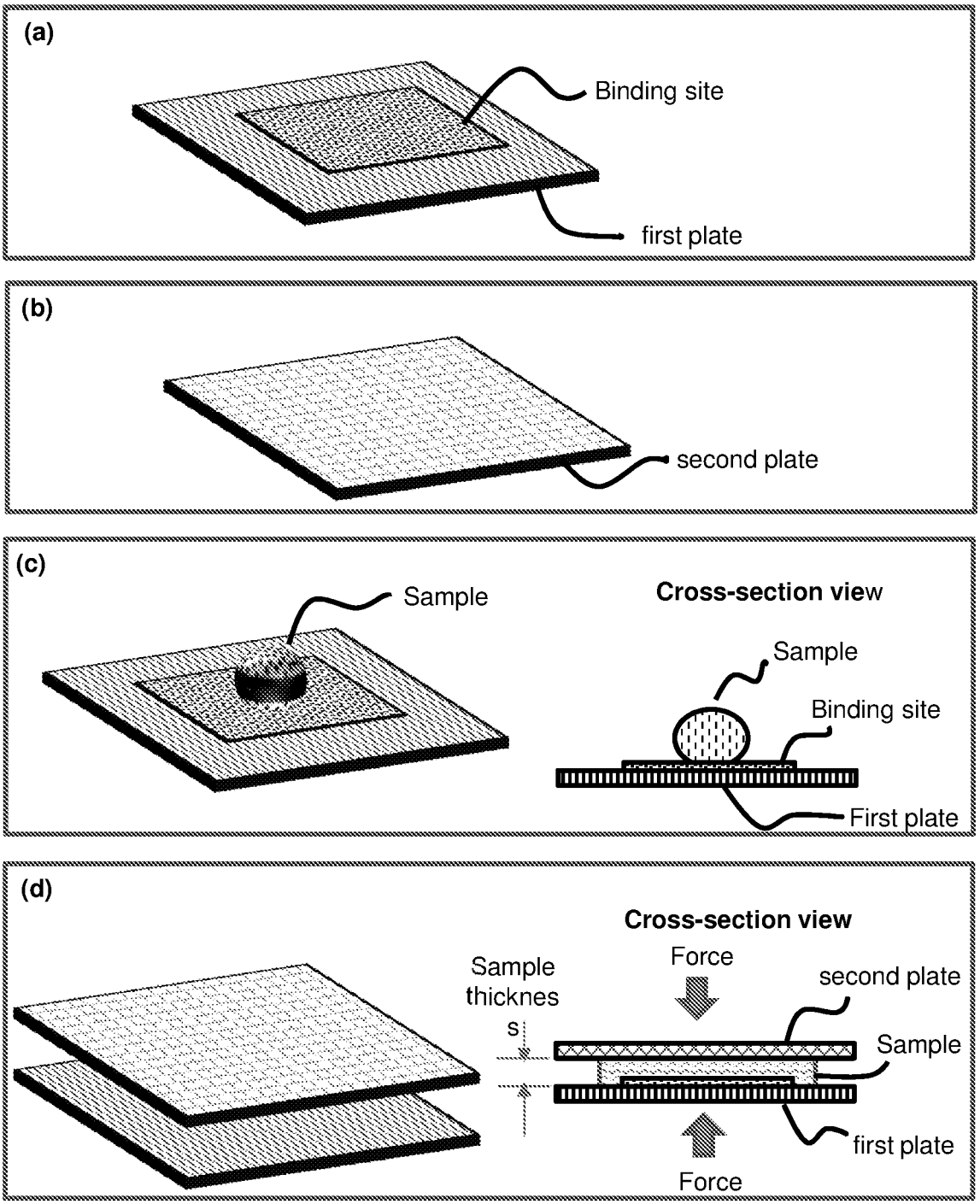

(a)
Binding site
first plate
(b)
second plate
(c)
Sample
Cross-section view
Sample
Binding site
First plate
(d)
Cross-section view
Sample thicknes s
Force
second plate
Sample
first plate
Force

FIG. 3

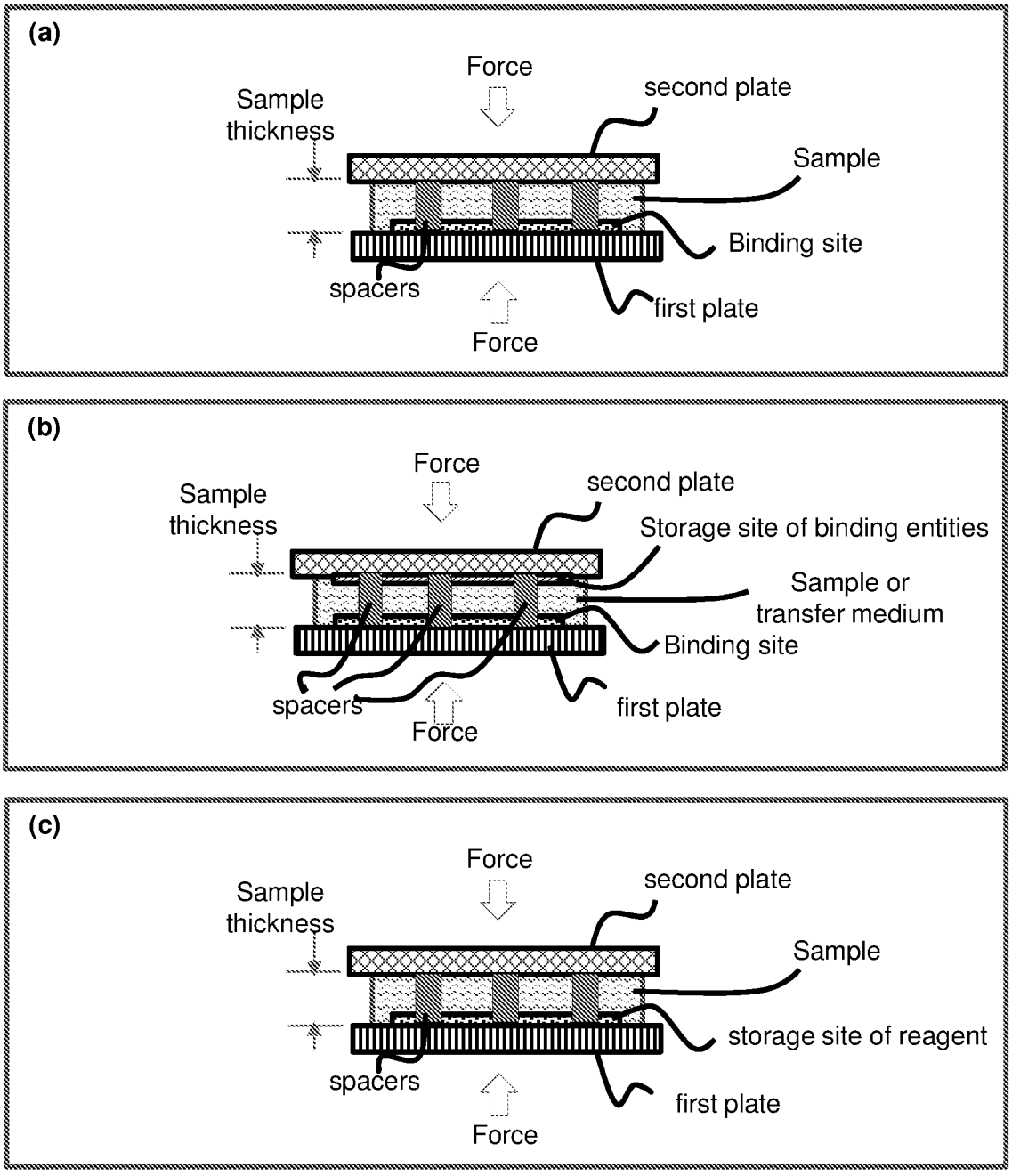

(a)
Force
Sample thickness
second plate
Sample
Binding site
spacers
first plate
Force
(b)
Force
Sample thickness
second plate
Storage site of binding entities
Sample or transfer medium
Binding site
spacers
first plate
Force
(c)
Force
Sample thickness
second plate
Sample
storage site of reagent
spacers
first plate
Force

FIG. 4

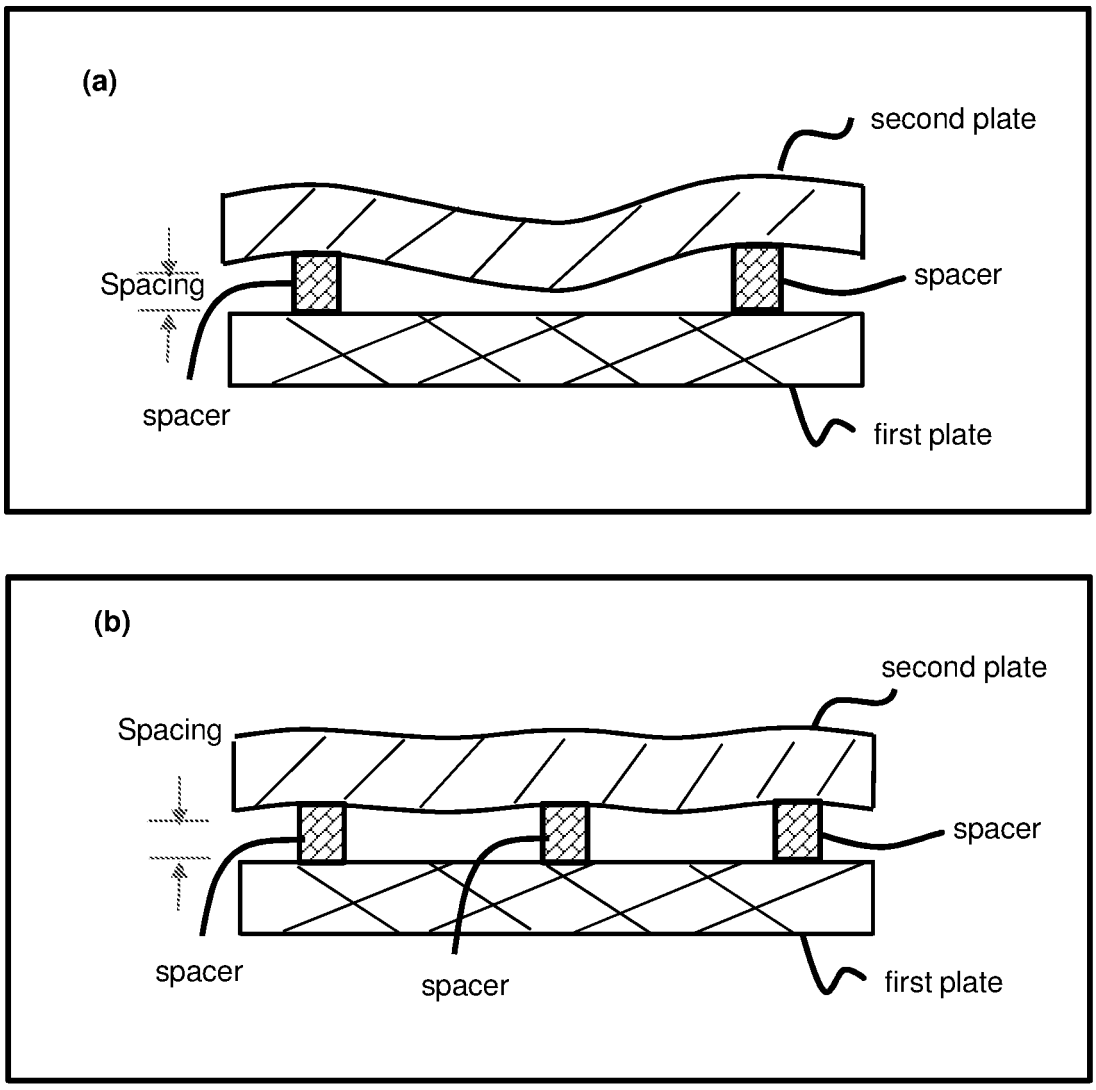

(a)
second plate
Spacing
spacer
spacer
first plate
(b)
second plate
Spacing
spacer
spacer
spacer
first plate

FIG. 5

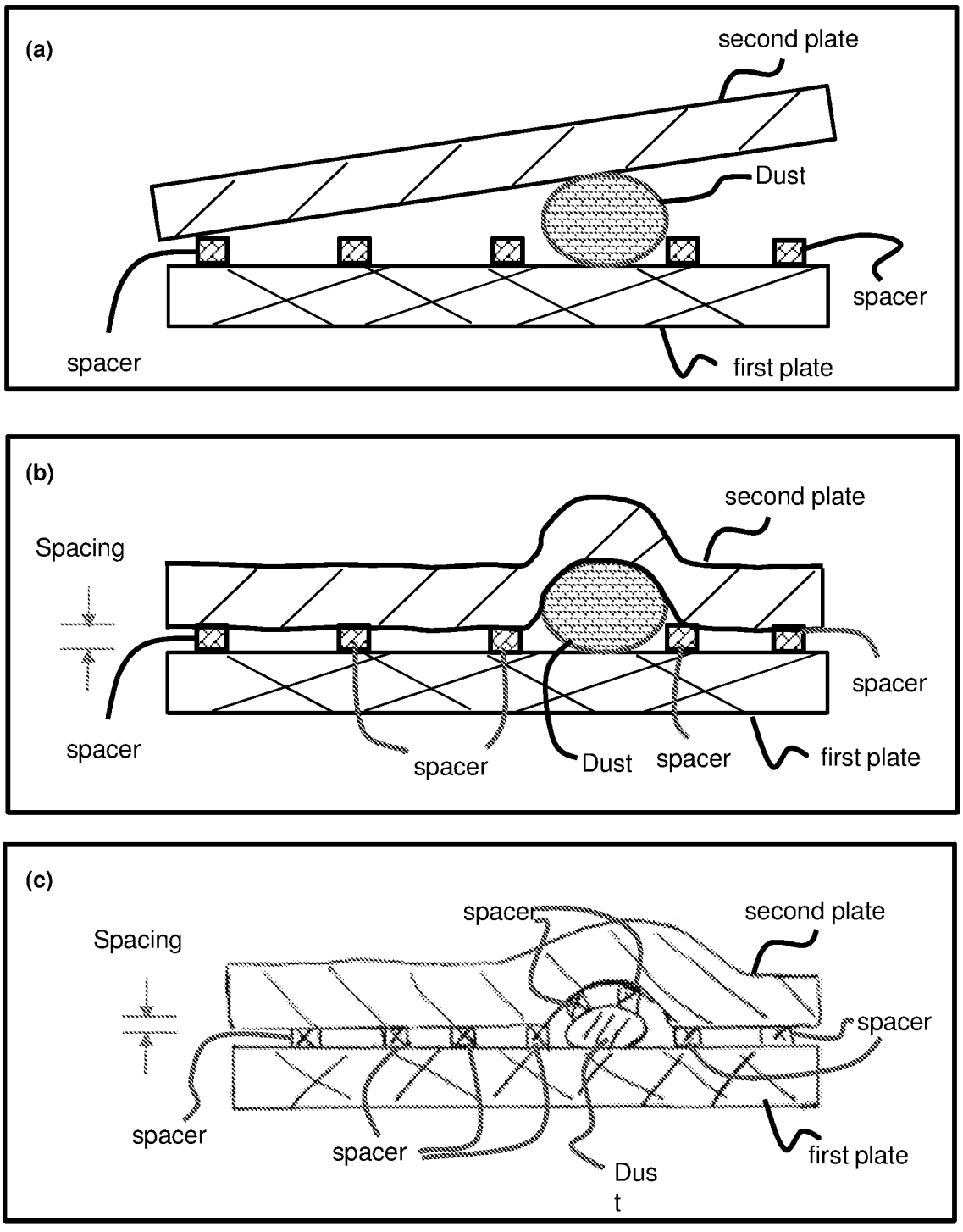

(a)
second plate
Dust
spacer
spacer
first plate
(b)
Spacing
second plate
spacer
spacer
spacer
Dust
spacer
first plate
(c)
Spacing
spacer
second plate
spacer
spacer
spacer
Dus
t
first plate

FIG. 6

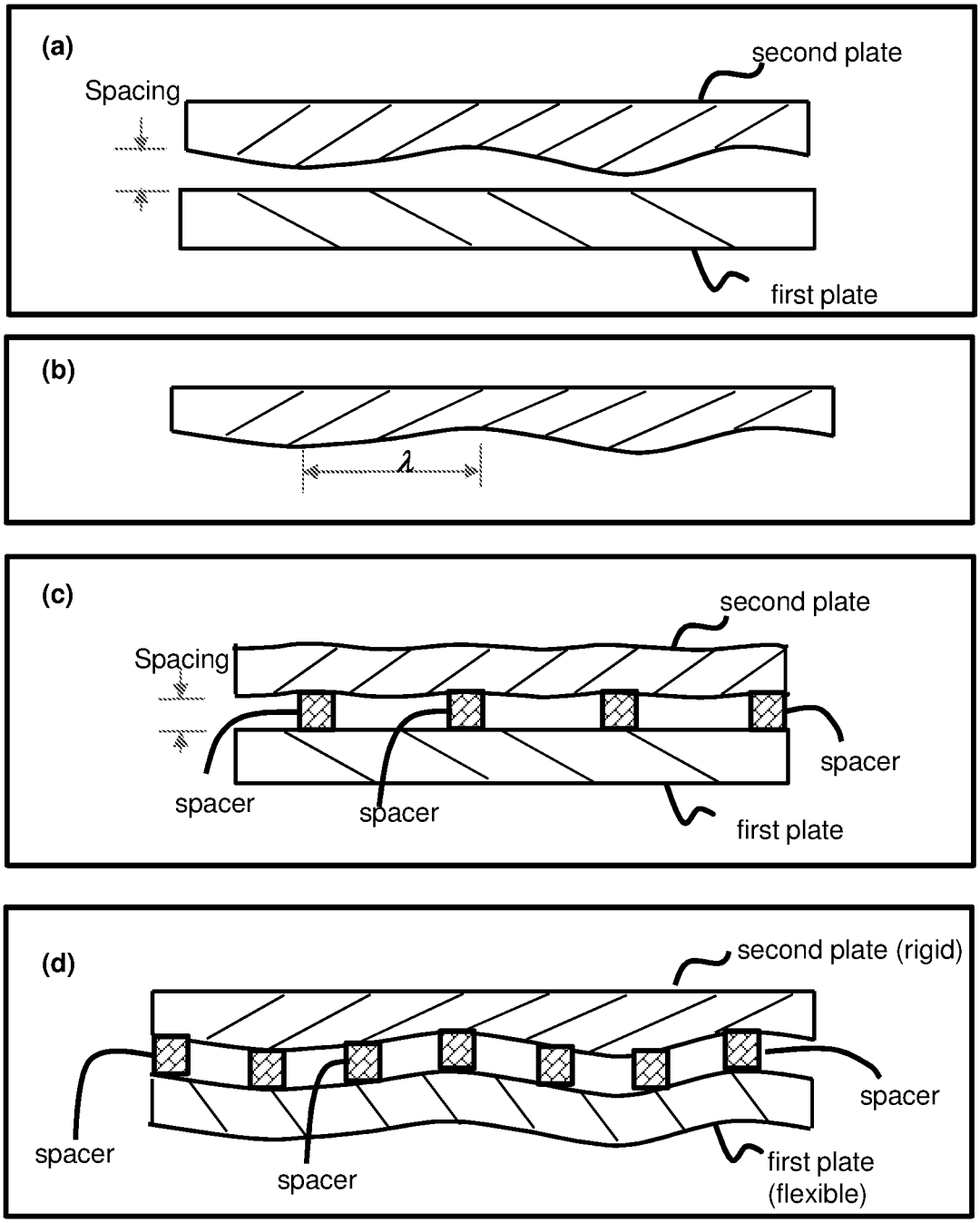

(a)
Spacing
second plate
first plate
(b)
λ
(c)
Spacing
second plate
spacer
spacer
spacer
first plate
(d)
second plate (rigid)
spacer
spacer
spacer
first plate
(flexible)

FIG. 7

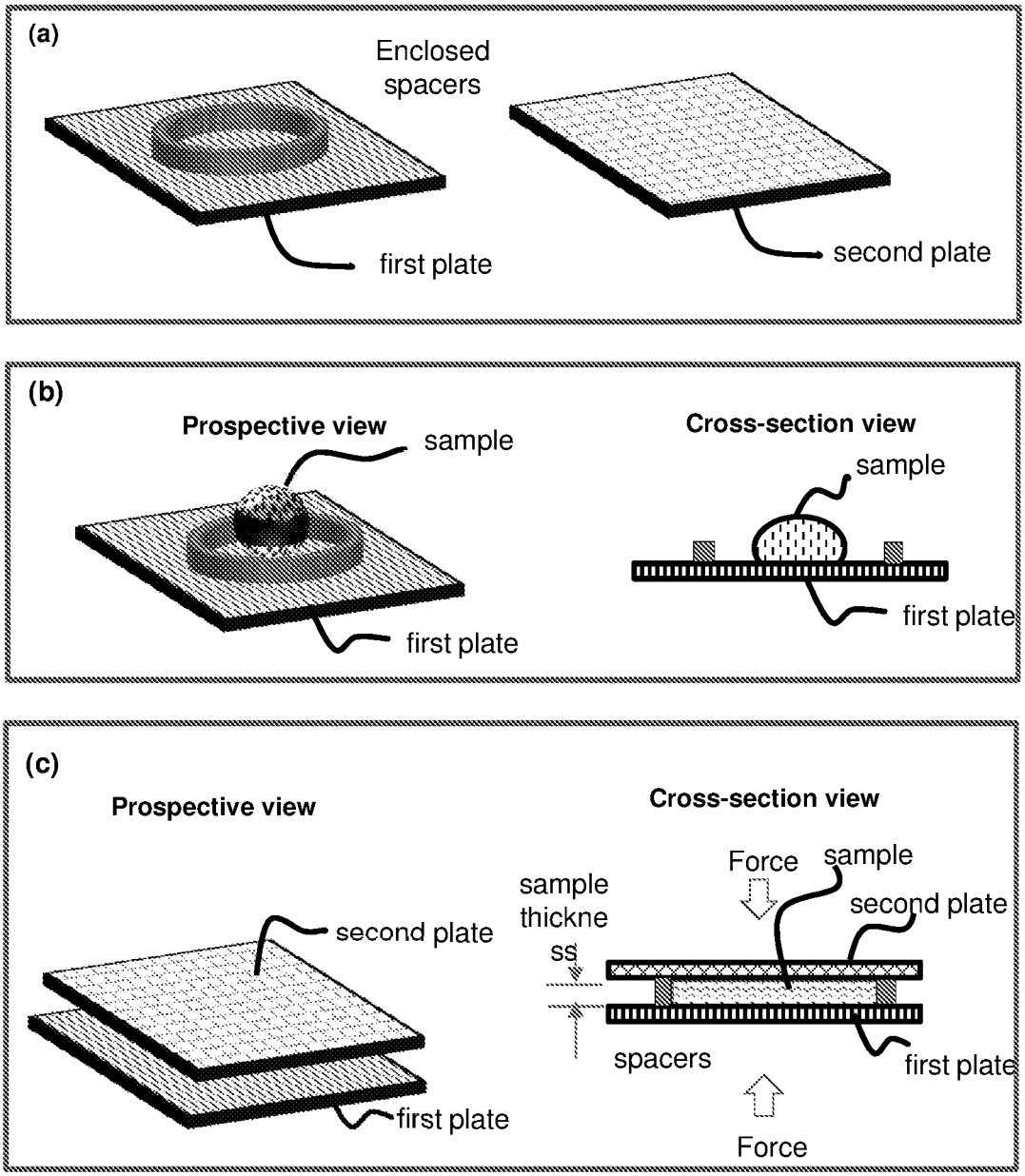

(a)
Enclosed spacers
first plate
second plate
(b)
Prospective view
sample
first plate
Cross-section view
sample
first plate
(c)
Prospective view
second plate
first plate
Cross-section view
Force
sample
sample thickness
second plate
spacers
first plate
Force

FIG. 8

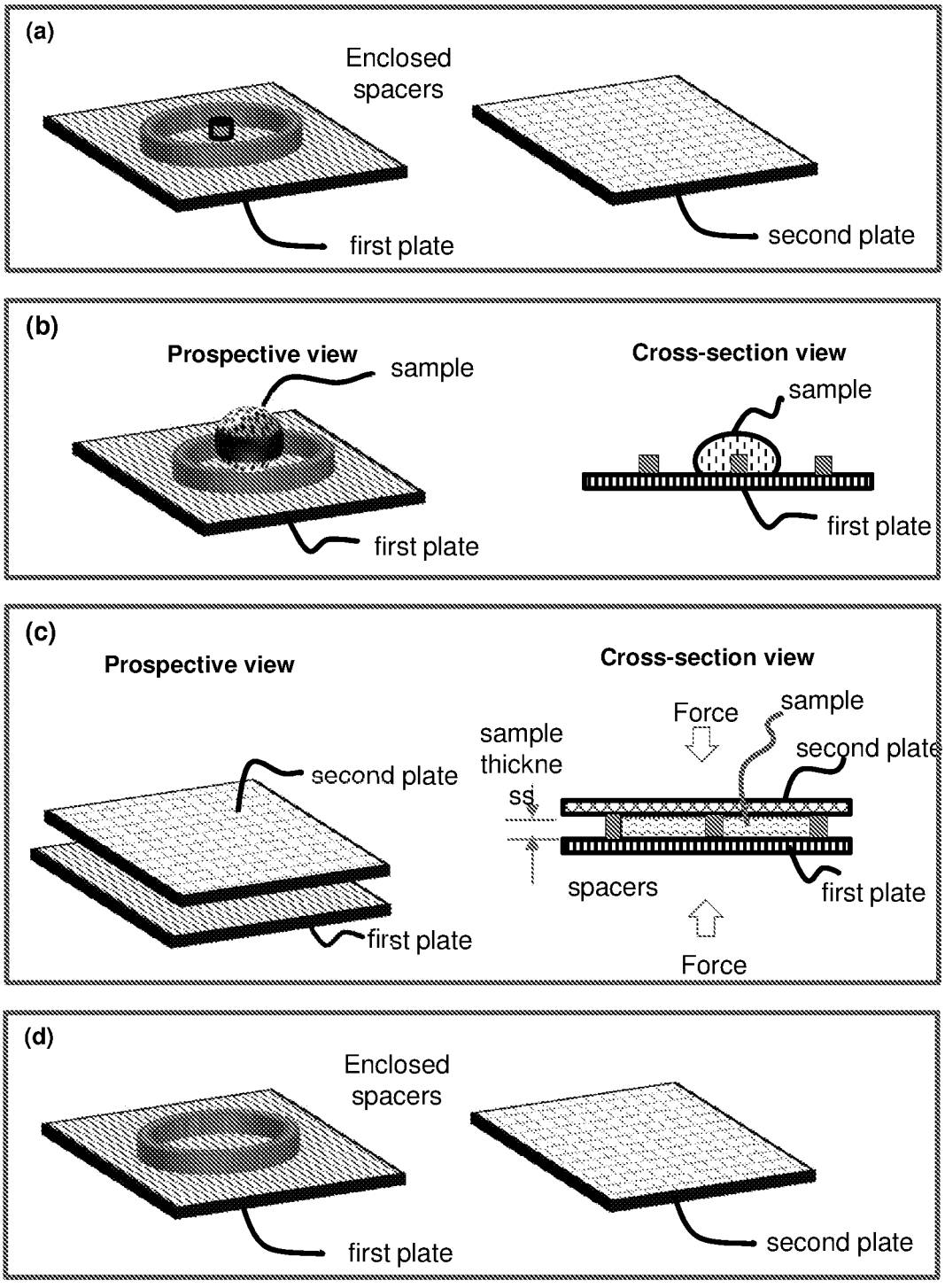
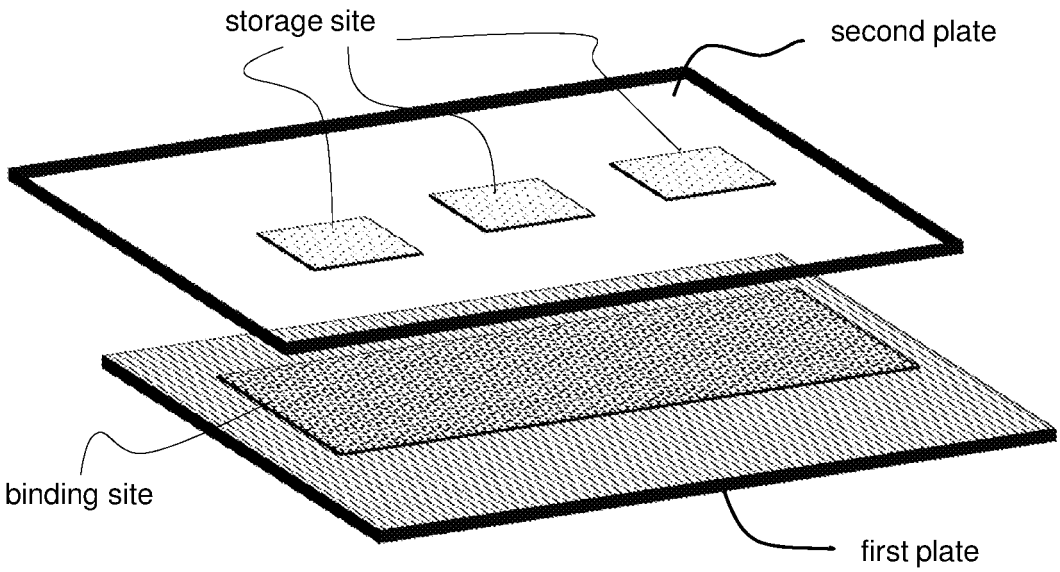

(a)
Enclosed spacers
first plate
second plate
(b)
Prospective view
sample
first plate
Cross-section view
sample
first plate
(c)
Prospective view
second plate
first plate
Cross-section view
Force
sample
sample thickness
second plate
spacers
first plate
Force
(d)
Enclosed spacers
first plate
second plate

FIG. 9

Case 1. Multiplexing. One binding site for one or multiple storage sites

Different storage sites can have the same detection agent but different concentration or different detection agents of the same or different concentration.

**a**




**b**

**Cross-section view**

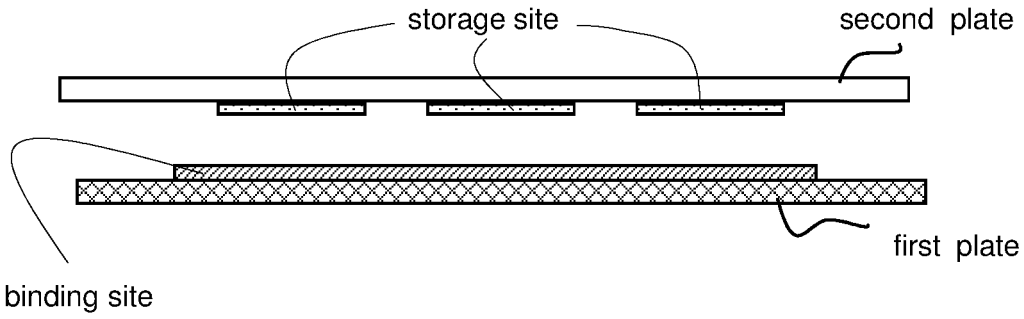
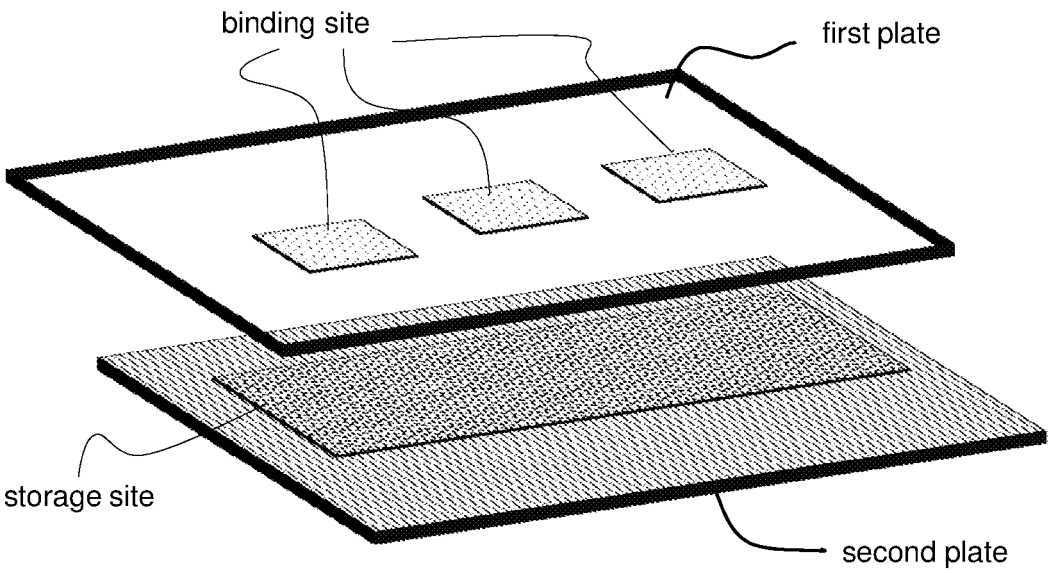



FIG. 10

Case 2. Multiplexing. One storage site for one or multiple binding sites

Different storage sites can have the same detection agent but different concentration or different detection agents of the same or different concentration.

**a**




**b**

**Cross-section view**

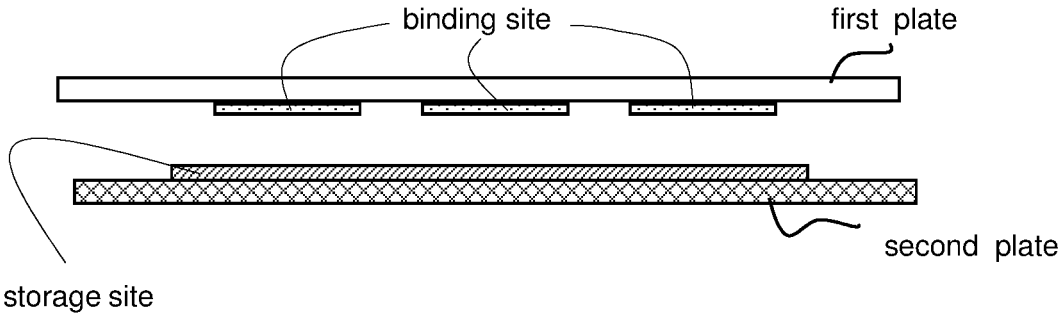
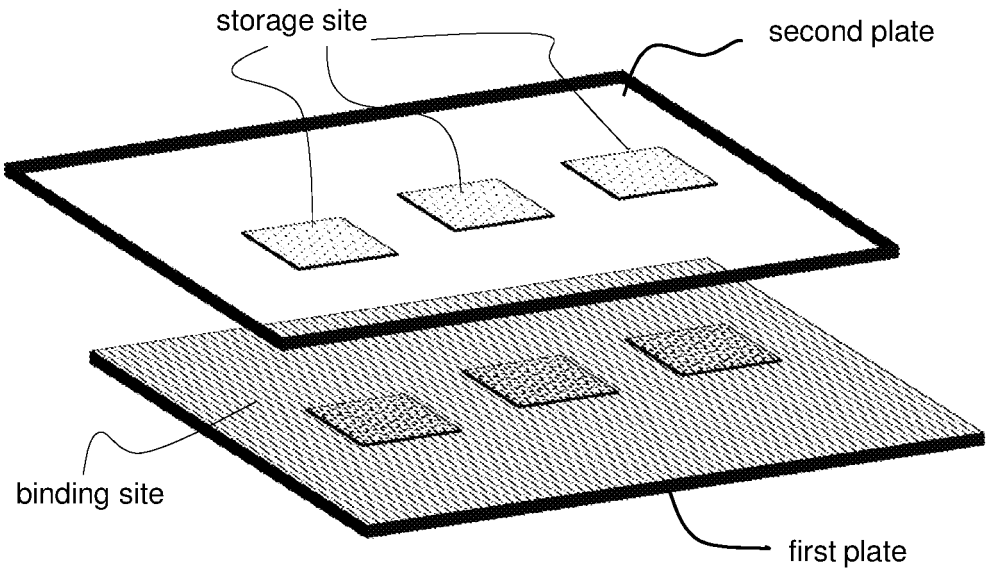



FIG. 11

Case 3. Multiplexing. Multiple binding sites and multiple corresponding storage sites

Different storage sites can have the same detection agent but different concentration or different detection agents of the same or different concentration.

**a**




**b**

**Cross-section view**

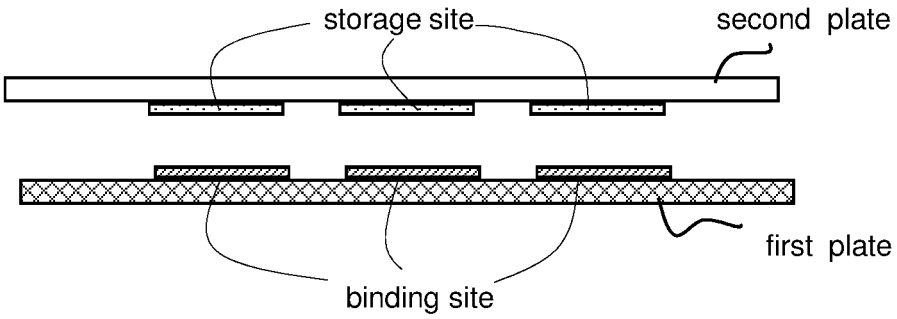
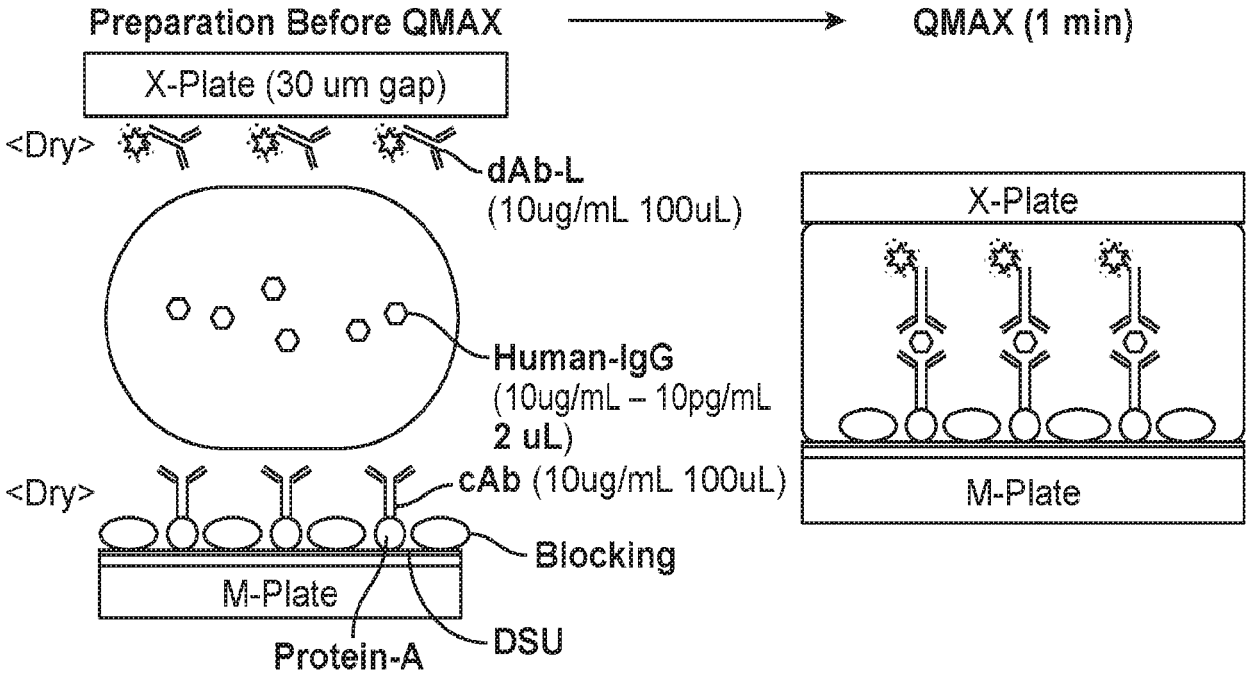



FIG. 12




Human IgG concentrations:

| Concentrations | 10 ug/mL | 100 ug/mL | 1 ug/mL | 10 pg/mL | 0 |
|---|---|---|---|---|---|

FIG. 13A

Experimental Data:

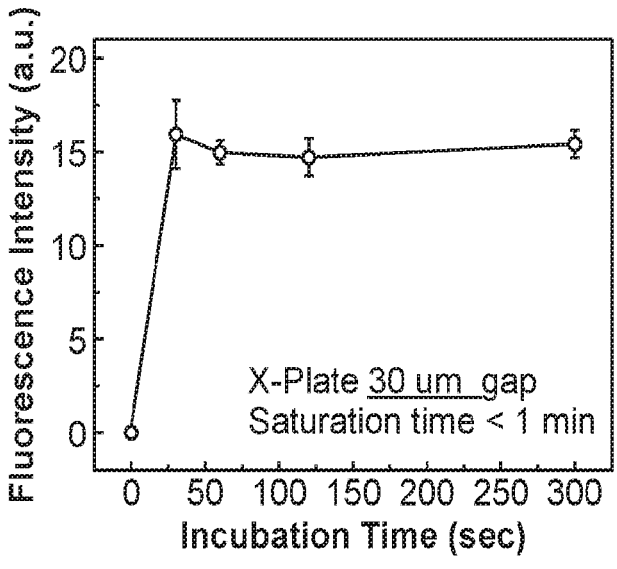
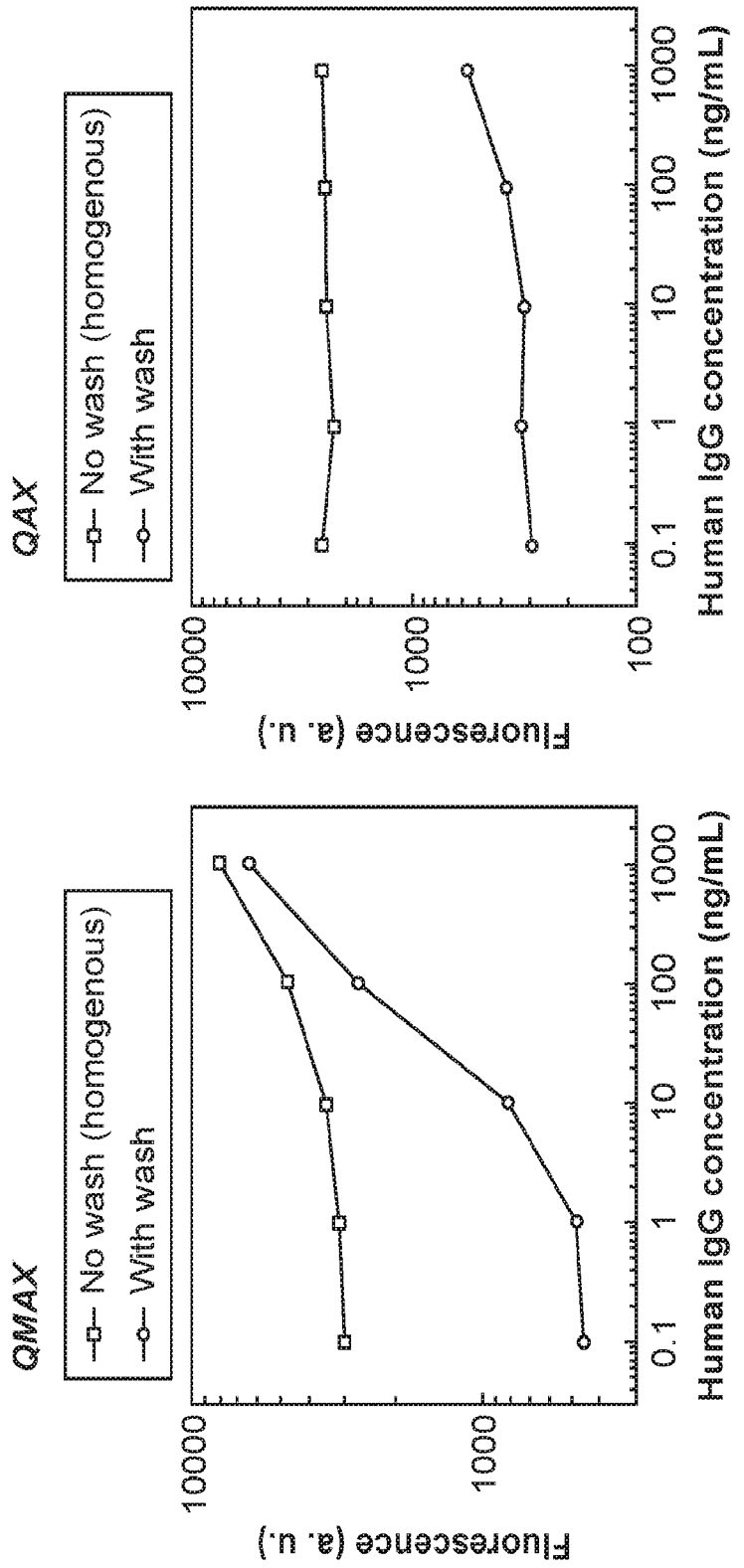



FIG. 13B




| *No.,* | *Device* | *Wash or No wash* | *LoD* |
|---|---|---|---|
| *1* | QMAX | With wash | 2 pM (300 pg/mL) |
| *2* | QMAX | No wash | 10 pM (1.5 ng/mL) |
| *3* | QAX | With wash | 200 pM (30 ng/mL) |
| *4* | QAX | No wash | --- |

FIG. 14

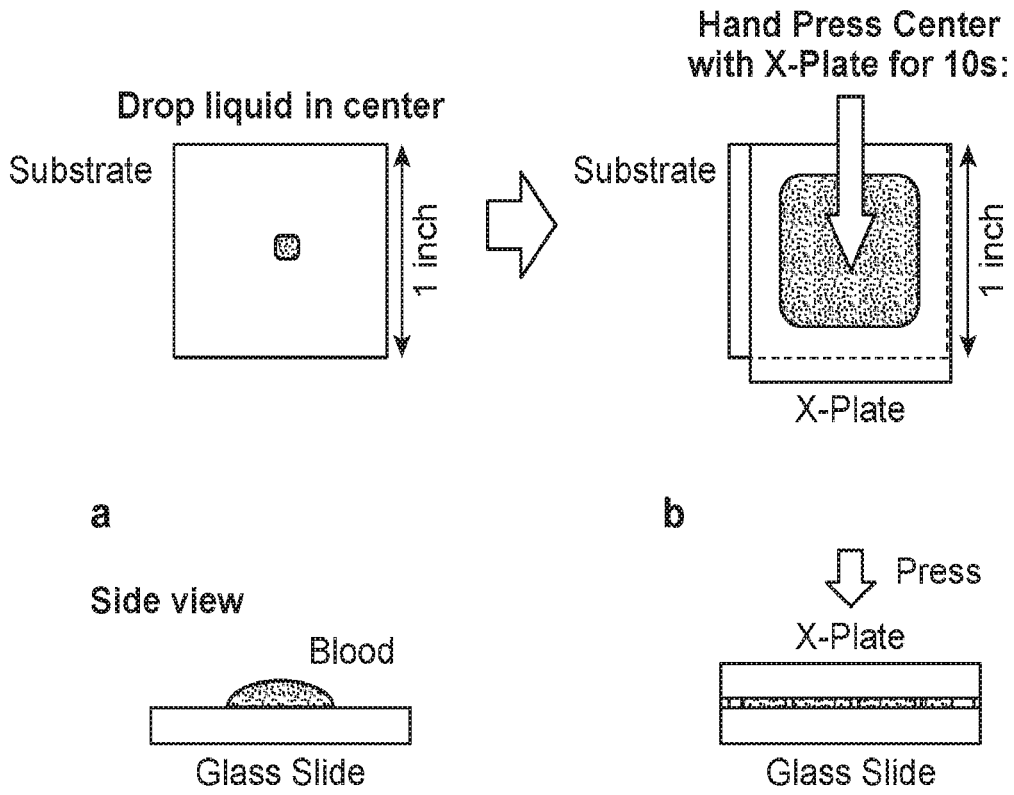

Drop liquid in center
Substrate
1 inch
Hand Press Center
with X-Plate for 10s:
Substrate
1 inch
X-Plate
a
Side view
Blood
Glass Slide
b
Press
X-Plate
Glass Slide

FIG. 15

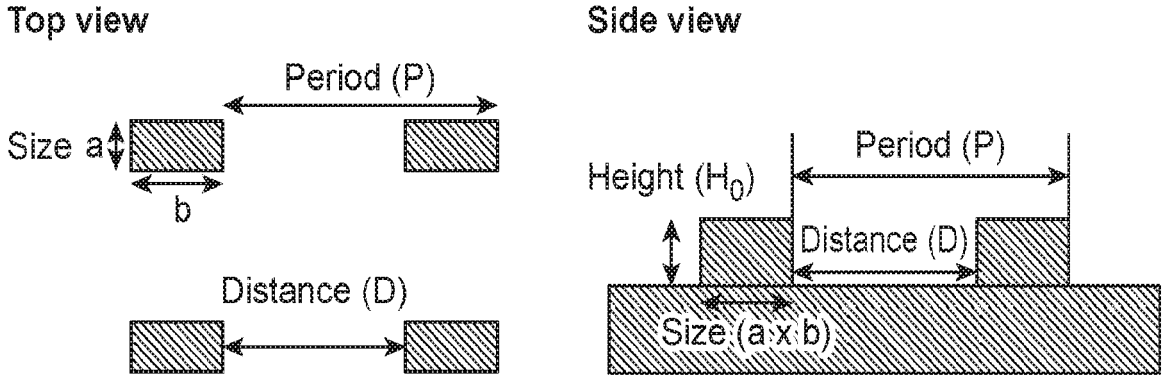

Top view
Period (P)
Size a
b
Distance (D)
Side view
Height ($H_0$)
Period (P)
Distance (D)
Size (a x b)

FIG. 16

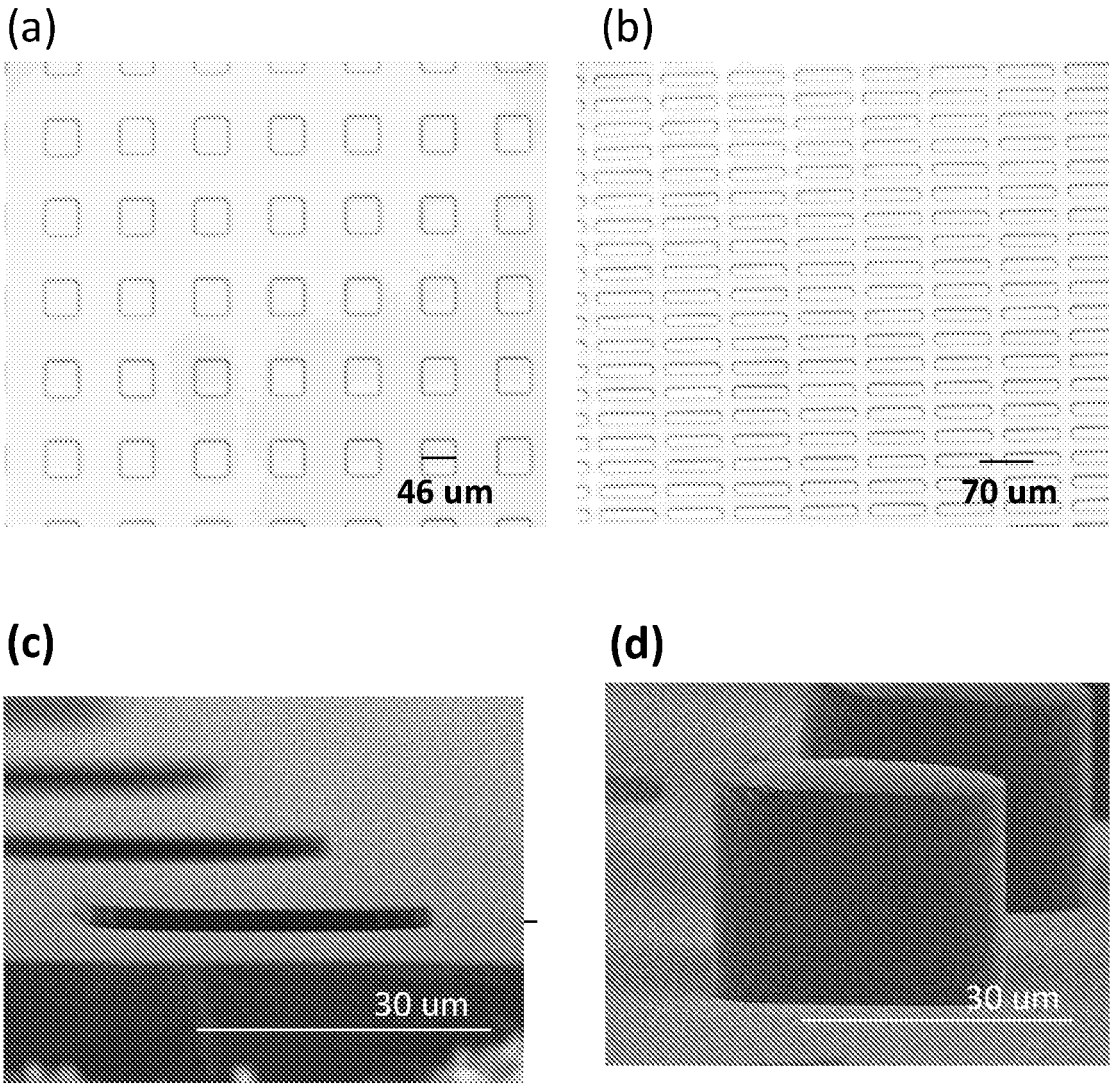
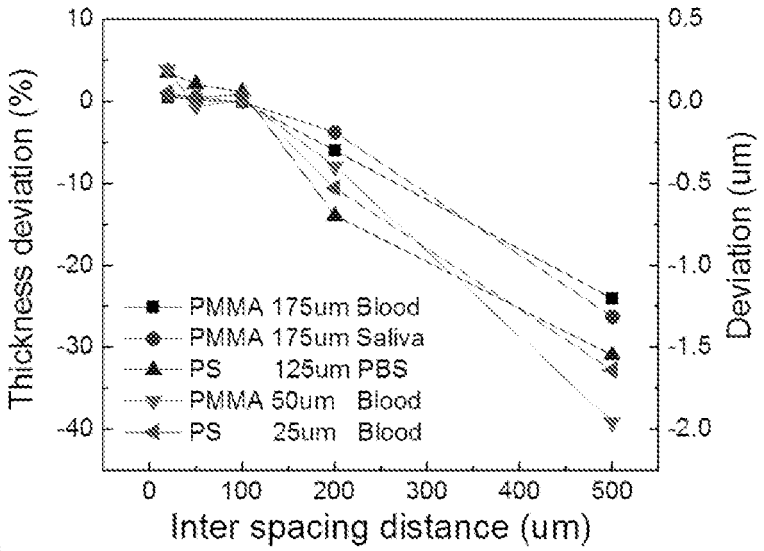



Fig. 17

a


Thickness deviation (%)
Deviation (um)
Inter spacing distance (um)
PMMA 175um Blood
PMMA 175um Saliva
PS 125um PBS
PMMA 50um Blood
PS 25um Blood

b

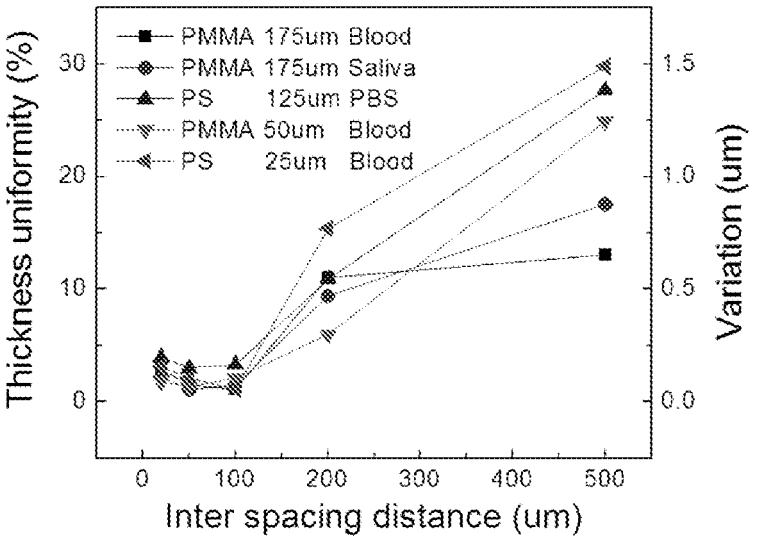

Thickness uniformity (%)
Variation (um)
Inter spacing distance (um)
PMMA 175um Blood
PMMA 175um Saliva
PS 125um PBS
PMMA 50um Blood
PS 25um Blood

Fig. 18

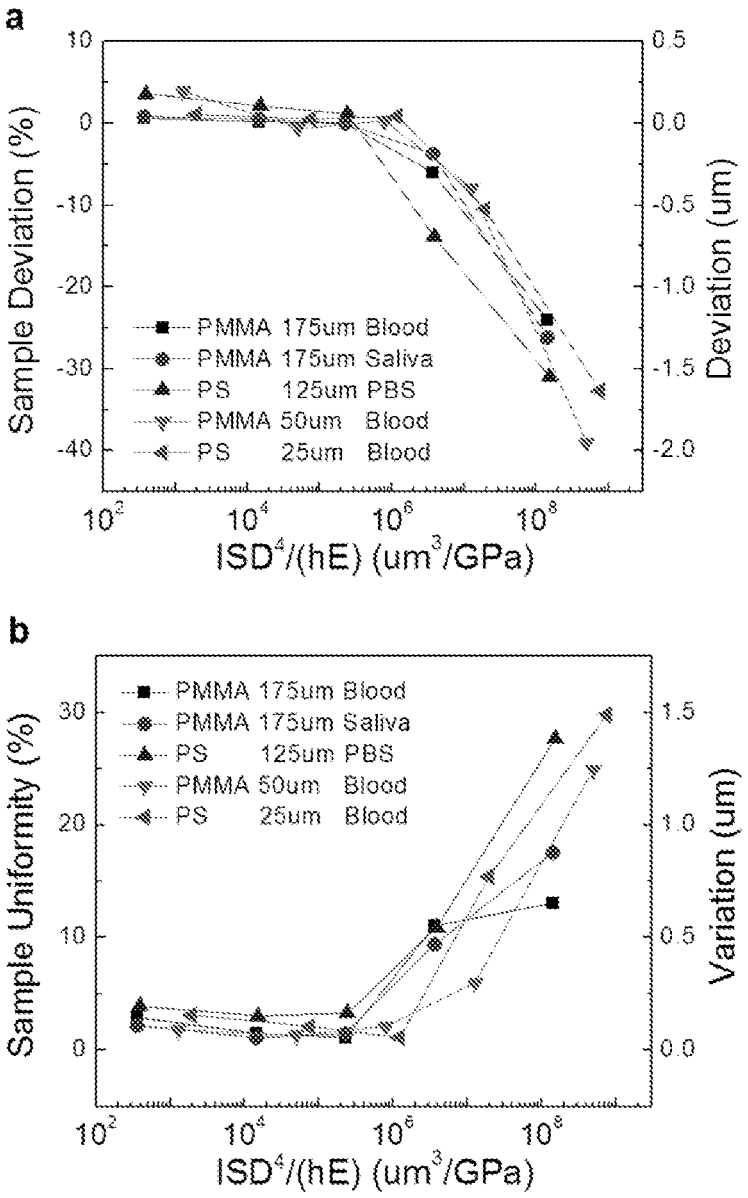

a
Sample Deviation (%)
Deviation (um)
ISD⁴/(hE) (um³/GPa)
PMMA 175um Blood
PMMA 175um Saliva
PS 125um PBS
PMMA 50um Blood
PS 25um Blood
b
Sample Uniformity (%)
Variation (um)
ISD⁴/(hE) (um³/GPa)
PMMA 175um Blood
PMMA 175um Saliva
PS 125um PBS
PMMA 50um Blood
PS 25um Blood

Fig. 19

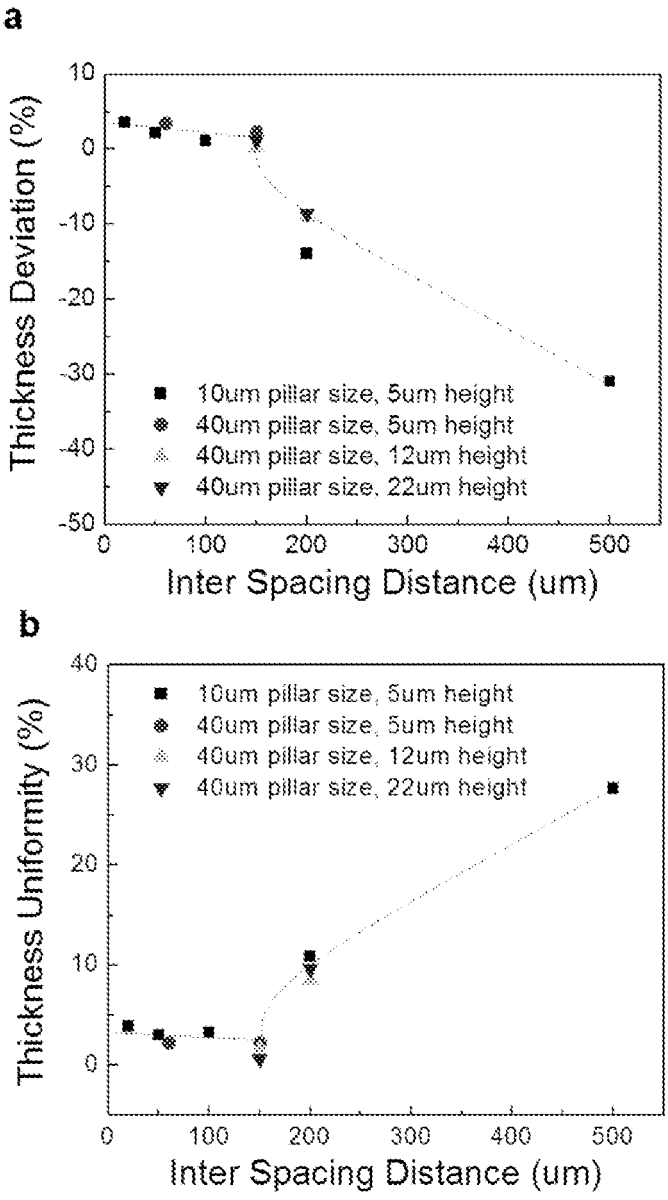

a
Thickness Deviation (%)
10
0
-10
-20
-30
-40
-50
0
100
200
300
400
500
Inter Spacing Distance (um)
10um pillar size, 5um height
40um pillar size, 5um height
40um pillar size, 12um height
40um pillar size, 22um height
b
Thickness Uniformity (%)
40
30
20
10
0
0
100
200
300
400
500
Inter Spacing Distance (um)
10um pillar size, 5um height
40um pillar size, 5um height
40um pillar size, 12um height
40um pillar size, 22um height

Fig. 20

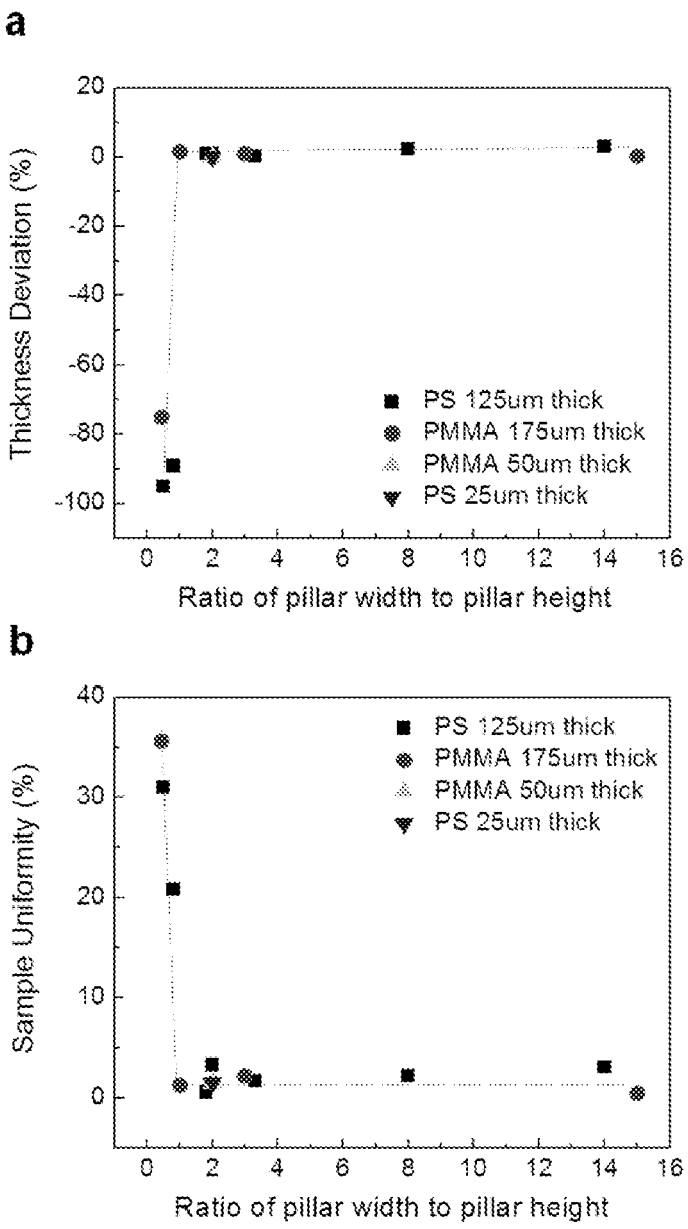

a
Thickness Deviation (%)
20
0
-20
-40
-60
-80
-100
0
2
4
6
8
10
12
14
16
Ratio of pillar width to pillar height
PS 125um thick
PMMA 175um thick
PMMA 50um thick
PS 25um thick
b
Sample Uniformity (%)
40
30
20
10
0
0
2
4
6
8
10
12
14
16
Ratio of pillar width to pillar height
PS 125um thick
PMMA 175um thick
PMMA 50um thick
PS 25um thick

Fig. 21

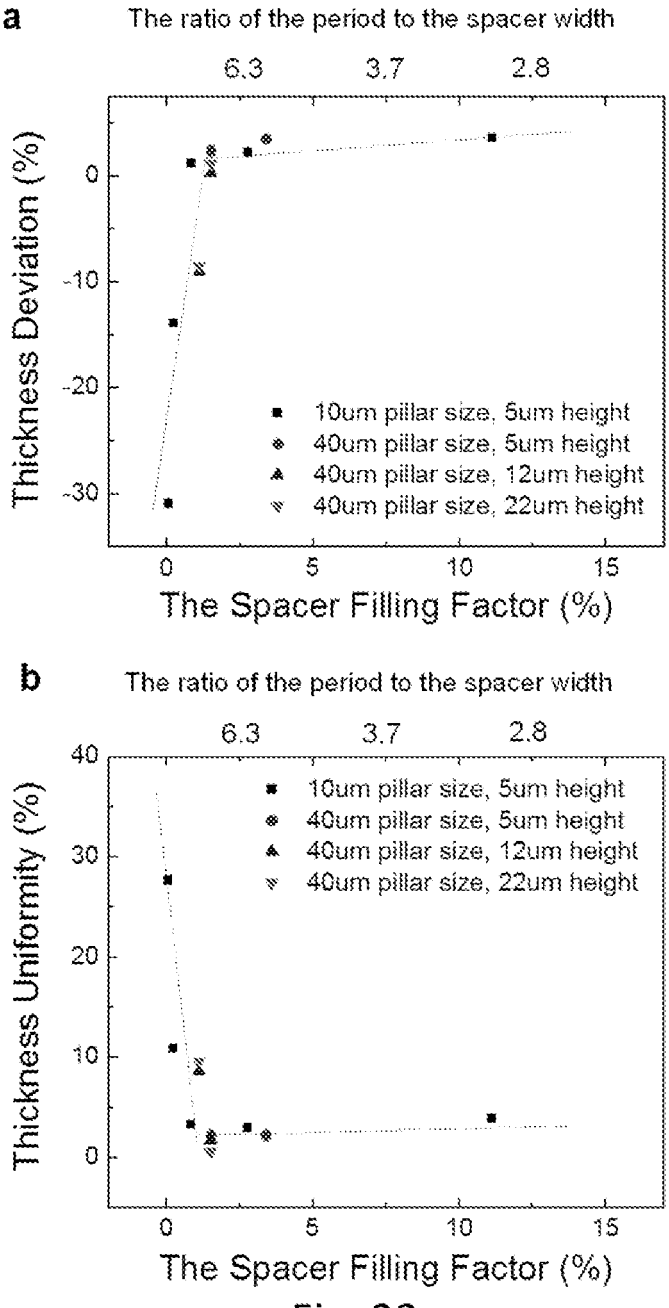

a
The ratio of the period to the spacer width
6.3
3.7
2.8
Thickness Deviation (%)
0
-10
-20
-30
10um pillar size, 5um height
40um pillar size, 5um height
40um pillar size, 12um height
40um pillar size, 22um height
0
5
10
15
The Spacer Filling Factor (%)
b
The ratio of the period to the spacer width
6.3
3.7
2.8
Thickness Uniformity (%)
40
30
20
10
0
10um pillar size, 5um height
40um pillar size, 5um height
40um pillar size, 12um height
40um pillar size, 22um height
0
5
10
15
The Spacer Filling Factor (%)

Fig. 22

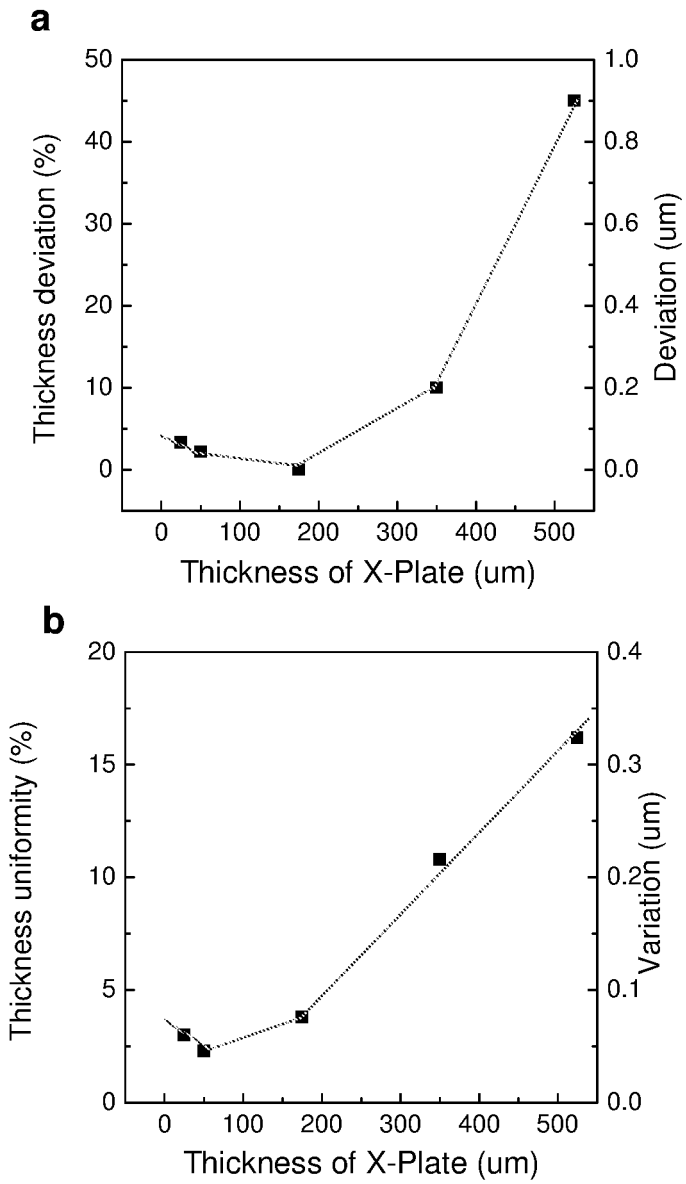

a
Thickness deviation (%)
Deviation (um)
Thickness of X-Plate (um)
b
Thickness uniformity (%)
Variation (um)
Thickness of X-Plate (um)

Fig. 23

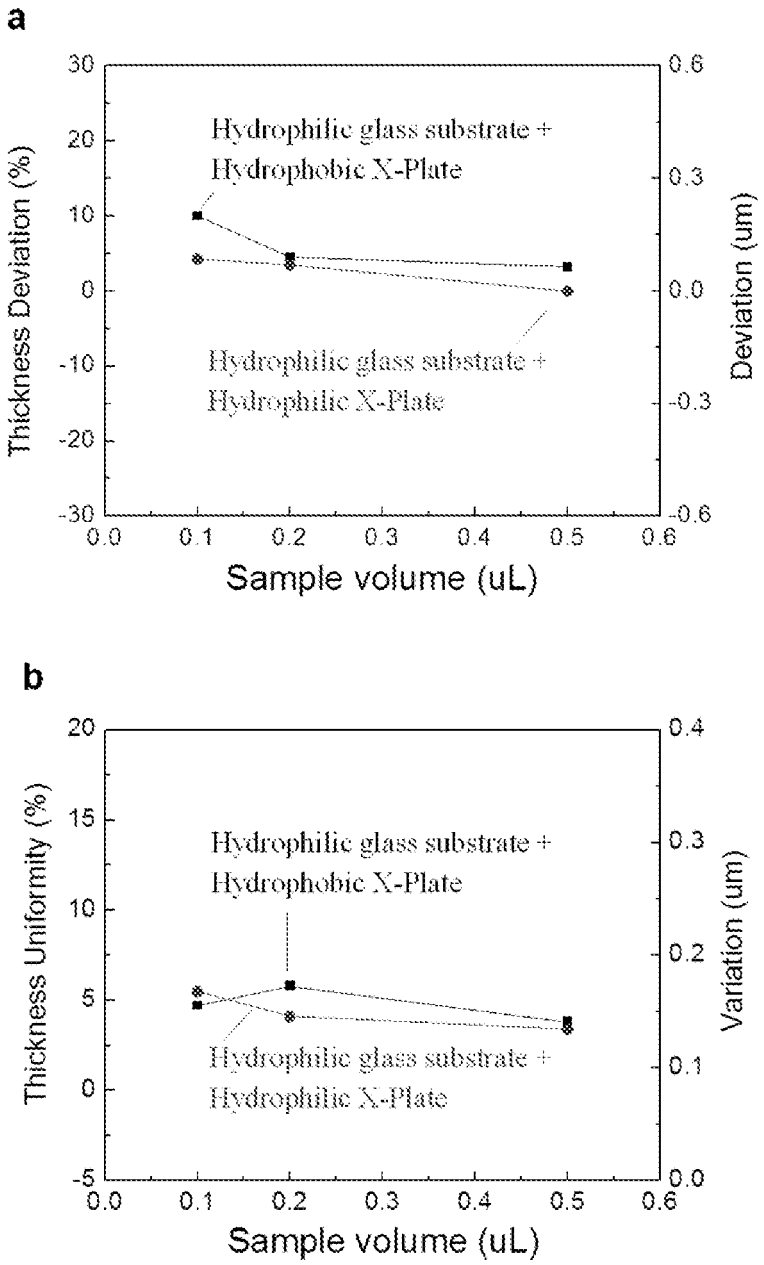

a
Thickness Deviation (%)
Deviation (um)
Sample volume (uL)
Hydrophilic glass substrate +
Hydrophobic X-Plate
Hydrophilic glass substrate +
Hydrophilic X-Plate
b
Thickness Uniformity (%)
Variation (um)
Sample volume (uL)
Hydrophilic glass substrate +
Hydrophobic X-Plate
Hydrophilic glass substrate +
Hydrophilic X-Plate

Fig. 24

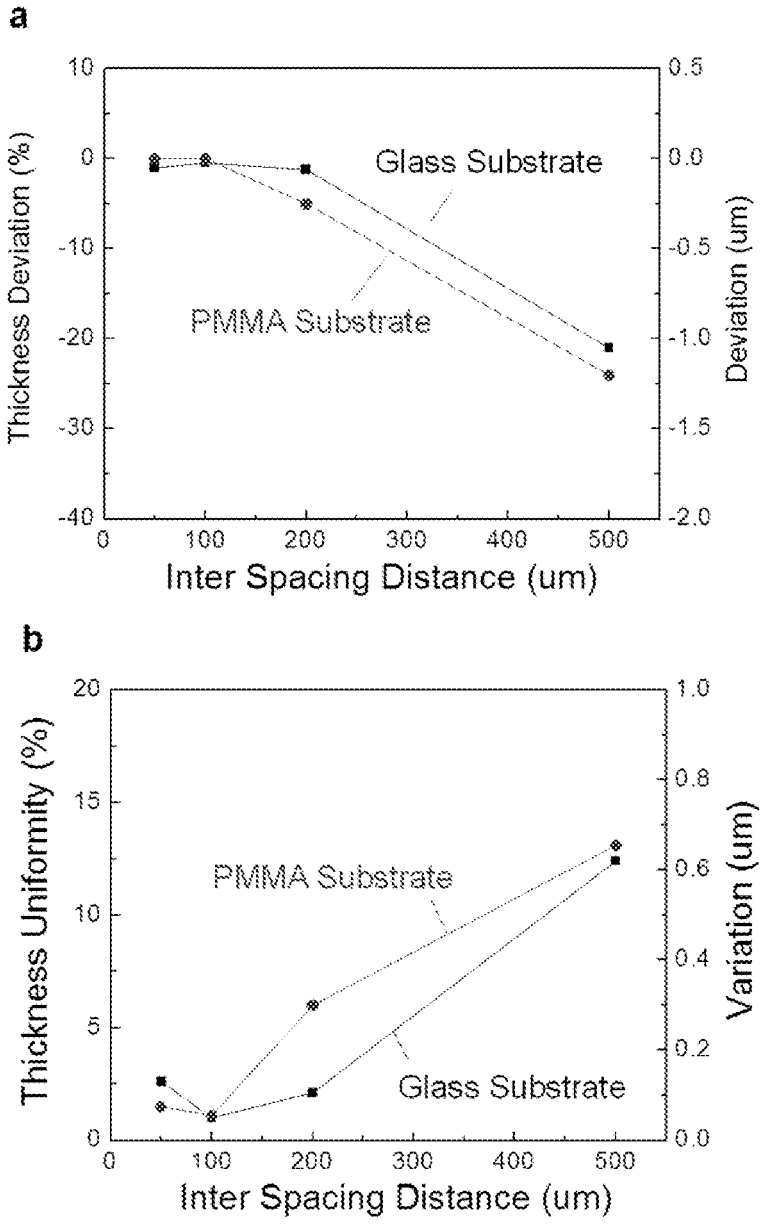

a
Thickness Deviation (%)
Deviation (um)
Glass Substrate
PMMA Substrate
Inter Spacing Distance (um)
b
Thickness Uniformity (%)
Variation (um)
PMMA Substrate
Glass Substrate
Inter Spacing Distance (um)

Fig. 25

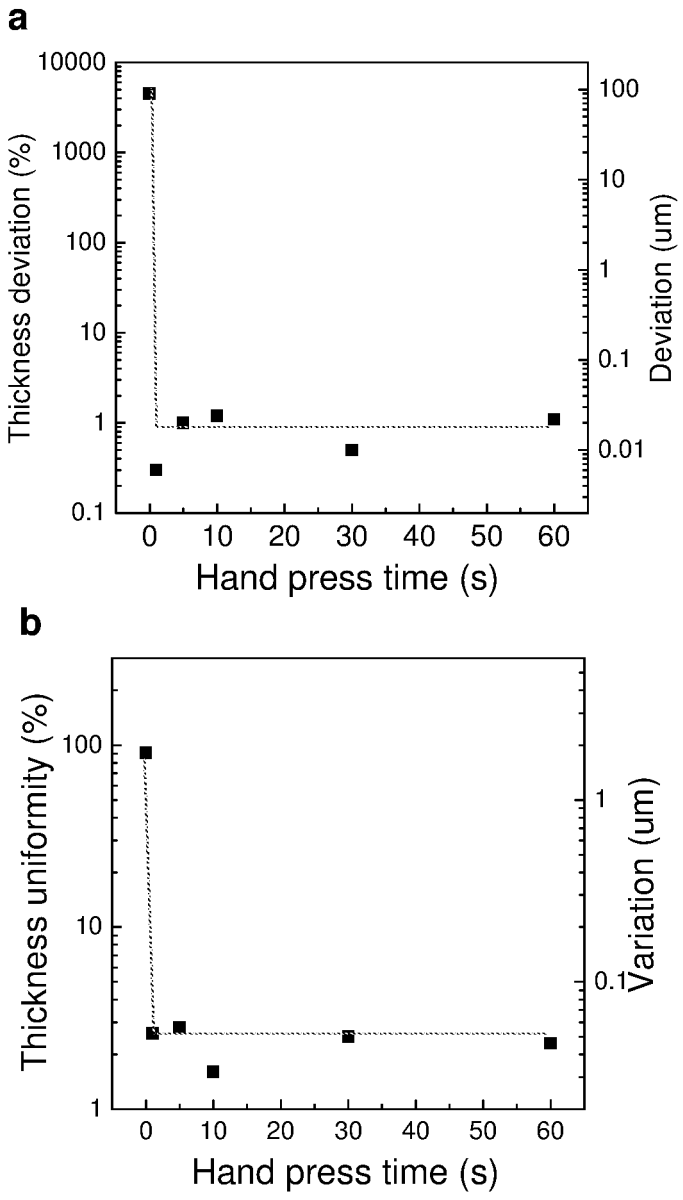

a
Thickness deviation (%)
10000
1000
100
10
1
0.1
Deviation (um)
100
10
1
0.1
0.01
0
10
20
30
40
50
60
Hand press time (s)
b
Thickness uniformity (%)
100
10
1
Variation (um)
1
0.1
0
10
20
30
40
50
60
Hand press time (s)

Fig. 26

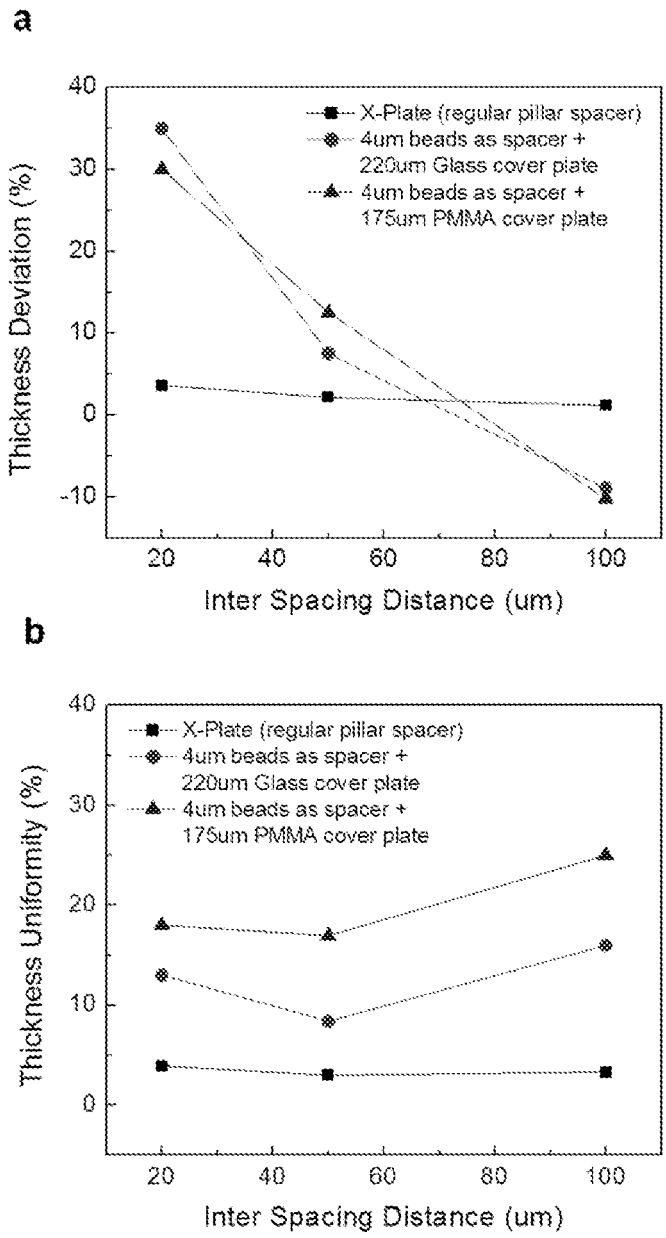

a
Thickness Deviation (%)
40
30
20
10
0
-10
20
40
60
80
100
Inter Spacing Distance (um)
X-Plate (regular pillar spacer)
4um beads as spacer +
220um Glass cover plate
4um beads as spacer +
175um PMMA cover plate
b
Thickness Uniformity (%)
40
30
20
10
0
20
40
60
80
100
Inter Spacing Distance (um)
X-Plate (regular pillar spacer)
4um beads as spacer +
220um Glass cover plate
4um beads as spacer +
175um PMMA cover plate

Fig. 27

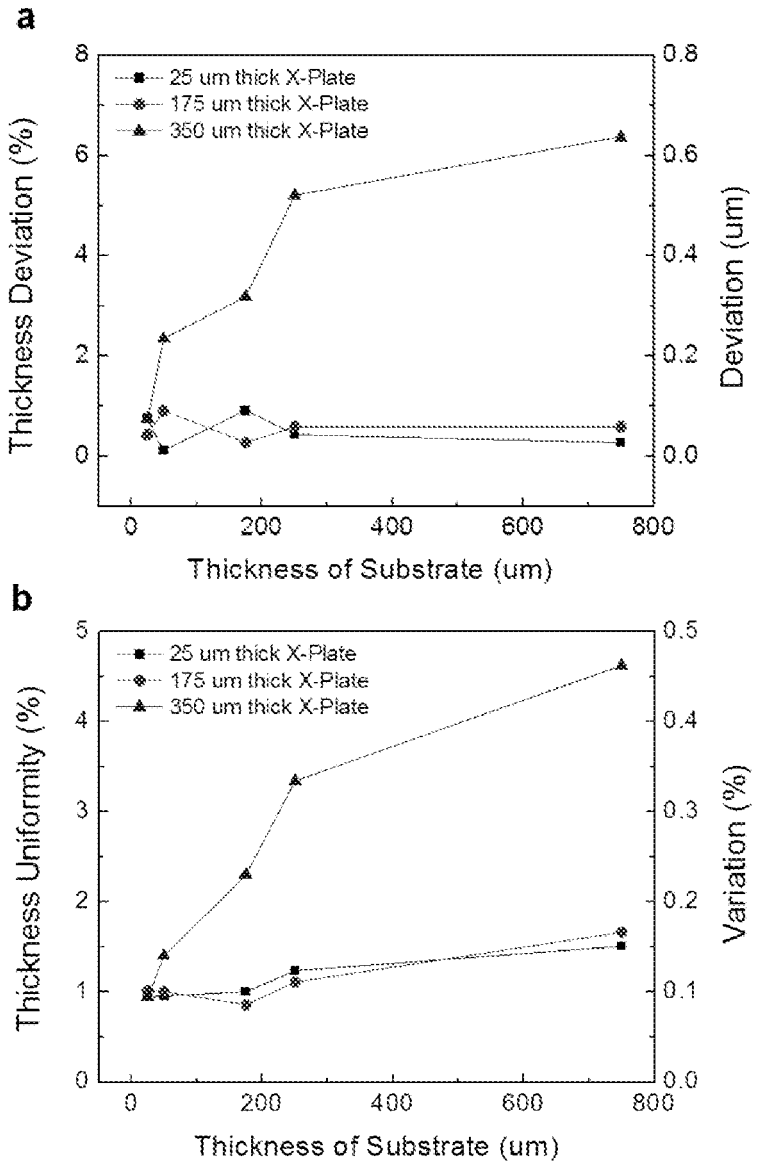

a
25 um thick X-Plate
175 um thick X-Plate
350 um thick X-Plate
Thickness Deviation (%)
Deviation (um)
Thickness of Substrate (um)
b
25 um thick X-Plate
175 um thick X-Plate
350 um thick X-Plate
Thickness Uniformity (%)
Variation (%)
Thickness of Substrate (um)

FIG. 28

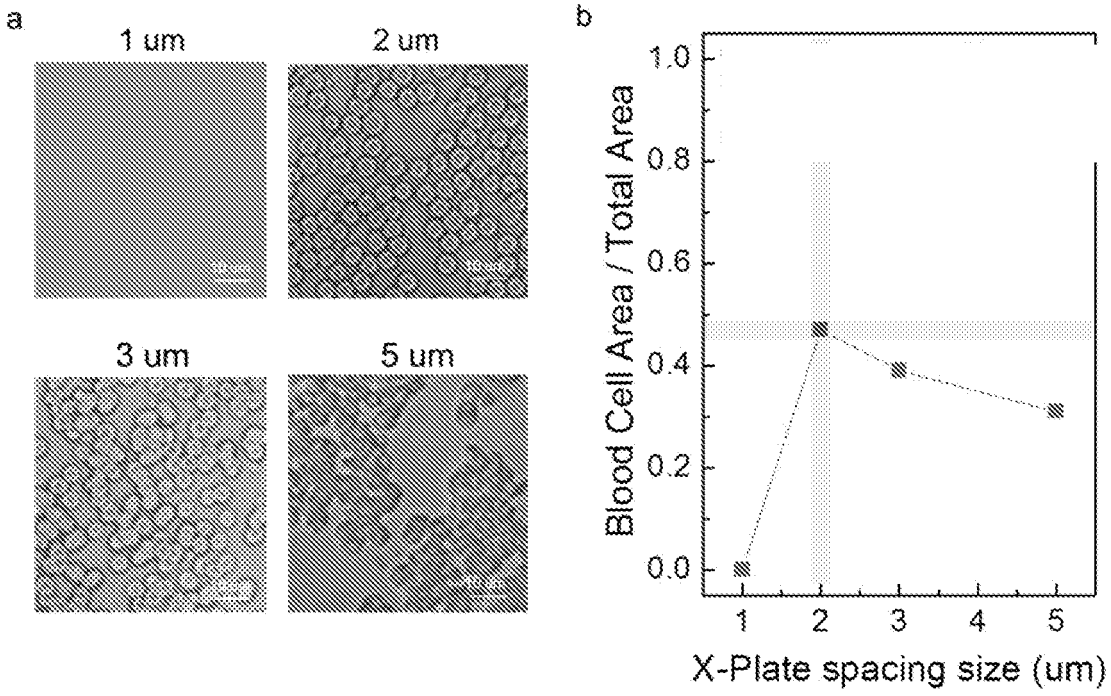
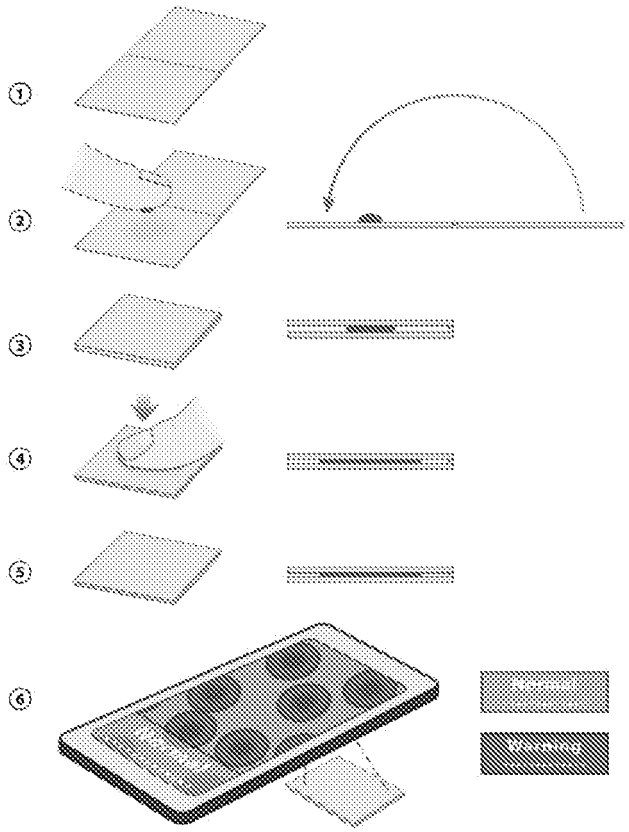

a
1 um
2 um
3 um
5 um
b
Blood Cell Area / Total Area
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
X-Plate spacing size (um)

FIG. 29

(a)



(b)

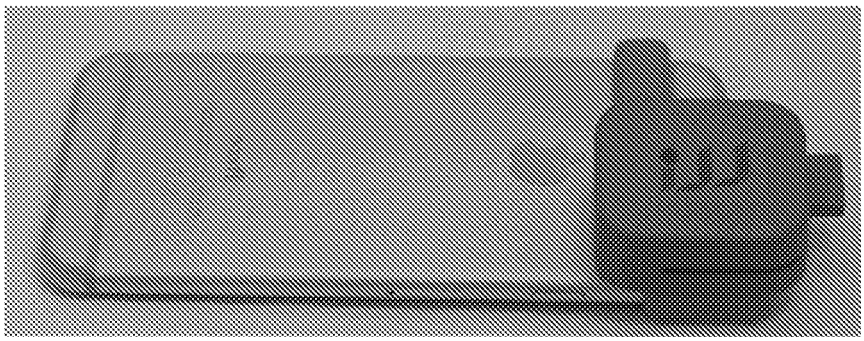


FIG. 30

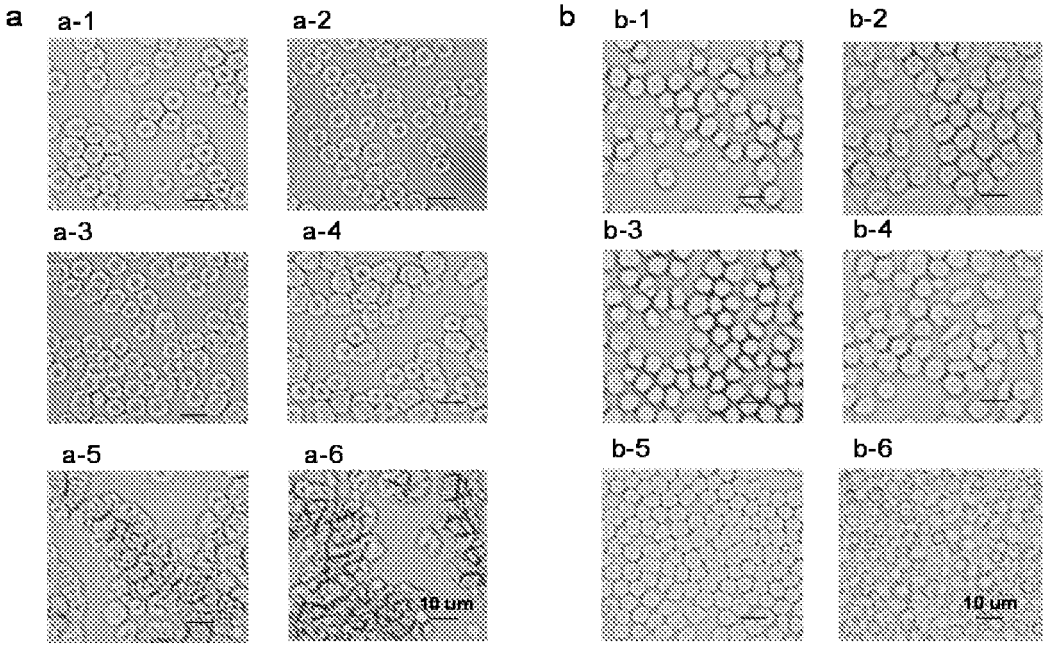



FIG. 31

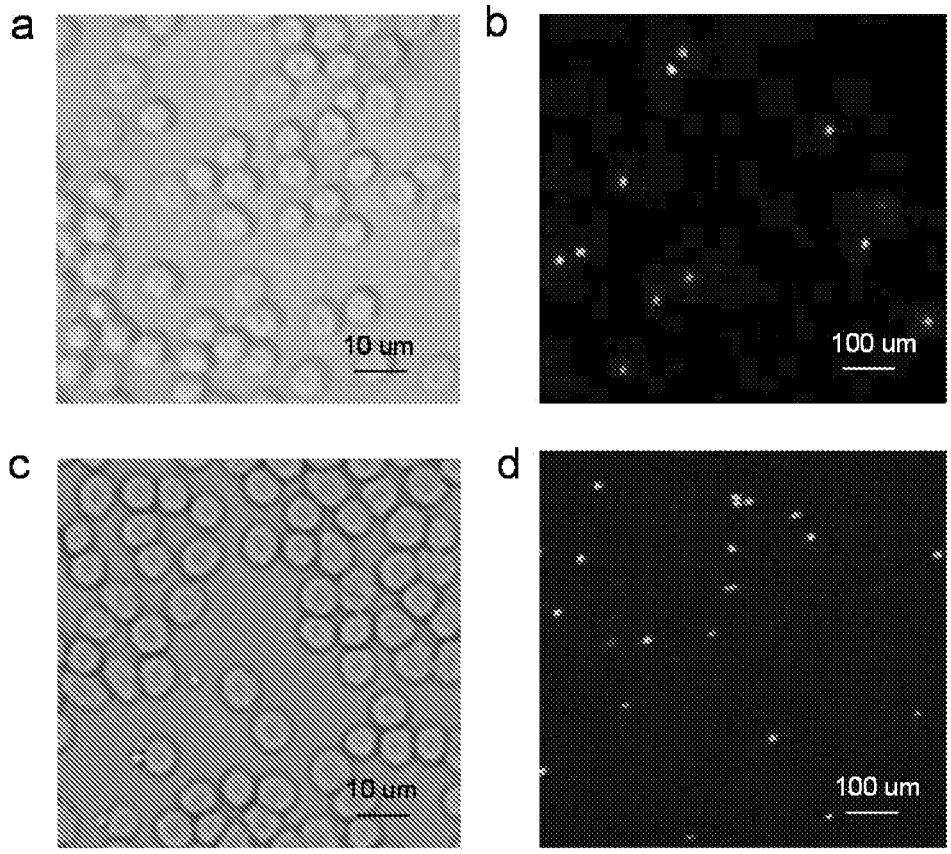



FIG. 32

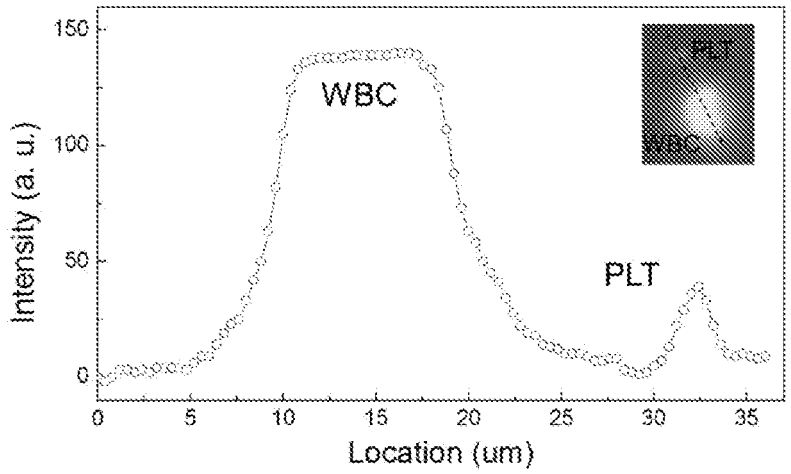
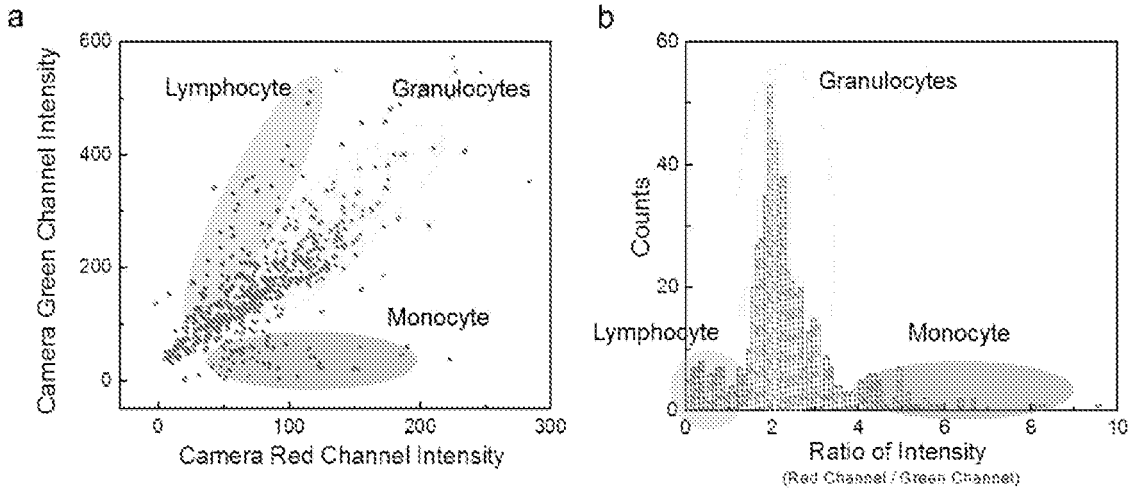



FIG. 33




| | Granulocytes | Lymphocyte | Monocyte |
|---|---|---|---|
| **Measured** | *70 %* | *22 %* | *8 %* |
| **Normal Value** | *50-70 %* | *25-35 %* | *3-9 %* |

FIG. 34