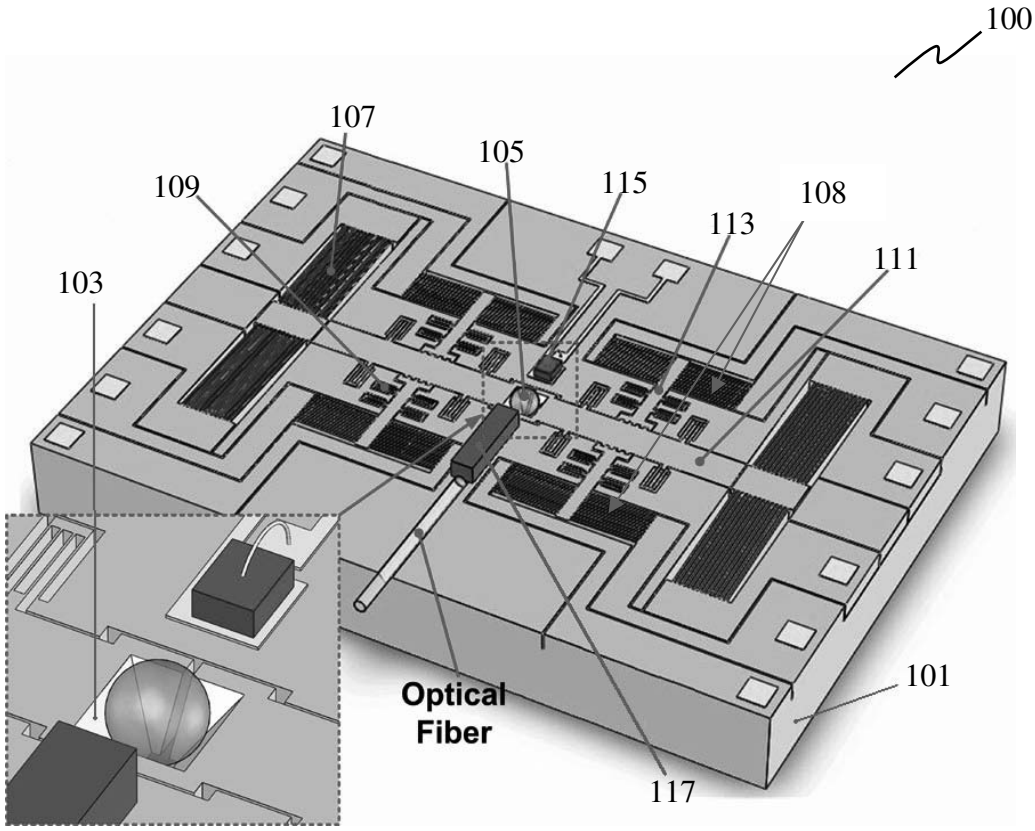


Fig. 1

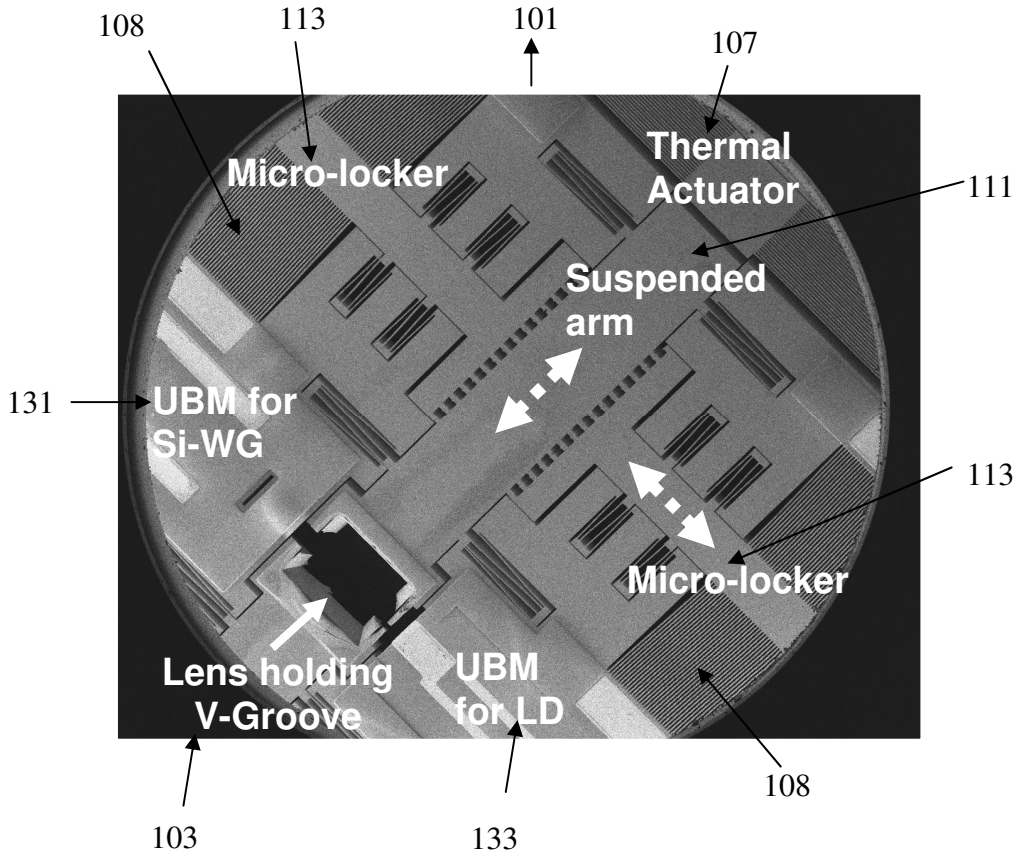

108
113
101
107
Micro-locker
Thermal Actuator
111
Suspended arm
131
UBM for Si-WG
113
Micro-locker
Lens holding V-Groove
UBM for LD
108
103
133

Fig. 2

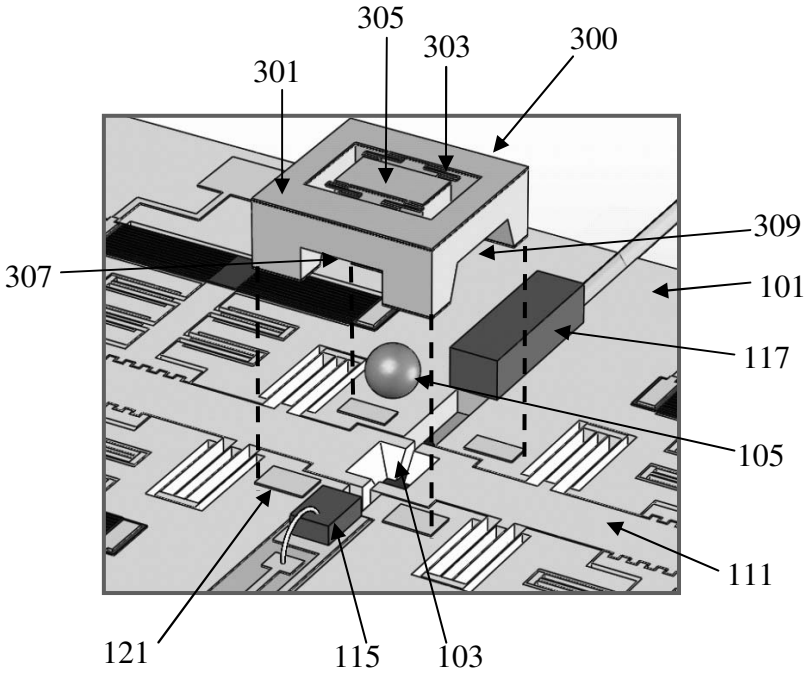

305
303
300
301
309
307
101
117
105
111
121
115
103

Fig. 3

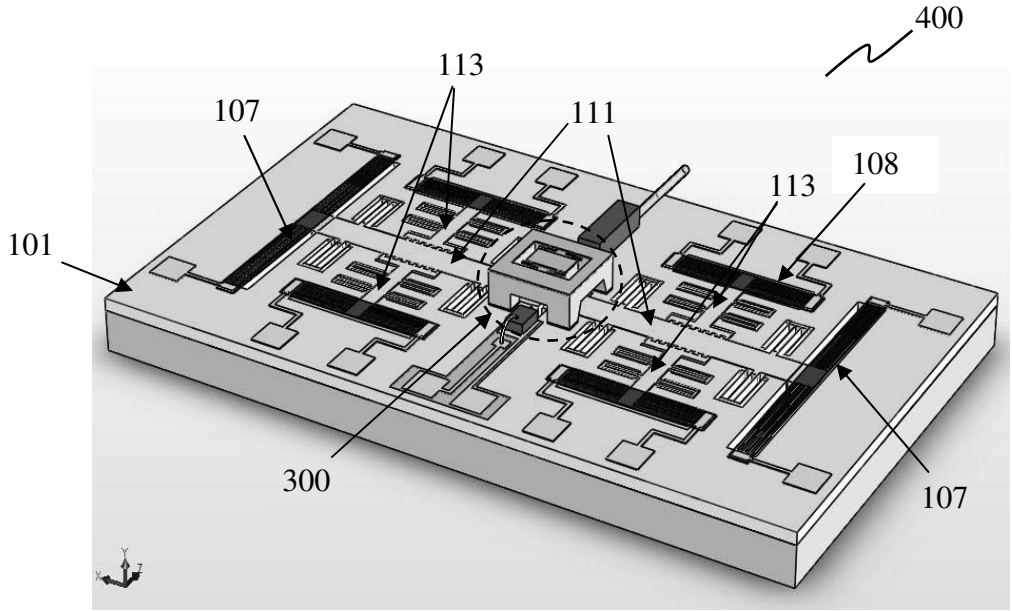

400
113
107
111
108
113
101
300
107

Fig. 4

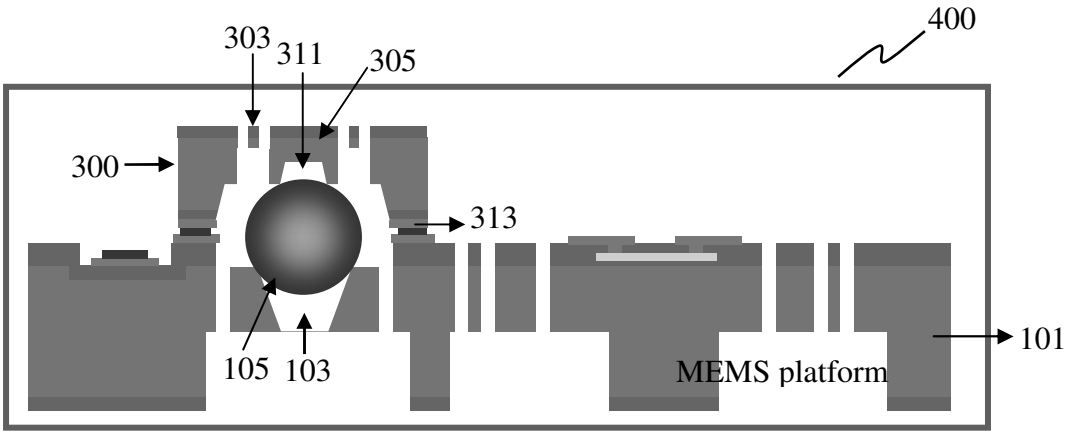

400
303
311
305
300
313
105
103
MEMS platform
101

Fig. 5

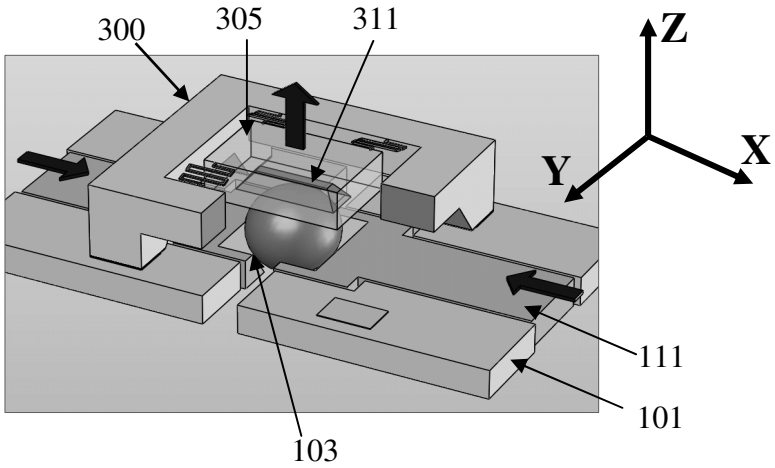

300
305
311
Z
Y
X
111
101
103

Fig. 6

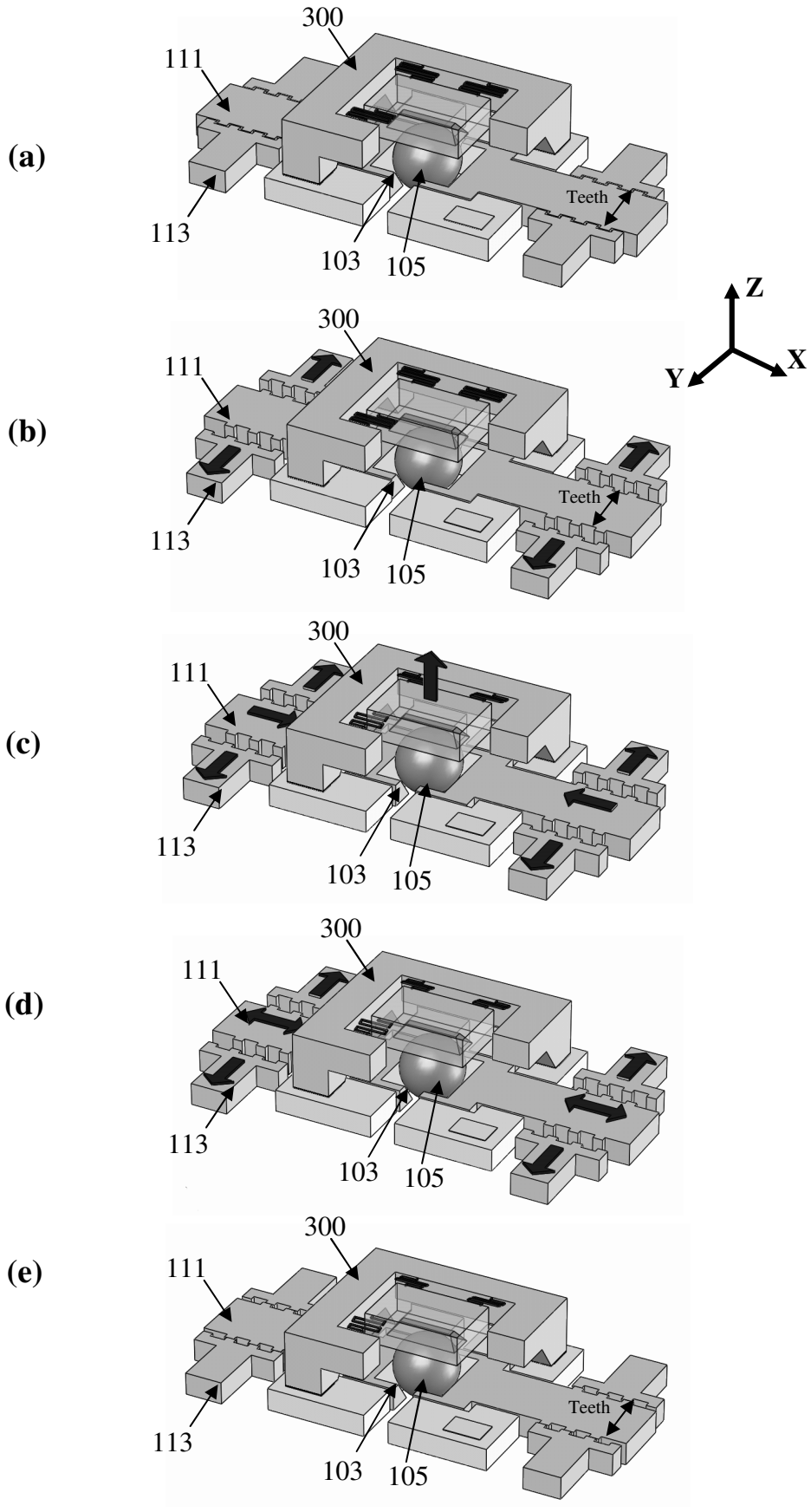


Fig. 7

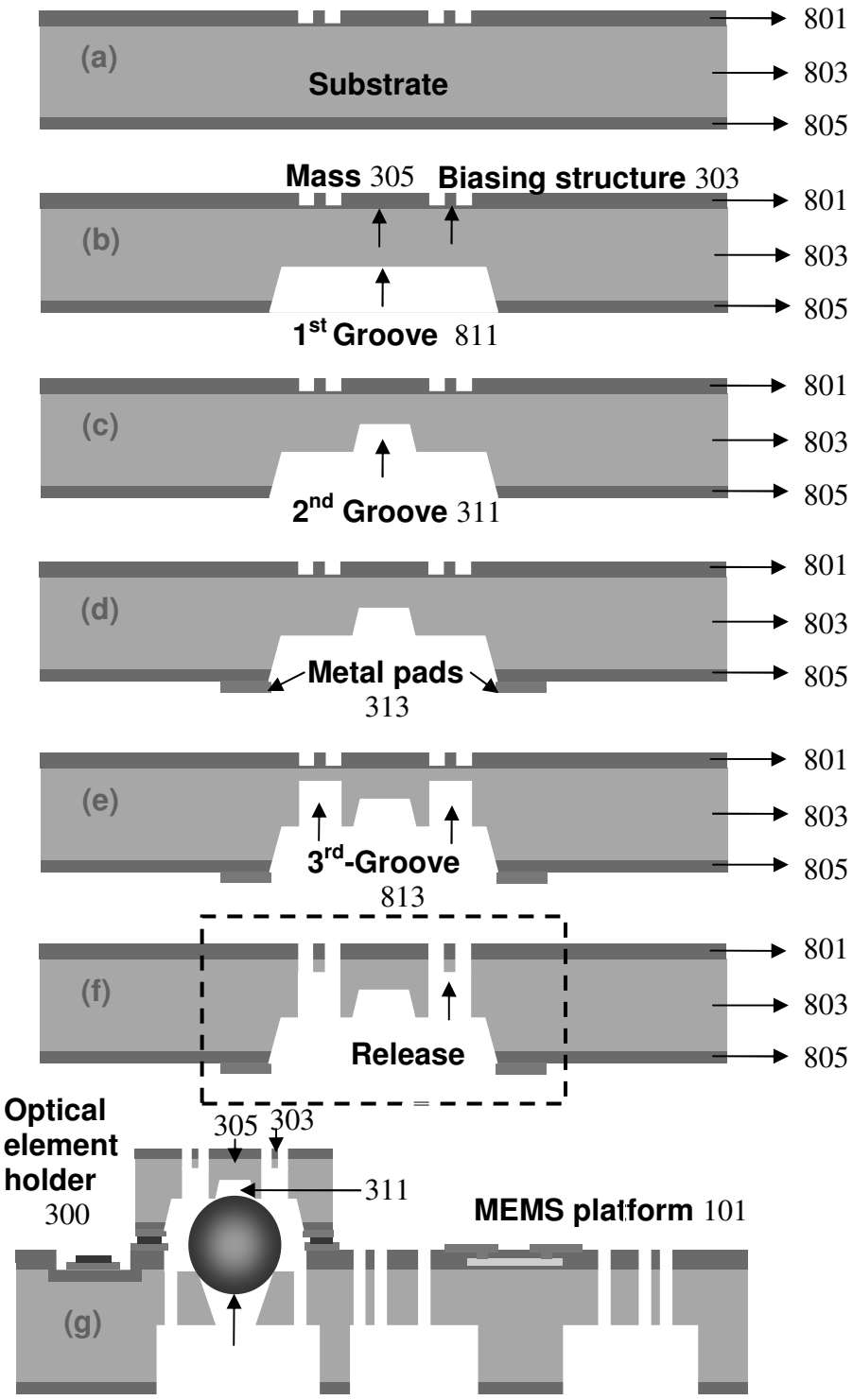

(a)
Substrate
801
803
805
Mass 305
Biasing structure 303
(b)
1st Groove 811
(c)
2nd Groove 311
(d)
Metal pads
313
(e)
3rd-Groove
813
(f)
Release
Optical element holder 300
305
303
311
MEMS platform 101
(g)

Fig. 8

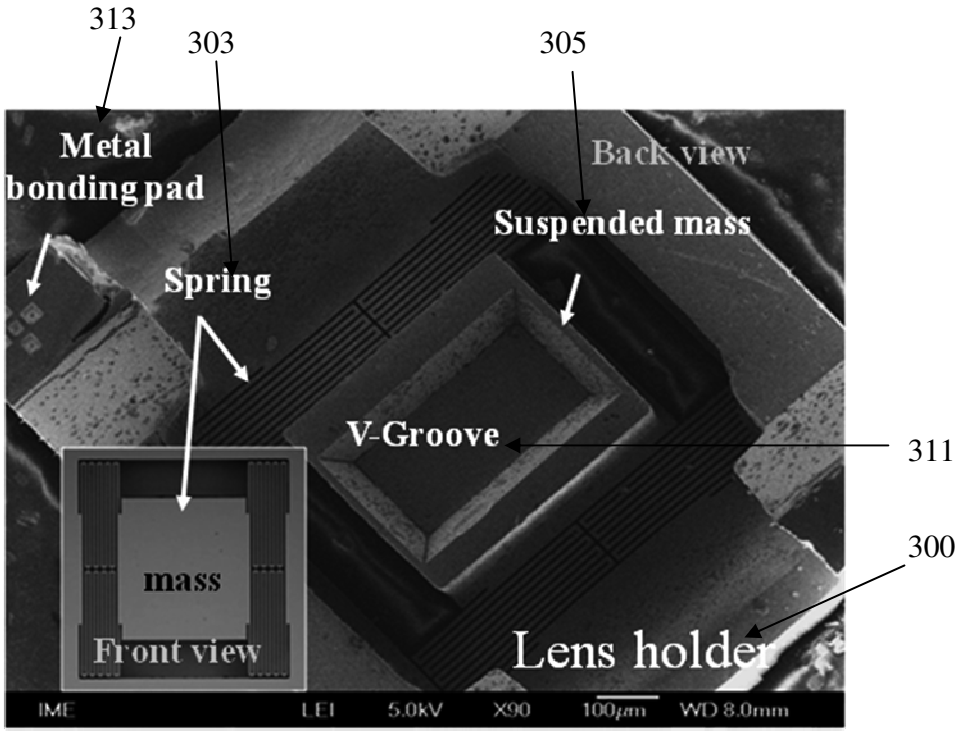

313
303
305
Metal bonding pad
Back view
Suspended mass
Spring
V-Groove
311
300
mass
Front view
Lens holder
IME
LEI
5.0kV
X90
100μm
WD 8.0mm

Fig. 9

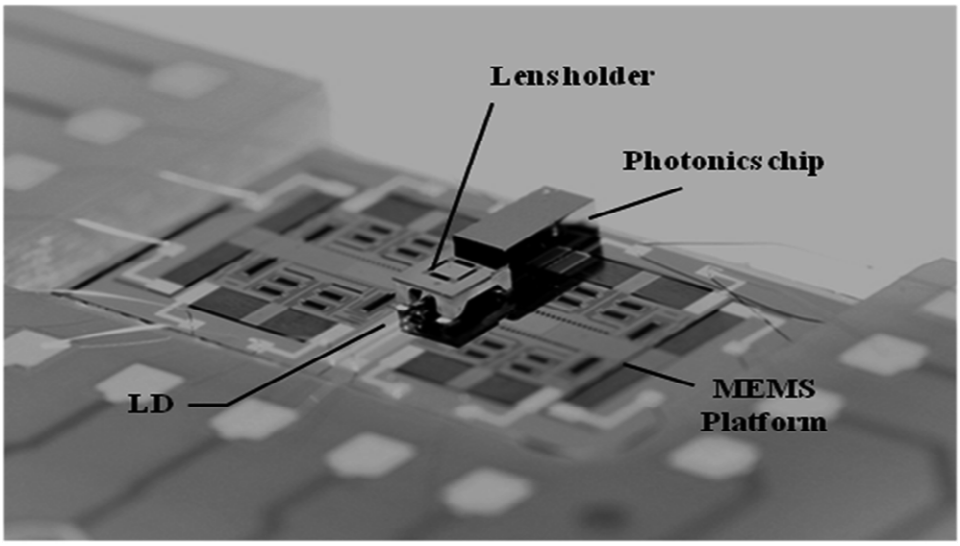

Lensholder
Photonics chip
LD
MEMS
Platform

Fig. 10

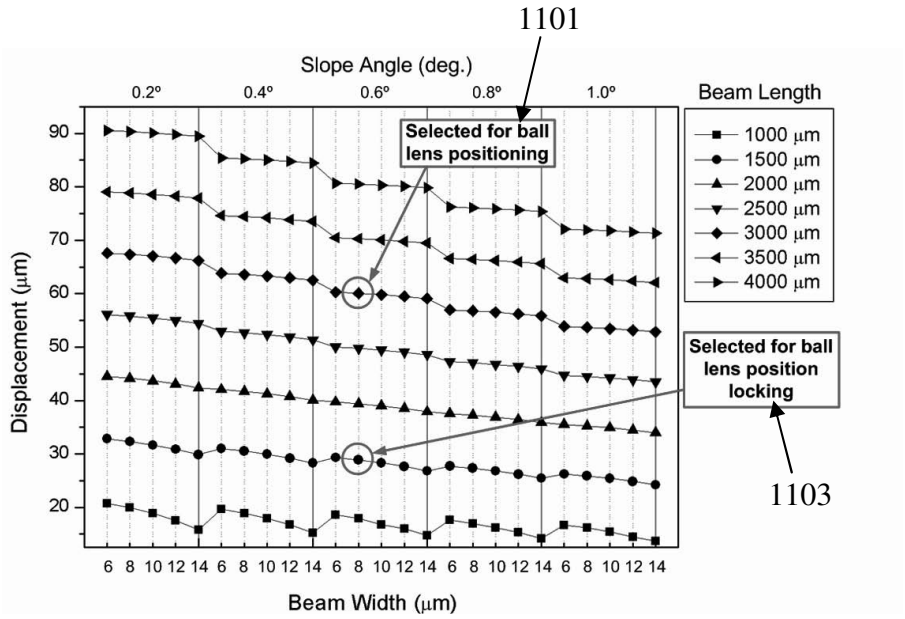

1101
Slope Angle (deg.)
0.2°
0.4°
0.6°
0.8°
1.0°
Beam Length
1000 μm
1500 μm
2000 μm
2500 μm
3000 μm
3500 μm
4000 μm
Selected for ball lens positioning
Selected for ball lens position locking
1103
Displacement (μm)
Beam Width (μm)

Fig. 11

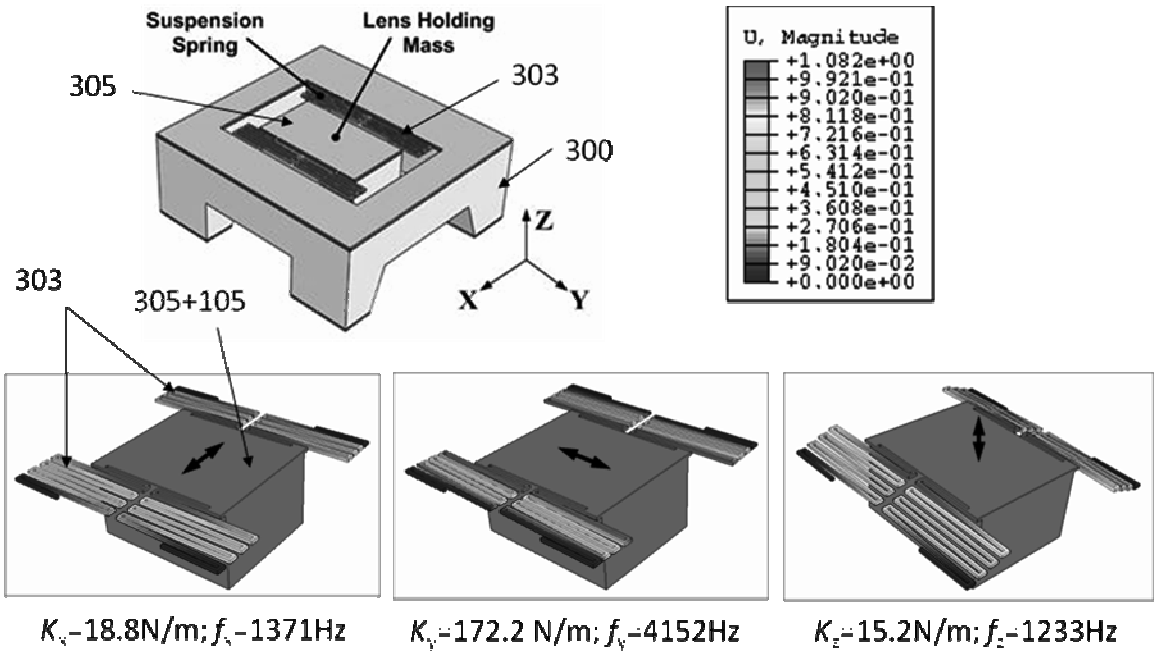

Suspension Spring
Lens Holding Mass
305
303
300
Z
X
Y
303
305+105
U, Magnitude
+1.082e+00
+9.921e-01
+9.020e-01
+8.118e-01
+7.216e-01
+6.314e-01
+5.412e-01
+4.510e-01
+3.608e-01
+2.706e-01
+1.804e-01
+9.020e-02
+0.000e+00
K_x=18.8N/m; f_x=1371Hz
K_y=172.2 N/m; f_y=4152Hz
K_z=15.2N/m; f_z=1233Hz

Fig. 12

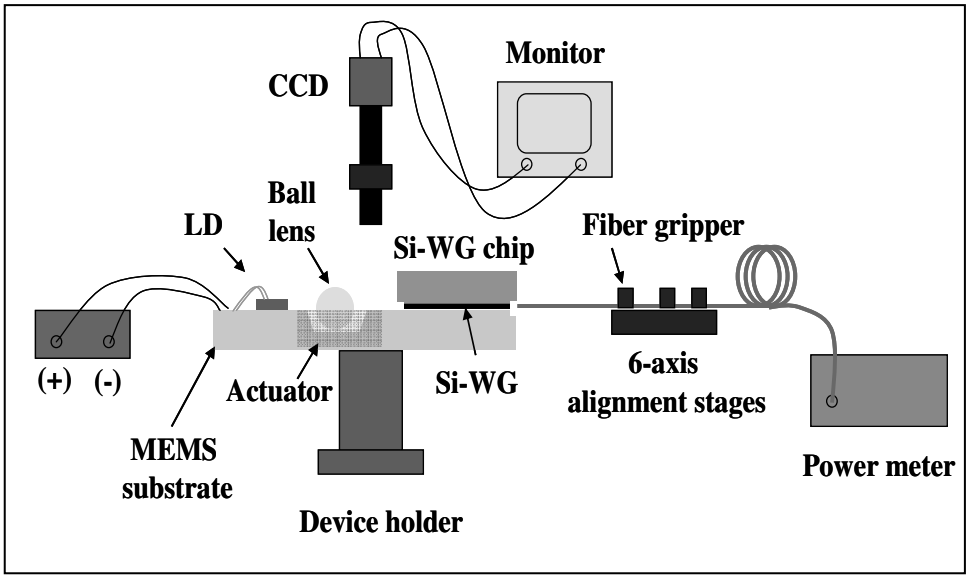

Monitor
CCD
Ball
lens
LD
Si-WG chip
Fiber gripper
(+) (-)
Actuator
Si-WG
6-axis
alignment stages
MEMS
substrate
Power meter
Device holder

Fig. 13

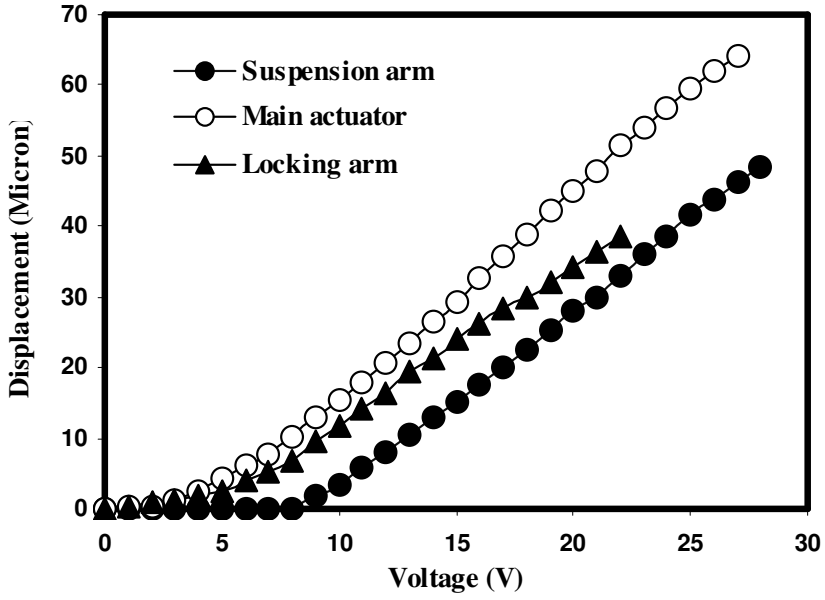
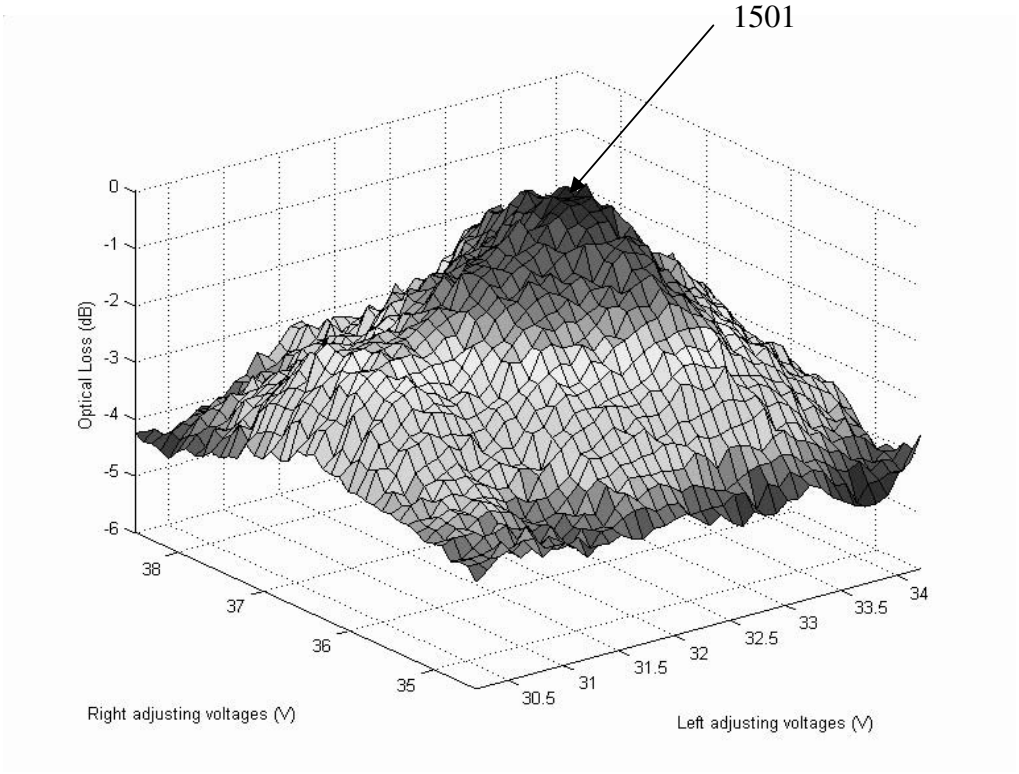

Suspension arm
Main actuator
Locking arm
Displacement (Micron)
Voltage (V)
0
10
20
30
40
50
60
70
0
5
10
15
20
25
30

Fig. 14

(a)


1501
Optical Loss (dB)
0
-1
-2
-3
-4
-5
-6
38
37
36
35
Right adjusting voltages (V)
30.5
31
31.5
32
32.5
33
33.5
34
Left adjusting voltages (V)

(b)

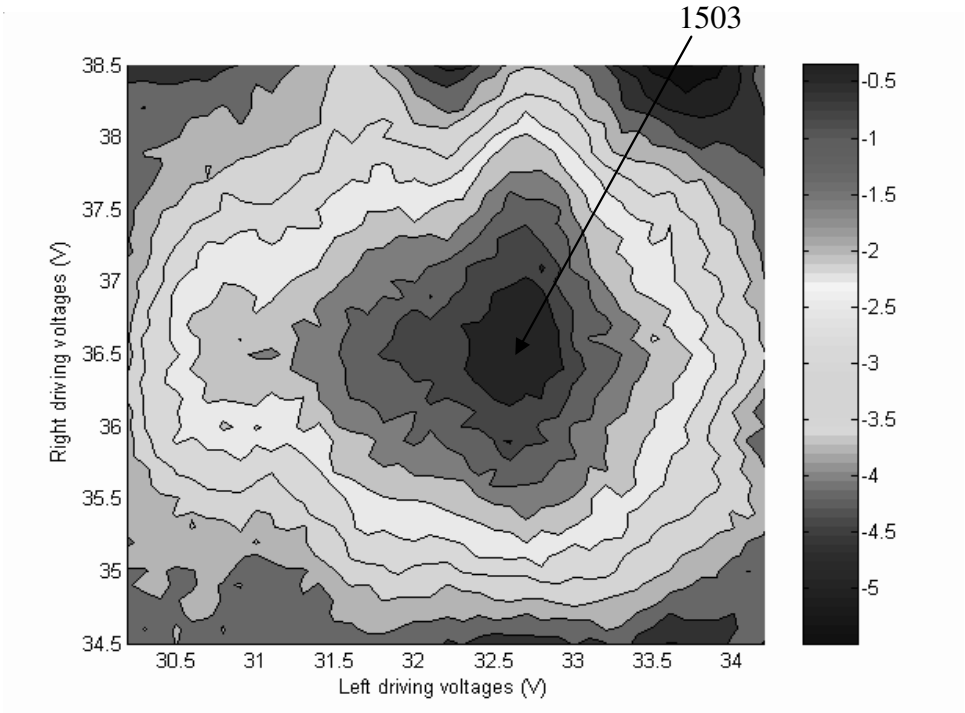

1503
Right driving voltages (V)
38.5
38
37.5
37
36.5
36
35.5
35
34.5
30.5
31
31.5
32
32.5
33
33.5
34
Left driving voltages (V)
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5

Fig. 15

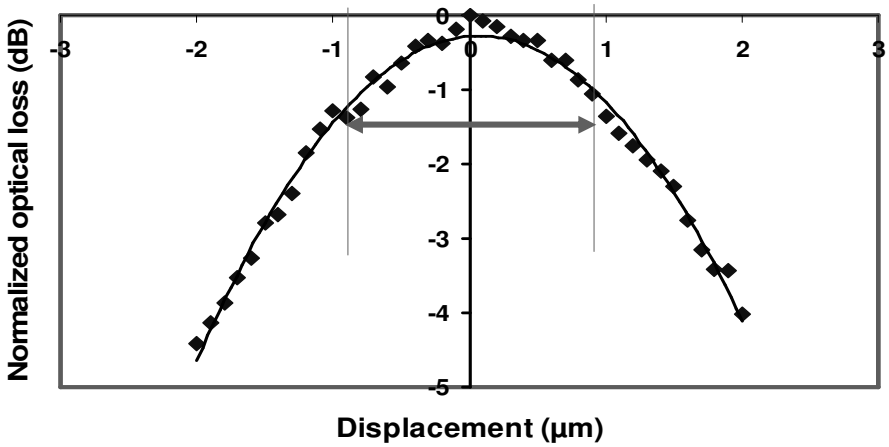

Normalized optical loss (dB)
0
-1
-2
-3
-4
-5
-3
-2
-1
0
1
2
3
Displacement (µm)

Fig. 16