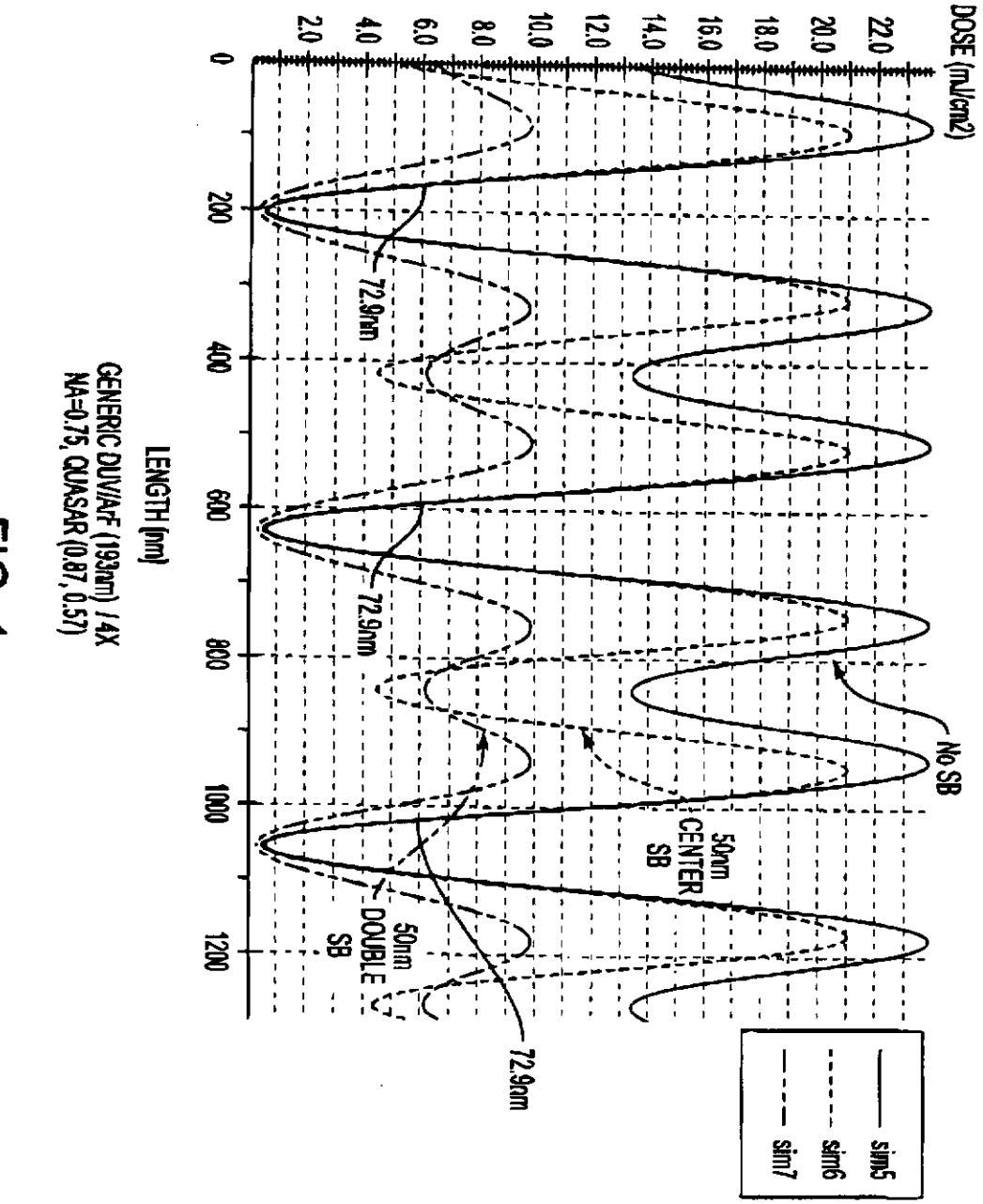

DOSE (mJ/cm2)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0
200
400
600
800
1000
1200
LENGTH (nm)
GENERIC DUV/ArF (193nm) / 4X
NA=0.75, QUASAR (0.87, 0.57)
sim5
sim6
sim7
No SB
50nm CENTER SB
50nm DOUBLE SB
72.9nm
72.9nm
72.9nm

FIG. 1

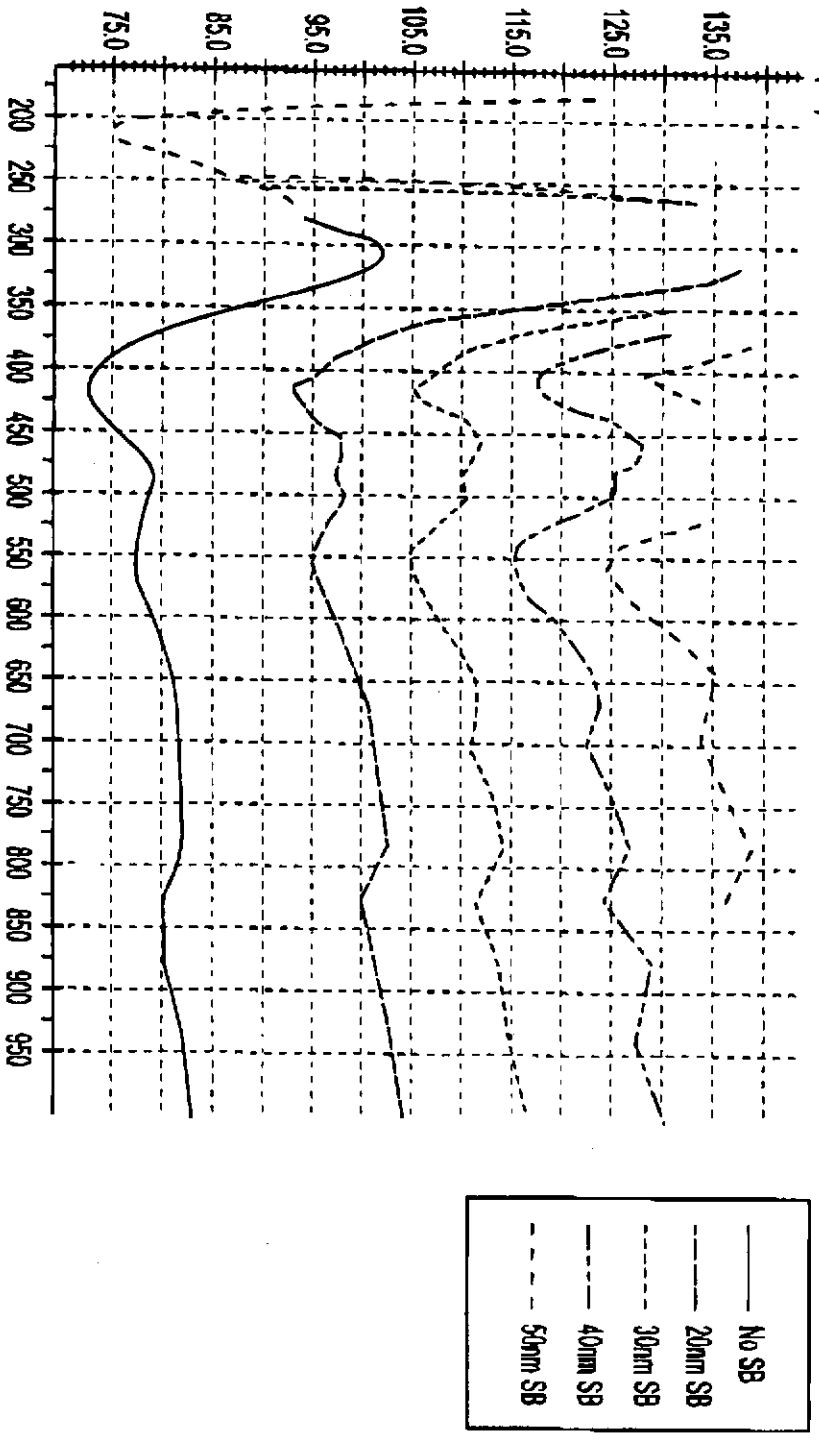
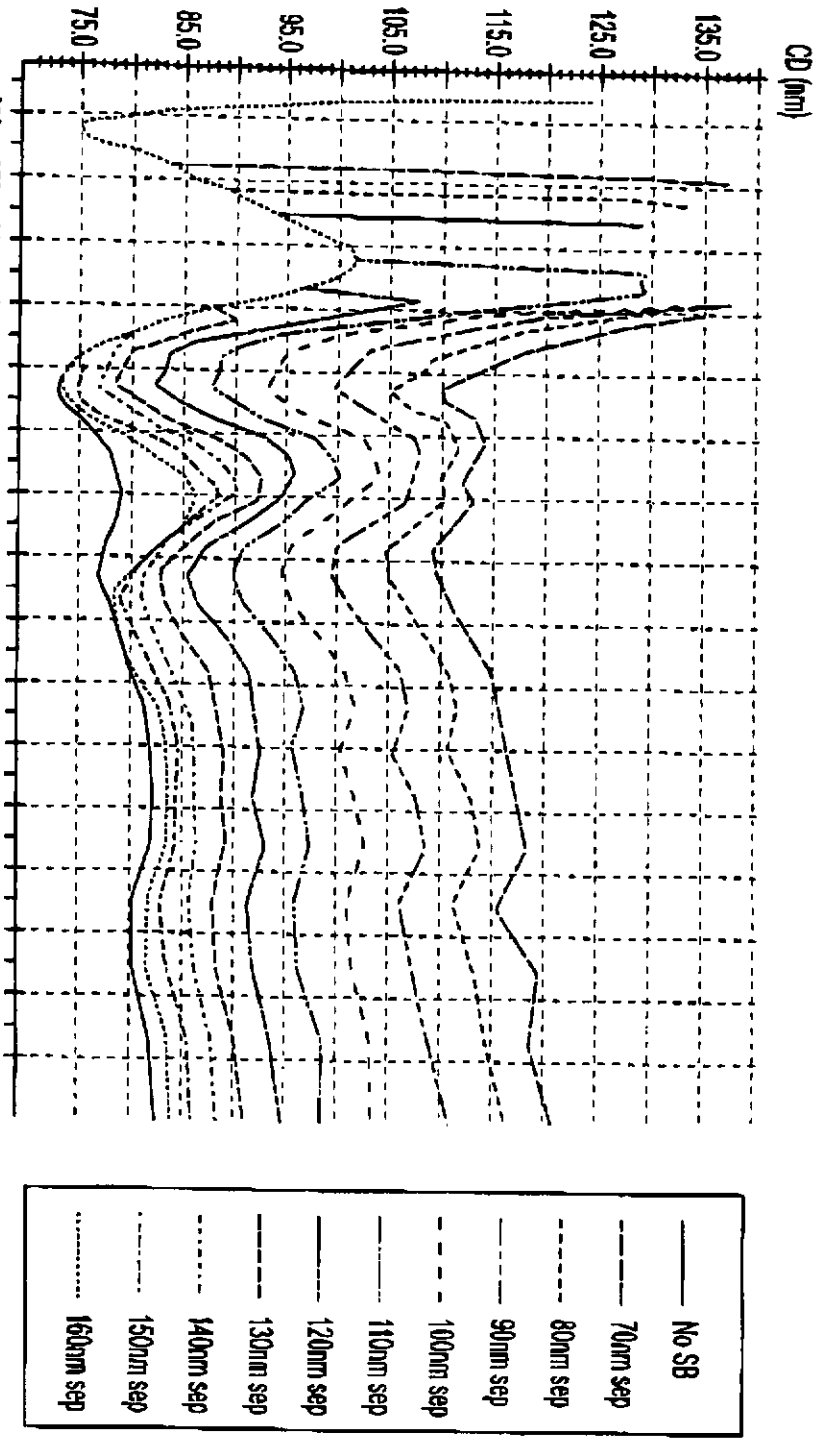

CD (nm)
135.0
125.0
115.0
105.0
95.0
85.0
75.0
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
PITCH (nm)
No SB
20nm SB
30nm SB
40nm SB
50nm SB
GENERIC DUV/AF (193nm) / 4X
NA=0.75, QUASAR (0.87, 0.57)

FIG. 2



GENERIC DUV/AF (193nm) / 4X
NA=0.75, QUASAR (0.87, 0.57)

FIG. 3

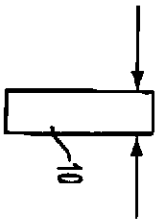


FIG. 4a

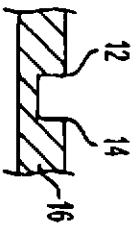


FIG. 4b

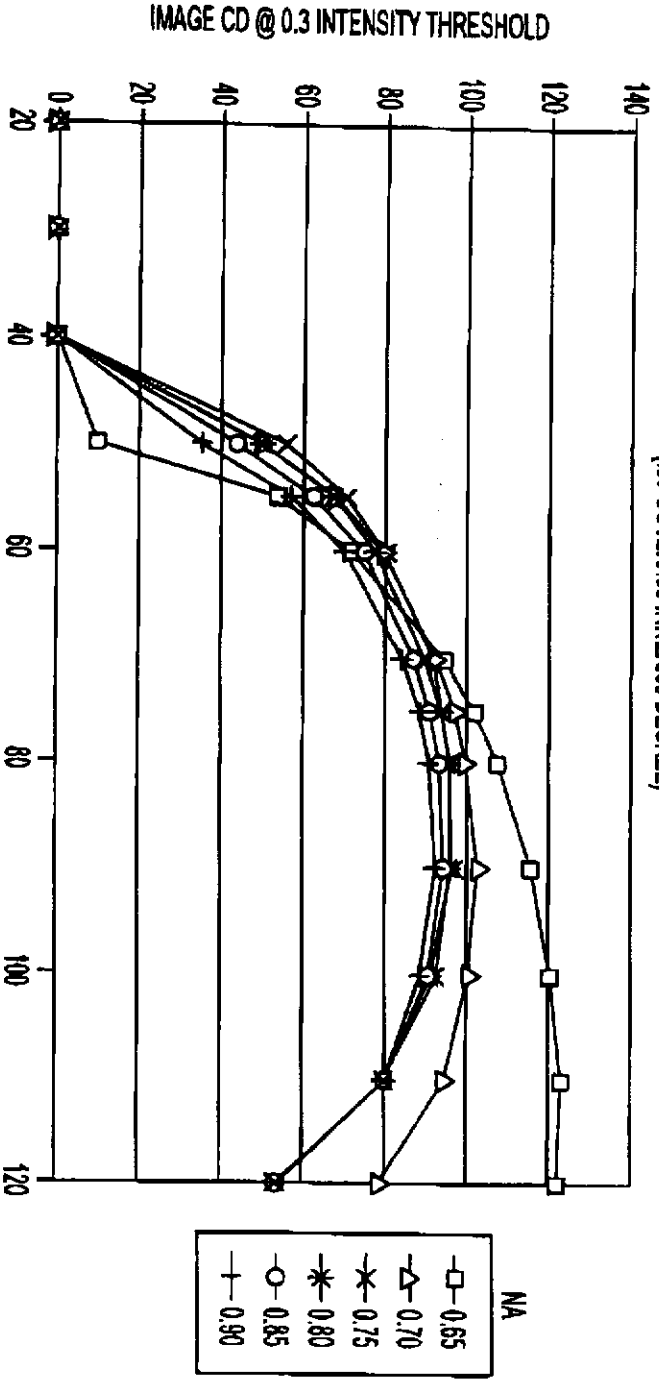


FIG. 4c

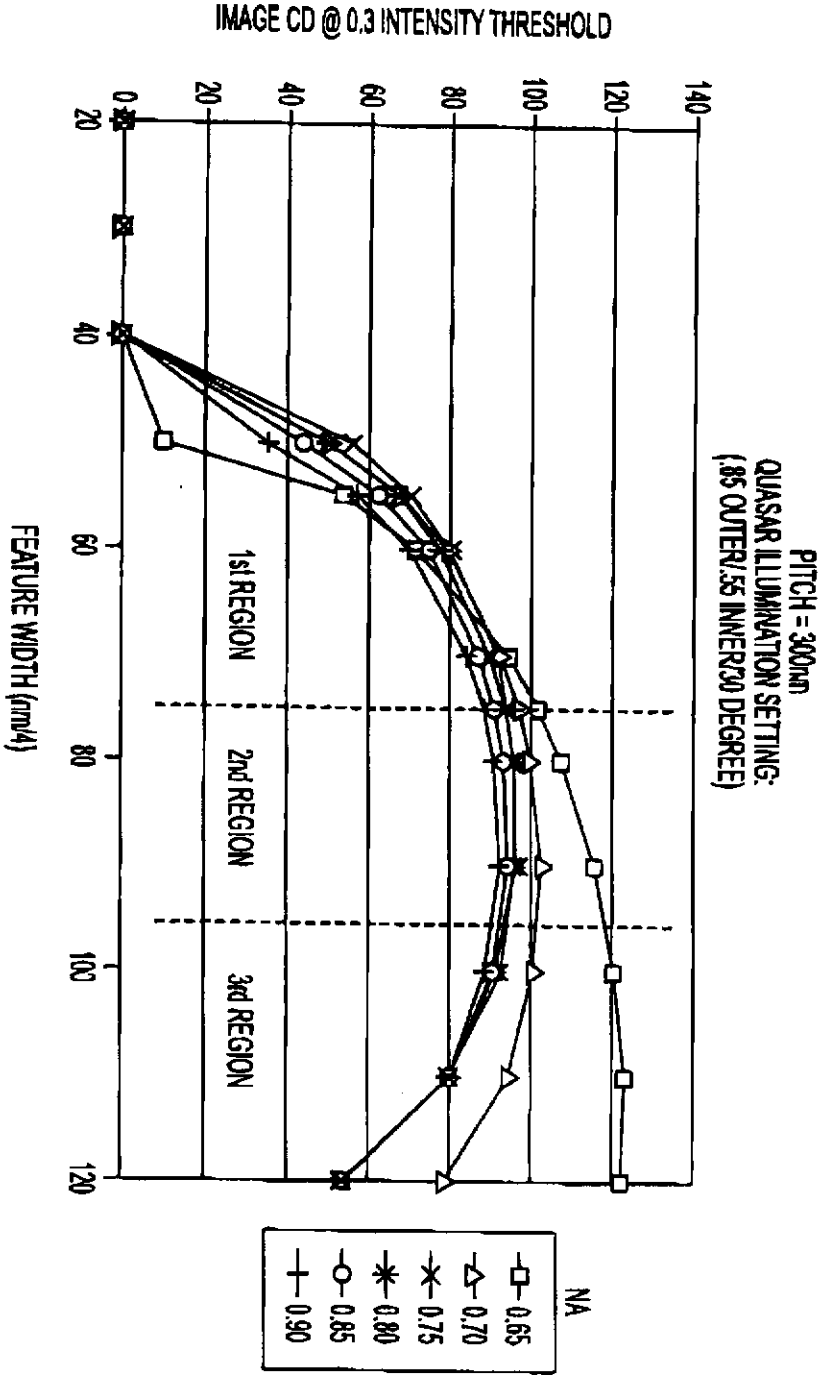

IMAGE CD @ 0.3 INTENSITY THRESHOLD
0
20
40
60
80
100
120
140
20
40
60
80
100
120
FEATURE WIDTH (nm/4)
1st REGION
2nd REGION
3rd REGION
PITCH = 300nm
QUASAR ILLUMINATION SETTING:
(.85 OUTER/.55 INNER/30 DEGREE)
NA
0.65
0.70
0.75
0.80
0.85
0.90

FIG. 5

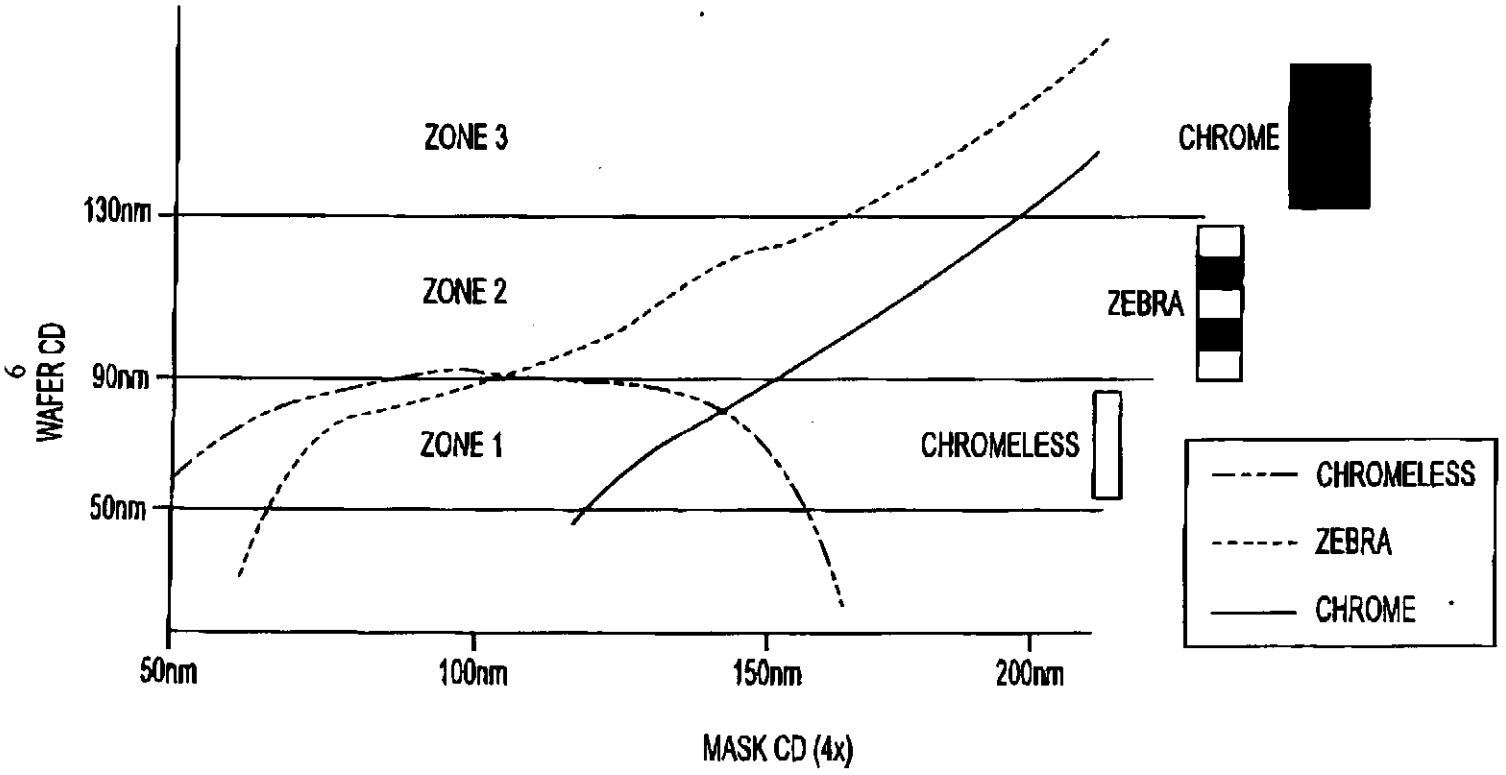

ZONE 3
ZONE 2
ZONE 1
130nm
90nm
50nm
WAFER CD
50nm
100nm
150nm
200nm
MASK CD (4x)
CHROME
ZEBRA
CHROMELESS
CHROMELESS
ZEBRA
CHROME

FIG. 6

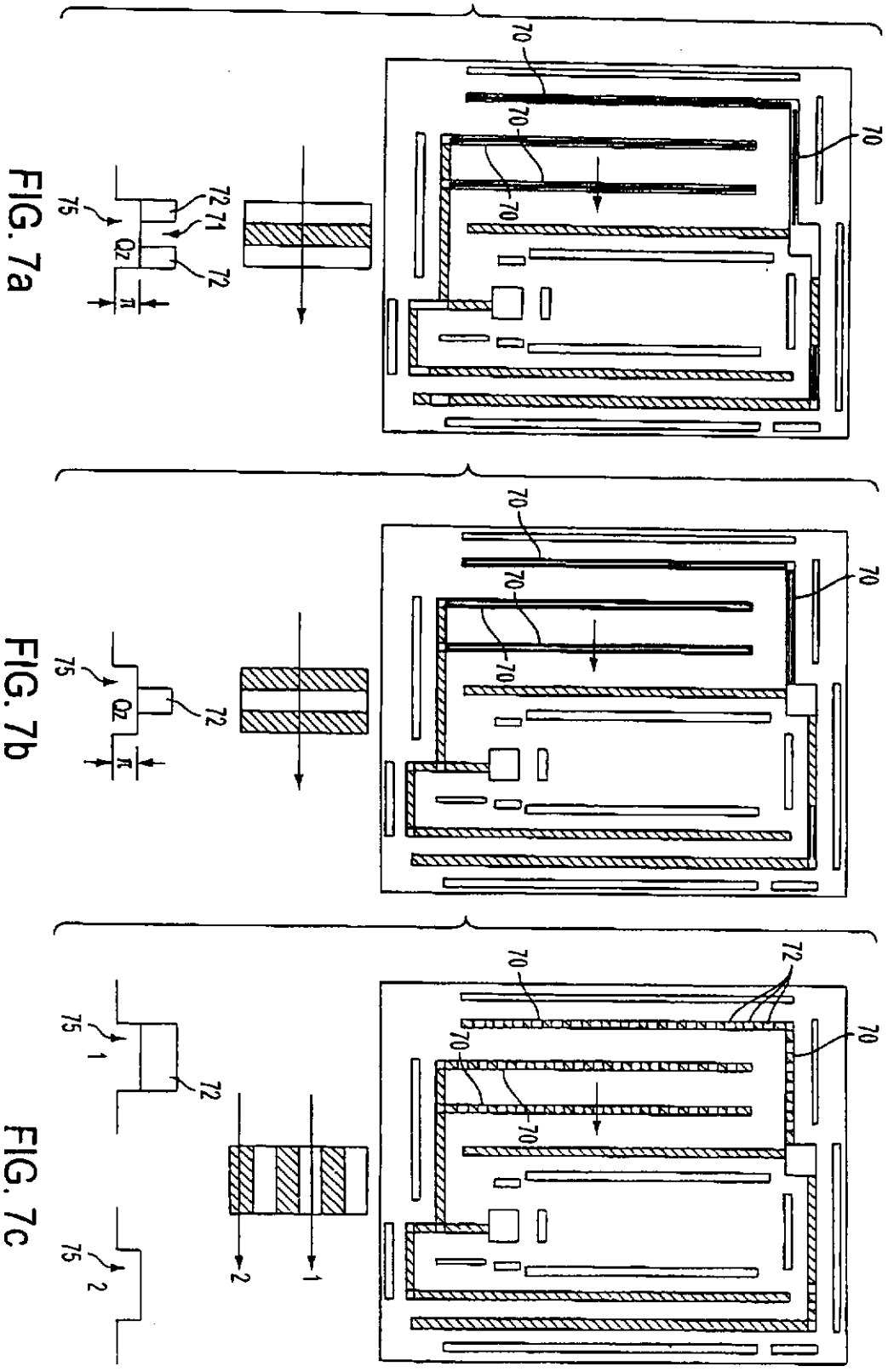


FIG. 7a

FIG. 7b

FIG. 7c

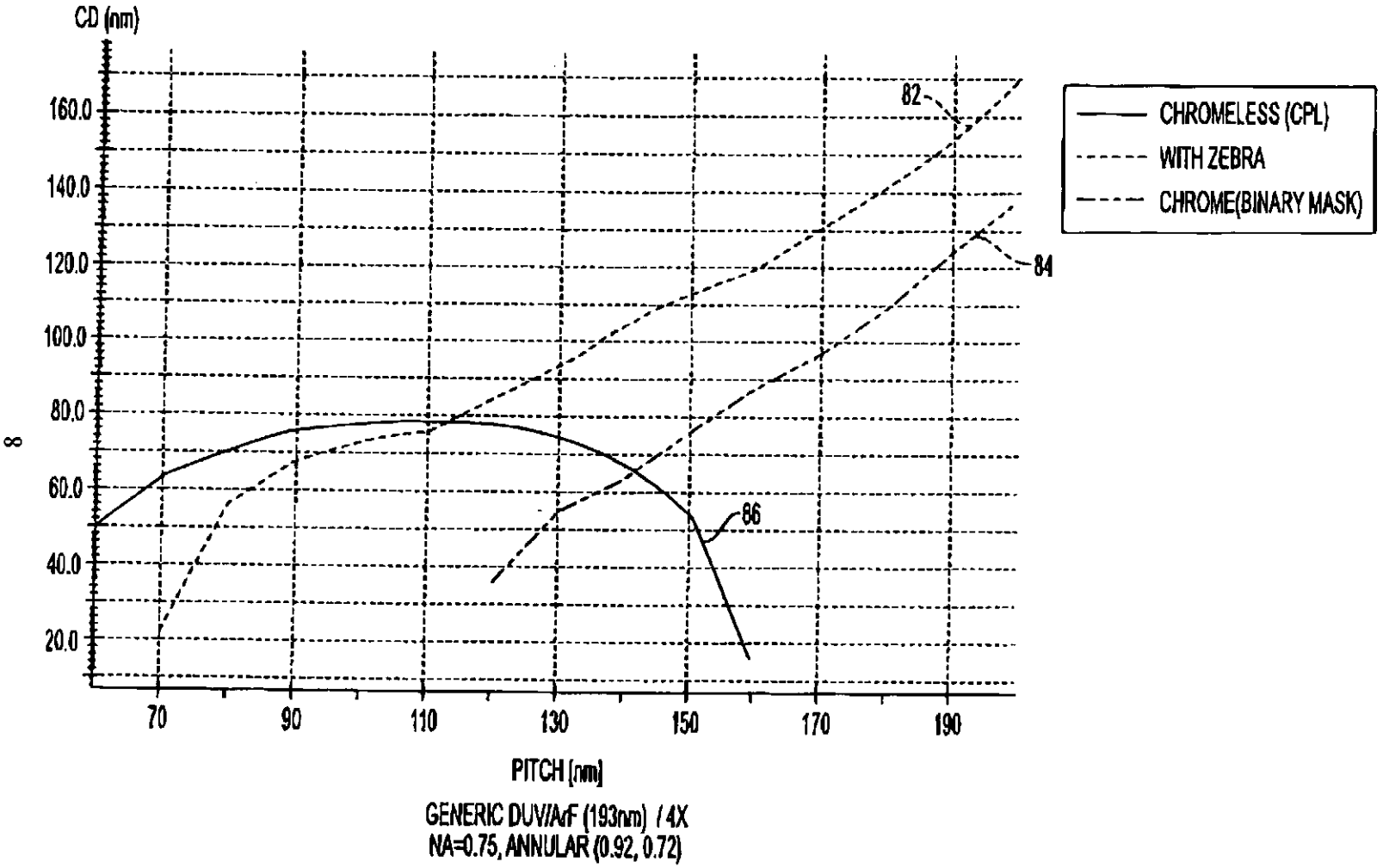

CD (nm)
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
70
90
110
130
150
170
190
PITCH [nm]
82
84
86
CHROMELESS (CPL)
WITH ZEBRA
CHROME(BINARY MASK)
GENERIC DUV/ArF (193nm) / 4X
NA=0.75, ANNULAR (0.92, 0.72)

FIG. 8

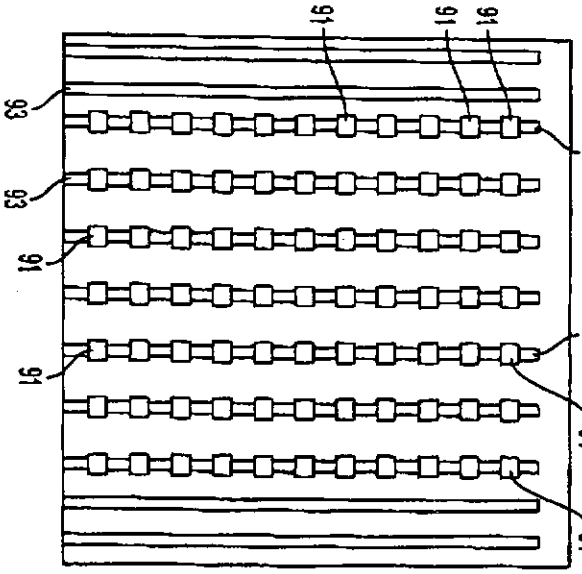


FIG. 9a

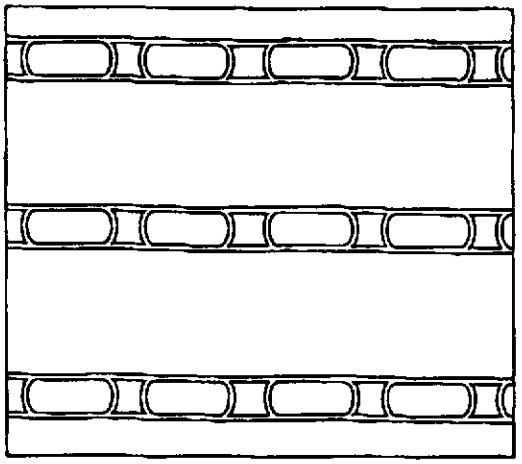


FIG. 9b

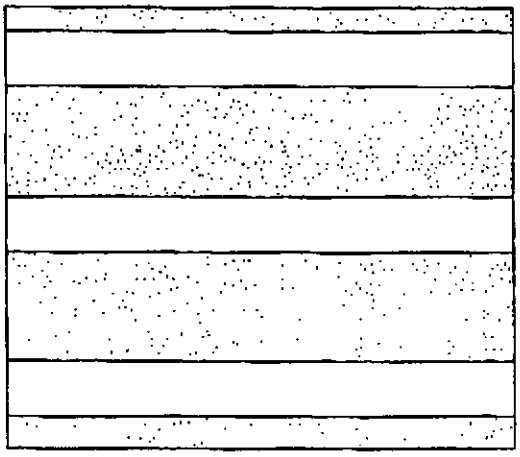


FIG. 9c

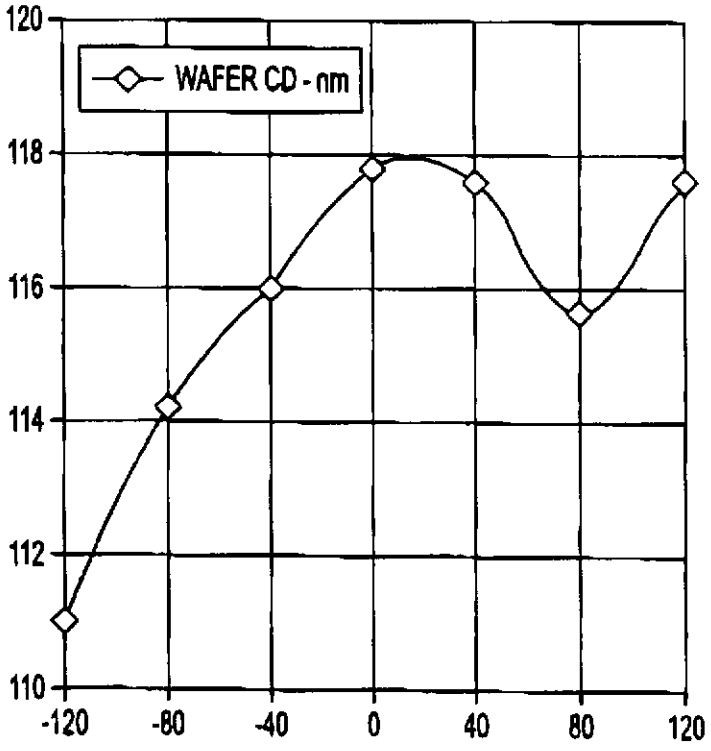


FIG. 10

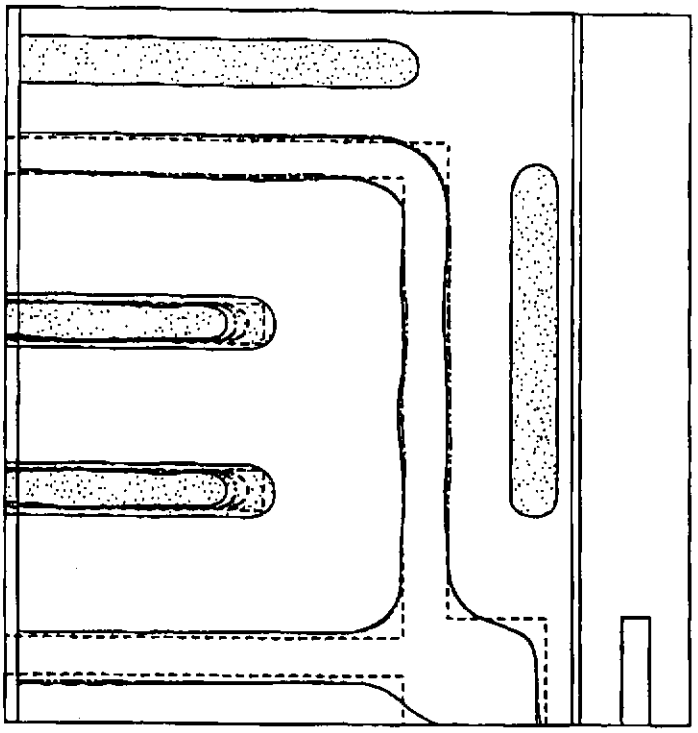


FIG. 11a

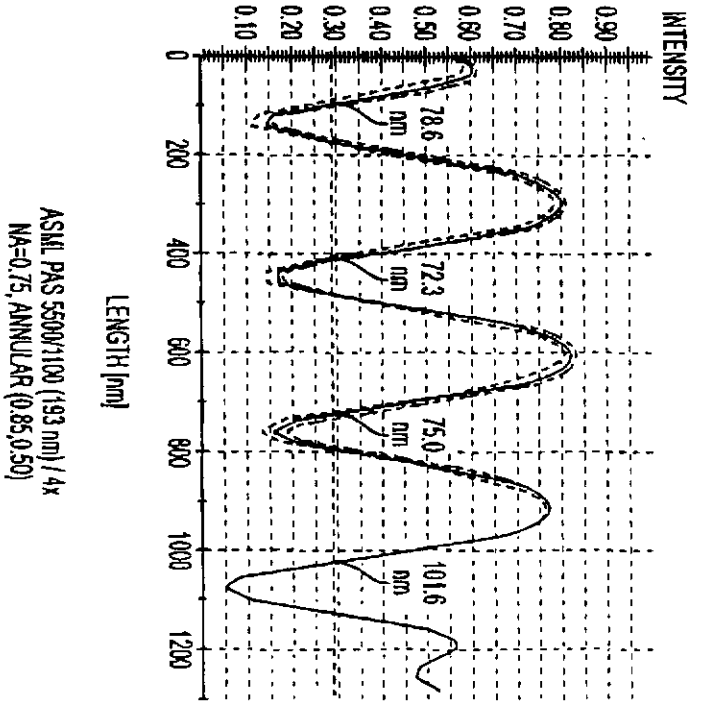


FIG. 11b

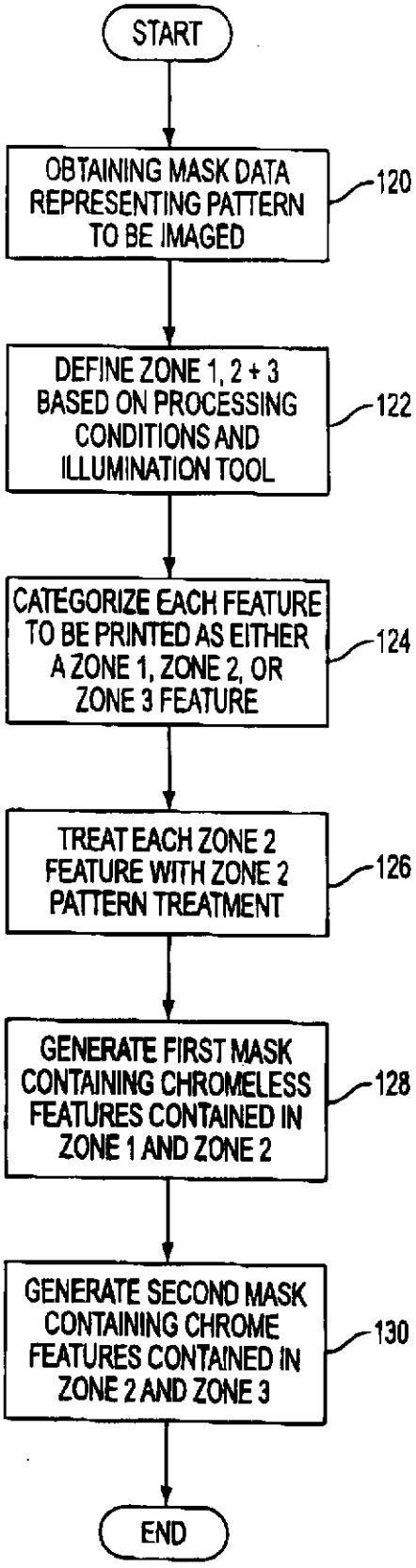

START
OBTAINING MASK DATA REPRESENTING PATTERN TO BE IMAGED
120
DEFINE ZONE 1, 2 + 3 BASED ON PROCESSING CONDITIONS AND ILLUMINATION TOOL
122
CATEGORIZE EACH FEATURE TO BE PRINTED AS EITHER A ZONE 1, ZONE 2, OR ZONE 3 FEATURE
124
TREAT EACH ZONE 2 FEATURE WITH ZONE 2 PATTERN TREATMENT
126
GENERATE FIRST MASK CONTAINING CHROMELESS FEATURES CONTAINED IN ZONE 1 AND ZONE 2
128
GENERATE SECOND MASK CONTAINING CHROME FEATURES CONTAINED IN ZONE 2 AND ZONE 3
130
END

FIG. 12

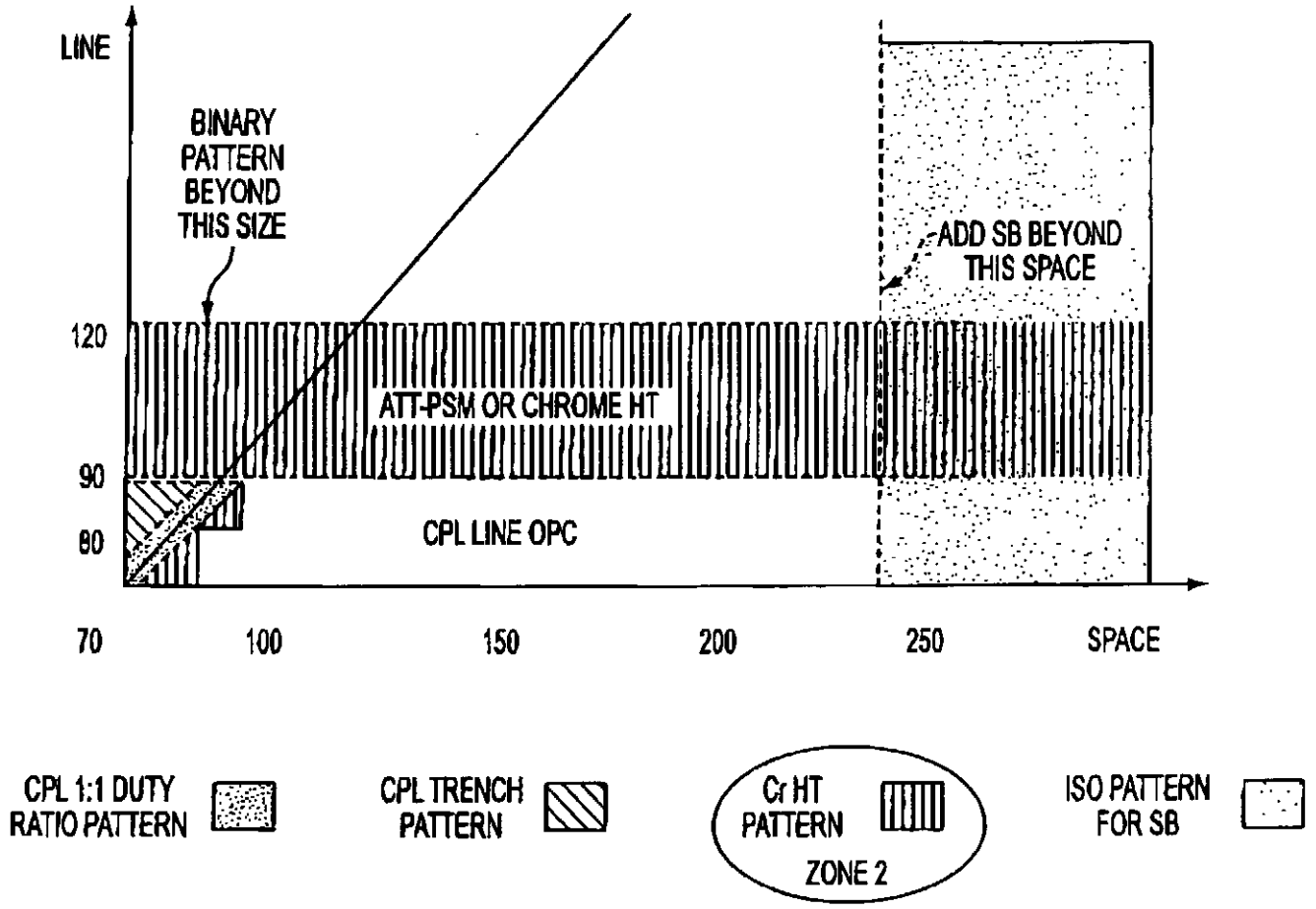

LINE
BINARY PATTERN BEYOND THIS SIZE
ADD SB BEYOND THIS SPACE
120
ATT-PSM OR CHROME HT
90
80
CPL LINE OPC
70
100
150
200
250
SPACE
CPL 1:1 DUTY RATIO PATTERN
CPL TRENCH PATTERN
Cr HT PATTERN
ZONE 2
ISO PATTERN FOR SB

FIG. 13

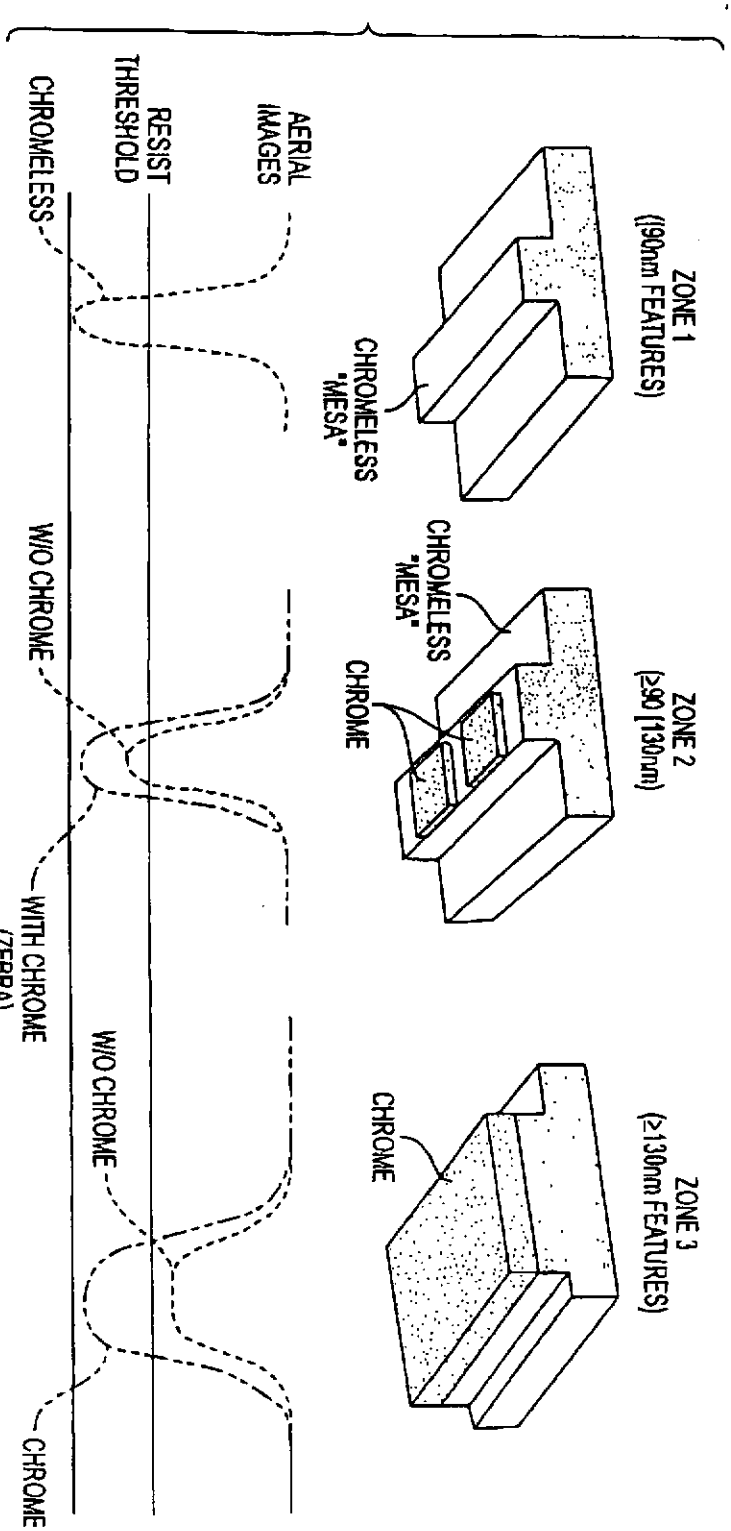

ZONE 1
(≤90nm FEATURES)
CHROMELESS
"MESA"
ZONE 2
(≥90 [130nm)
CHROMELESS
"MESA"
CHROME
ZONE 3
(≥130nm FEATURES)
CHROME
AERIAL
IMAGES
RESIST
THRESHOLD
CHROMELESS
W/O CHROME
WITH CHROME
(ZEBRA)
W/O CHROME
CHROME

FIG. 14

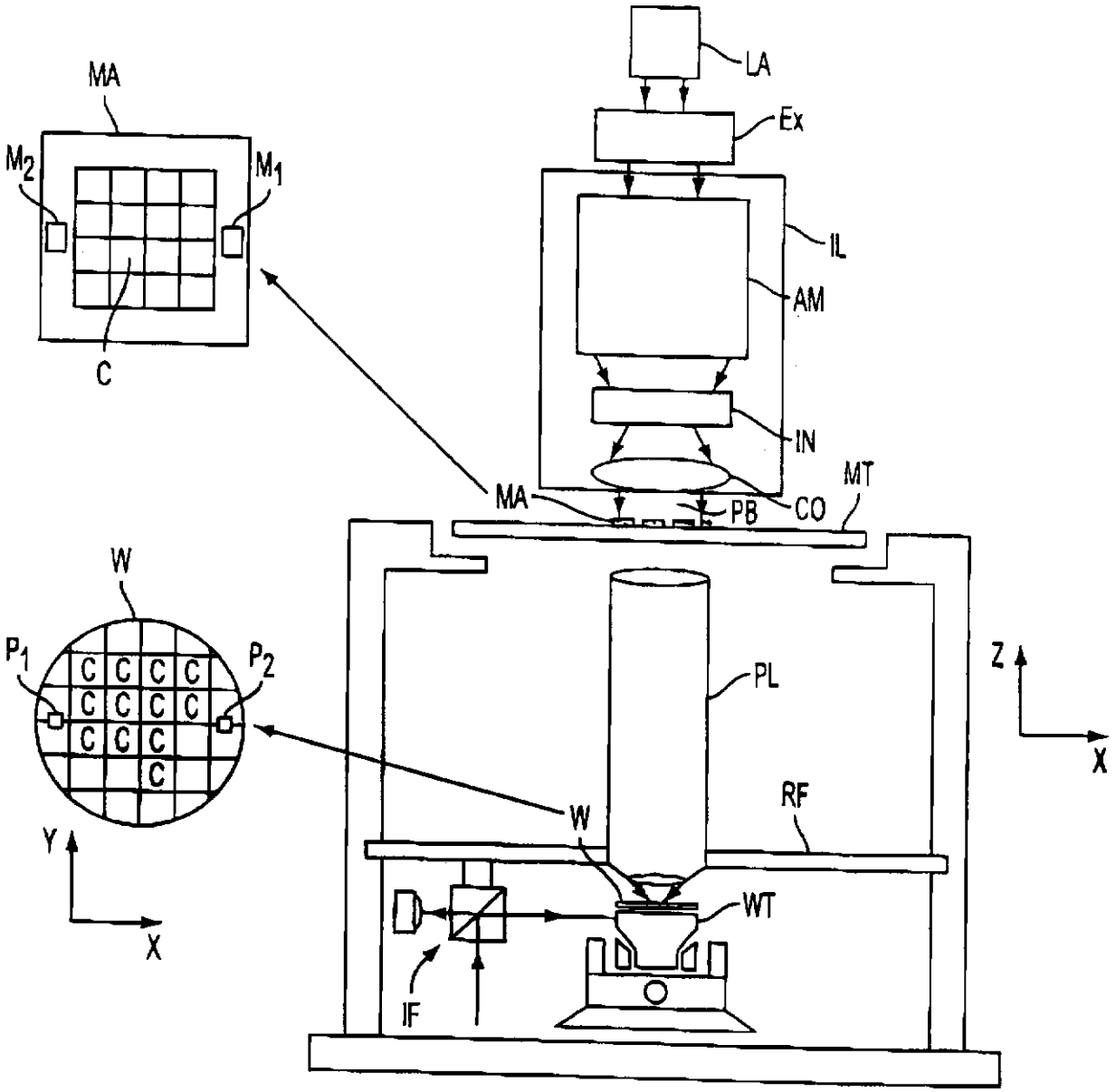


FIG. 15