FIG. 1A

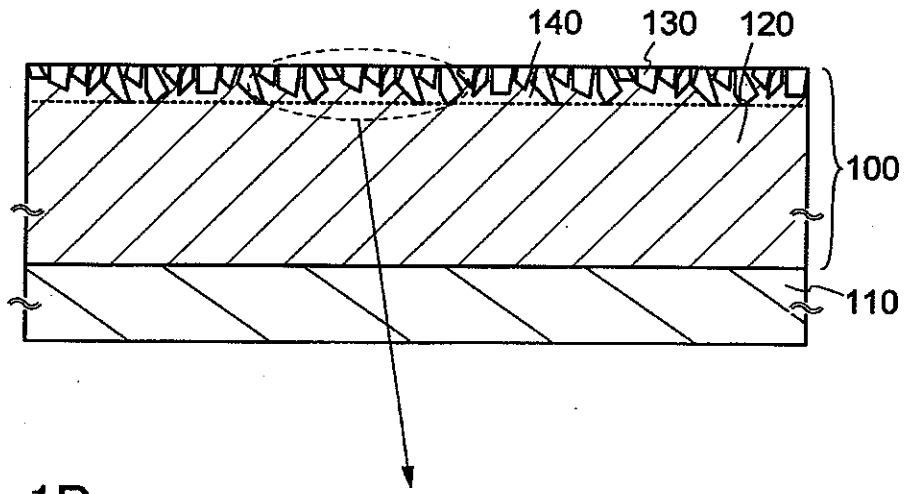


FIG. 1B

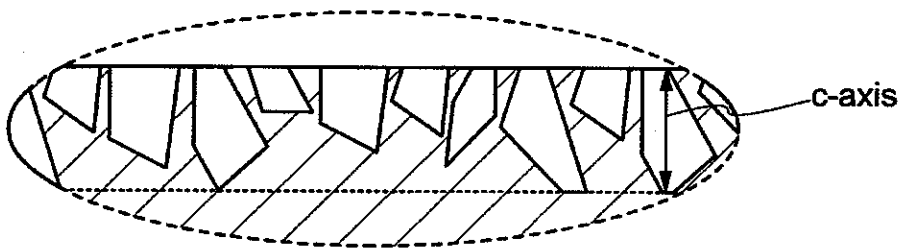
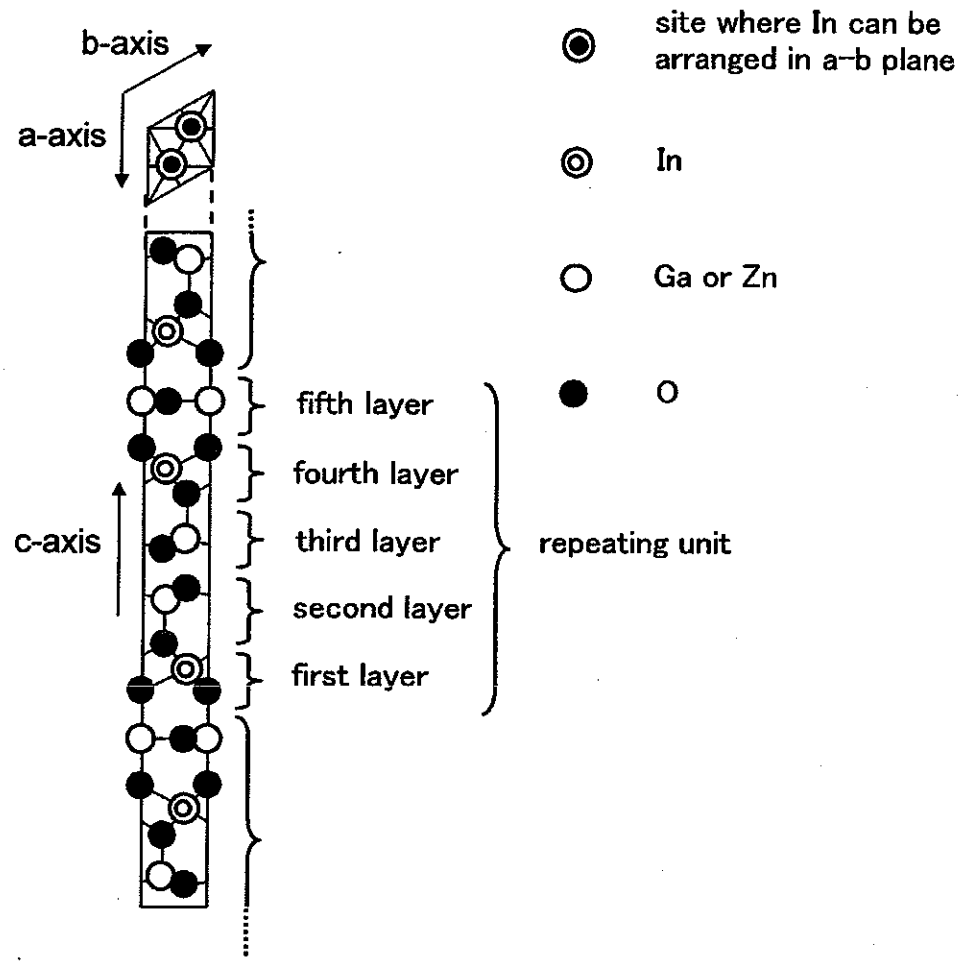


FIG. 2



Crystal structure of $In_2Ga_2ZnO_7$

FIG. 3A

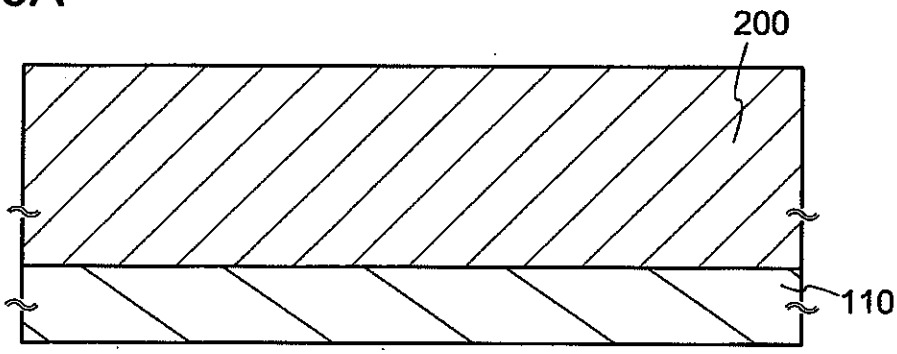


FIG. 3B

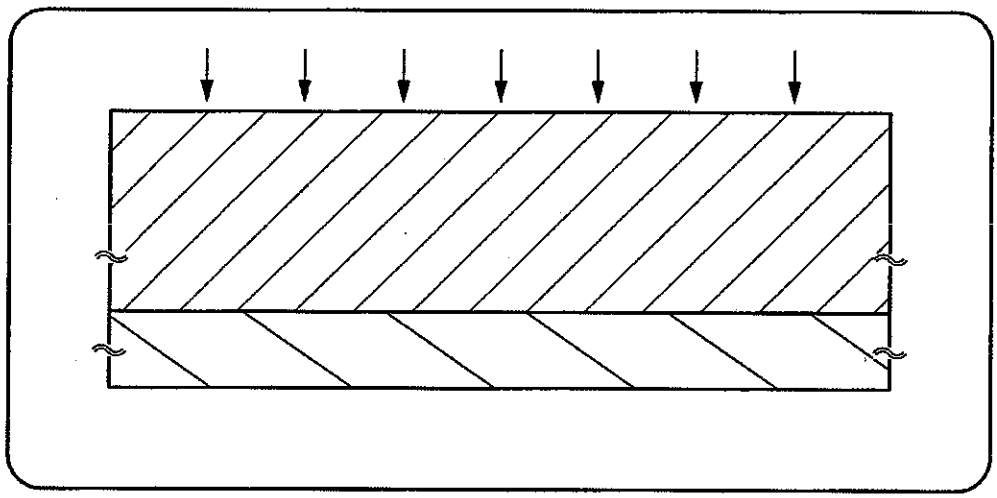


FIG. 3C

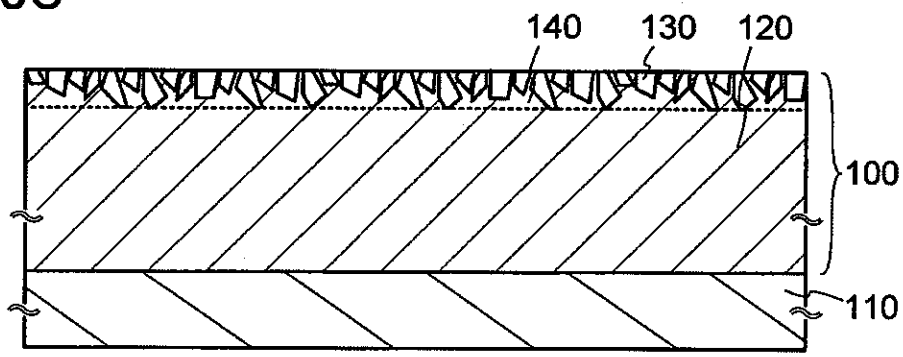


FIG. 4A

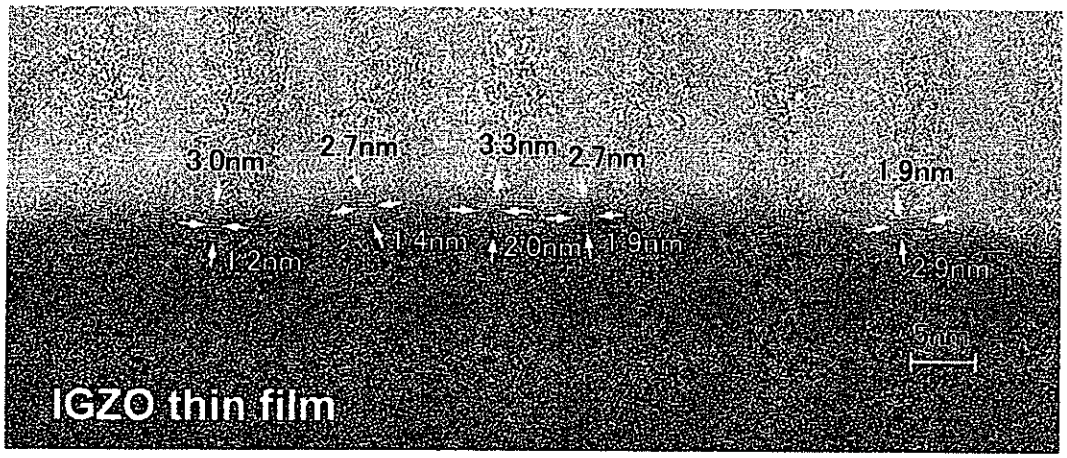

3.0nm
2.7nm
3.3nm
2.7nm
1.9nm
1.2nm
1.4nm
2.0nm
1.9nm
2.9nm
5nm
IGZO thin film

FIG. 4B

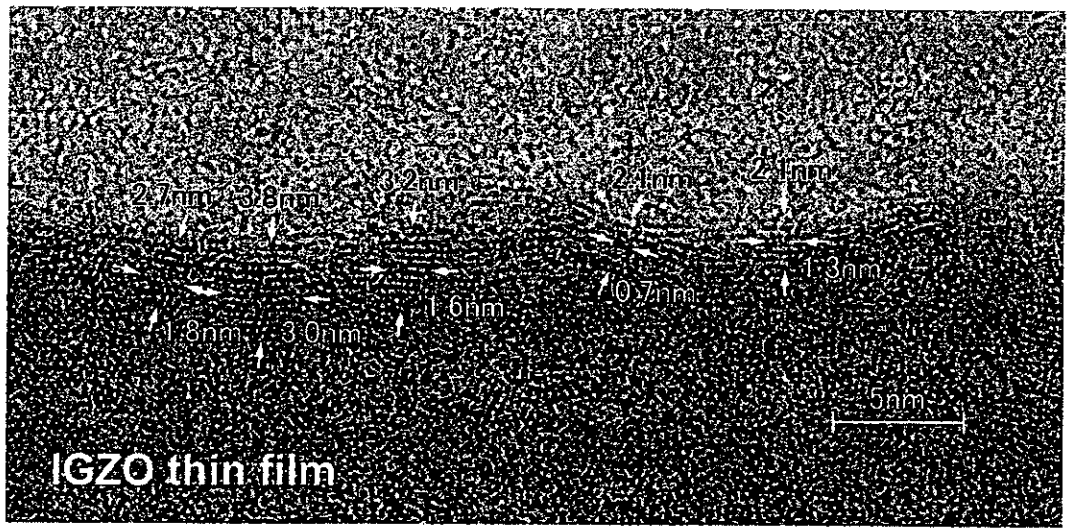

2.7nm
3.8nm
3.2nm
2.1nm
2.1nm
1.3nm
0.7nm
1.6nm
1.8nm
3.0nm
5nm
IGZO thin film

FIG. 5A-1

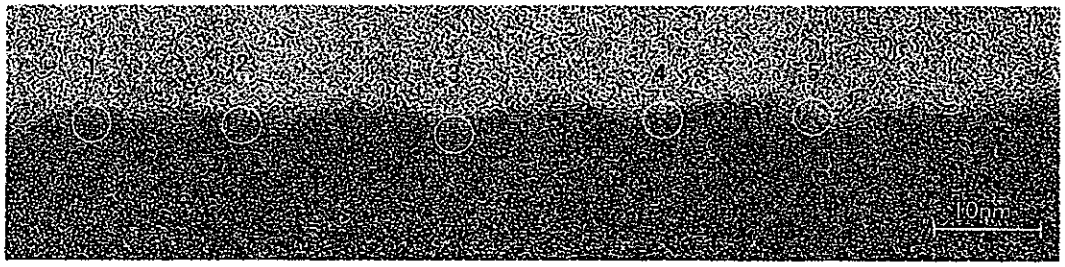


FIG. 5A-2

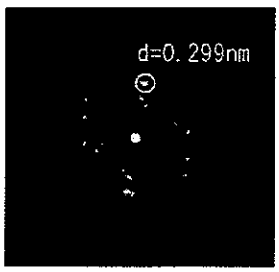


FIG. 5A-4

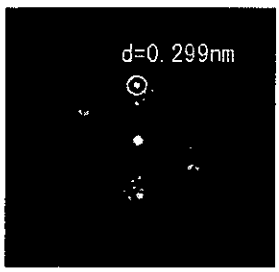


FIG. 5A-6

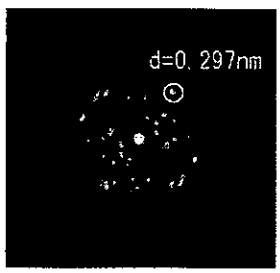


FIG. 5A-3

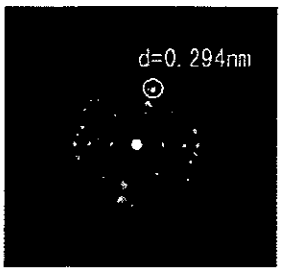


FIG. 5A-5

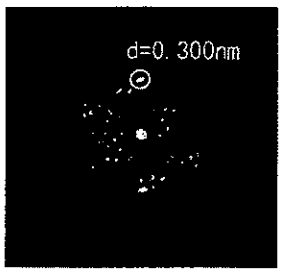


FIG. 5B

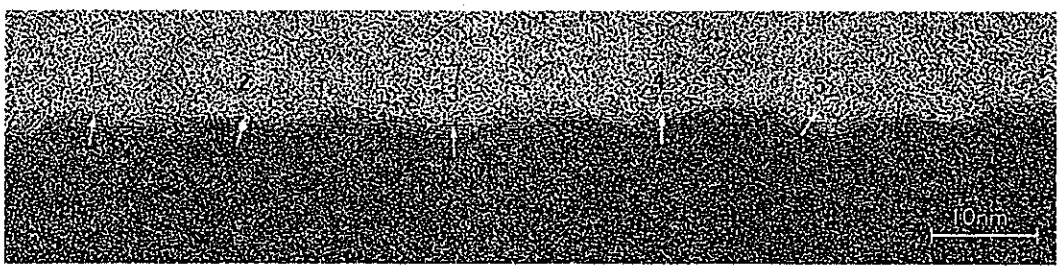
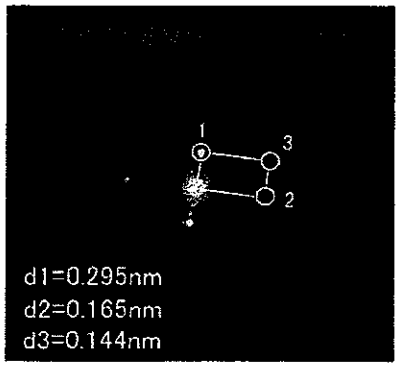


FIG. 6A-1

Vicinity of surface of IGZO film *1



$In_2Ga_2ZnO_7$

1 : 0 0 10 d=0.295nm
2 : 1 1 0 d=0.164nm
3 : 1 1 10 d=0.144nm

Direction of sample surface ↑

FIG. 6A-2

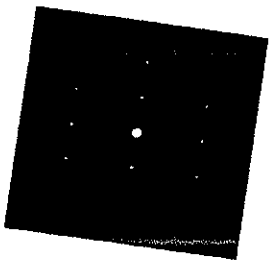


FIG. 6A-3

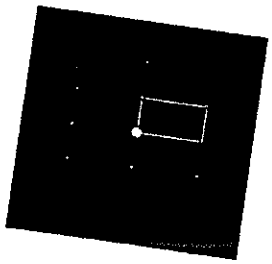
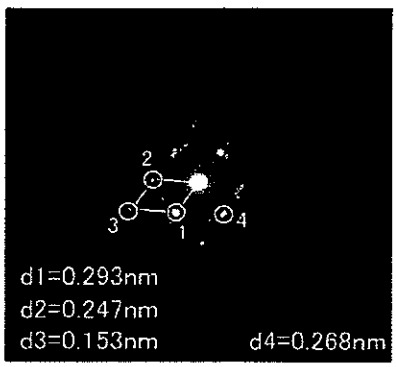


FIG. 6B-1

Vicinity of surface of IGZO film *5



$In_2Ga_2ZnO_7$

1 : 0 0 $\bar{1}$0 d=0.295nm
2 : 1 0 $\bar{6}$ d=0.247nm
3 : 1 0 16 d=0.155nm
4 : 1 0 4 d=0.267nm

Direction of sample surface ↑

FIG. 6B-2

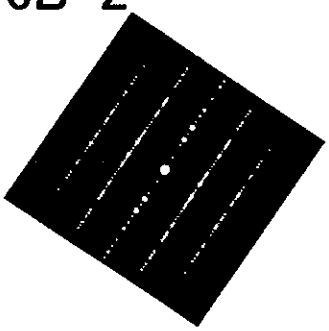


FIG. 6B-3

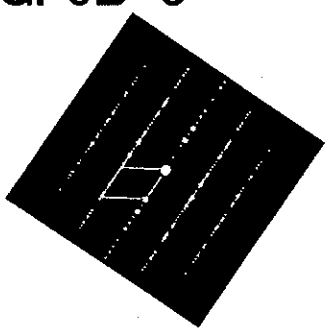


FIG. 7A

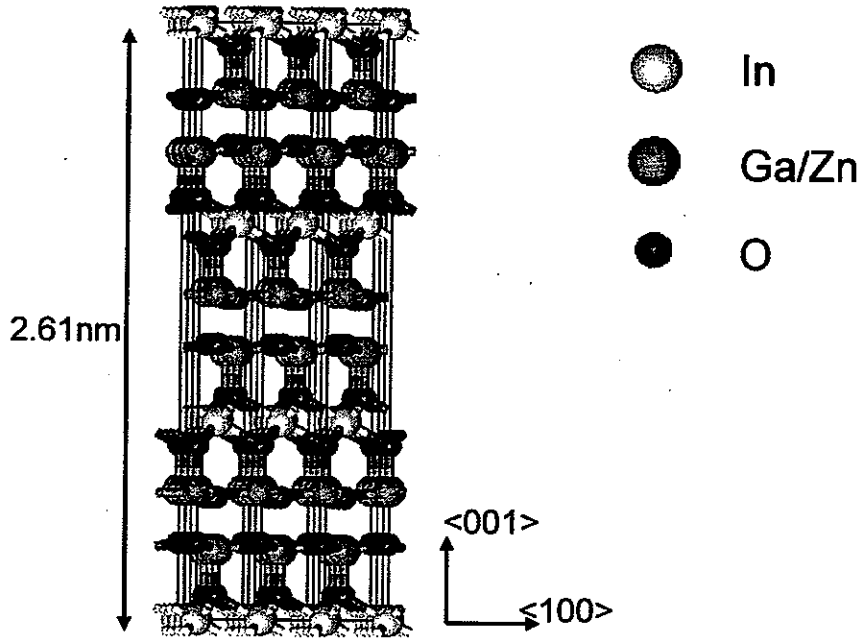


FIG. 7B

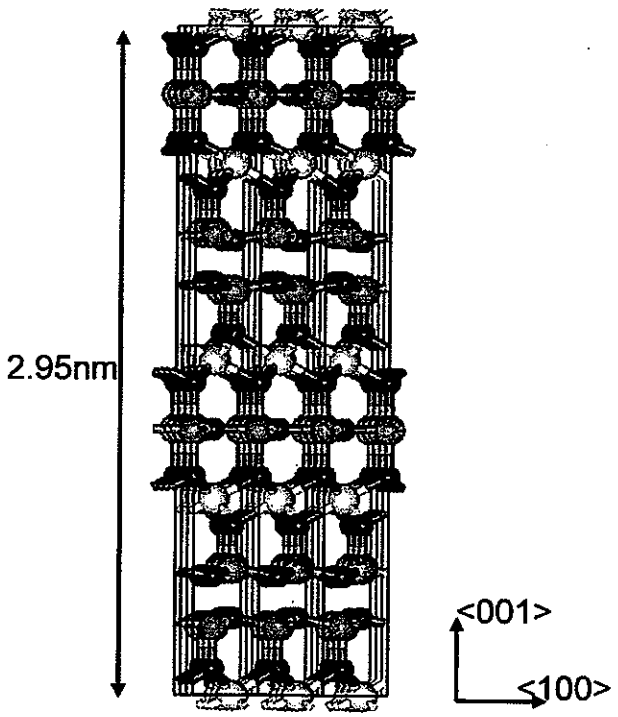


FIG. 8A-1

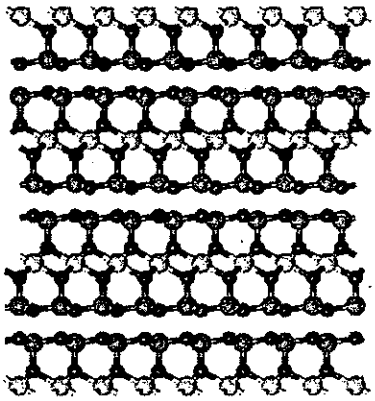


FIG. 8A-2

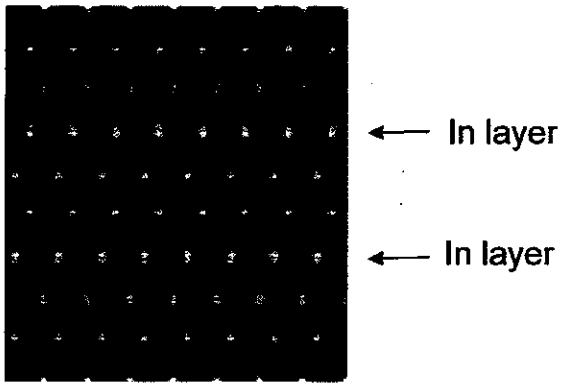


FIG. 8B-1

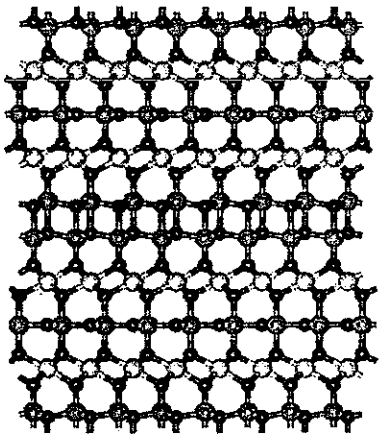
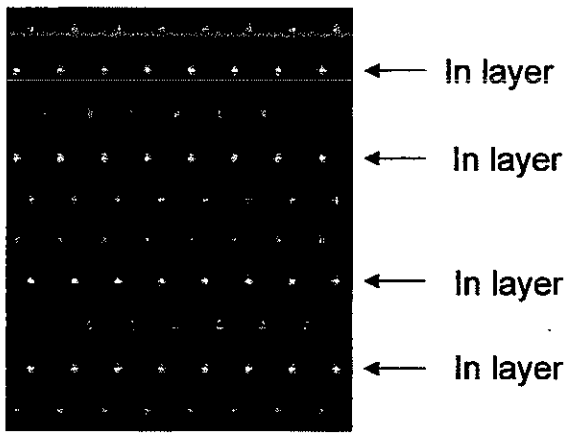


FIG. 8B-2



In Ga/Zn O

FIG. 9

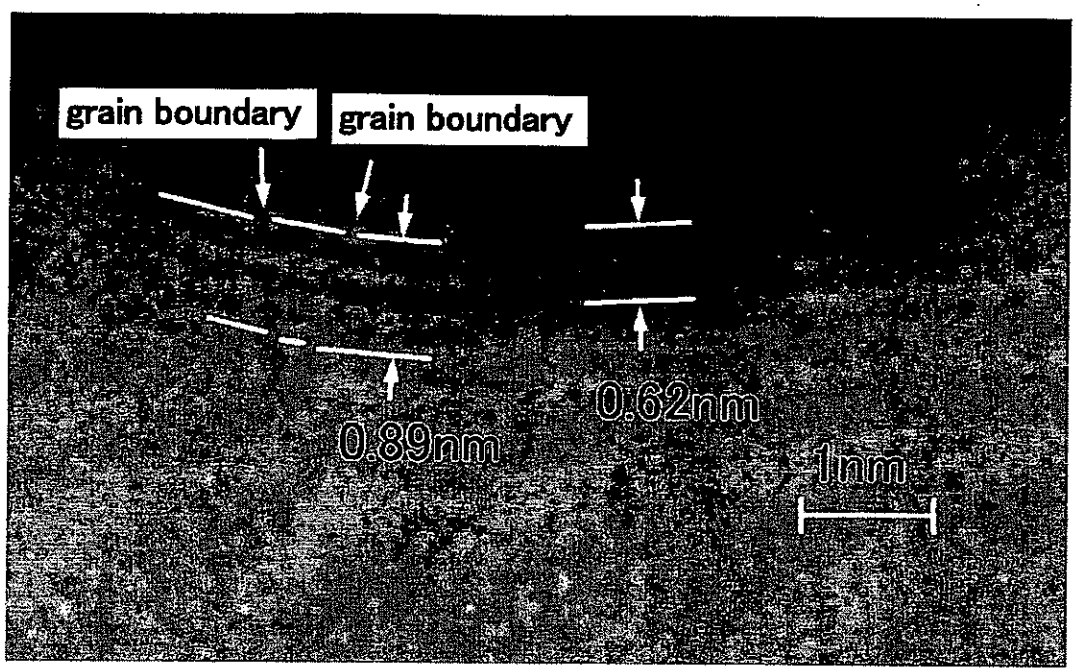


FIG. 10

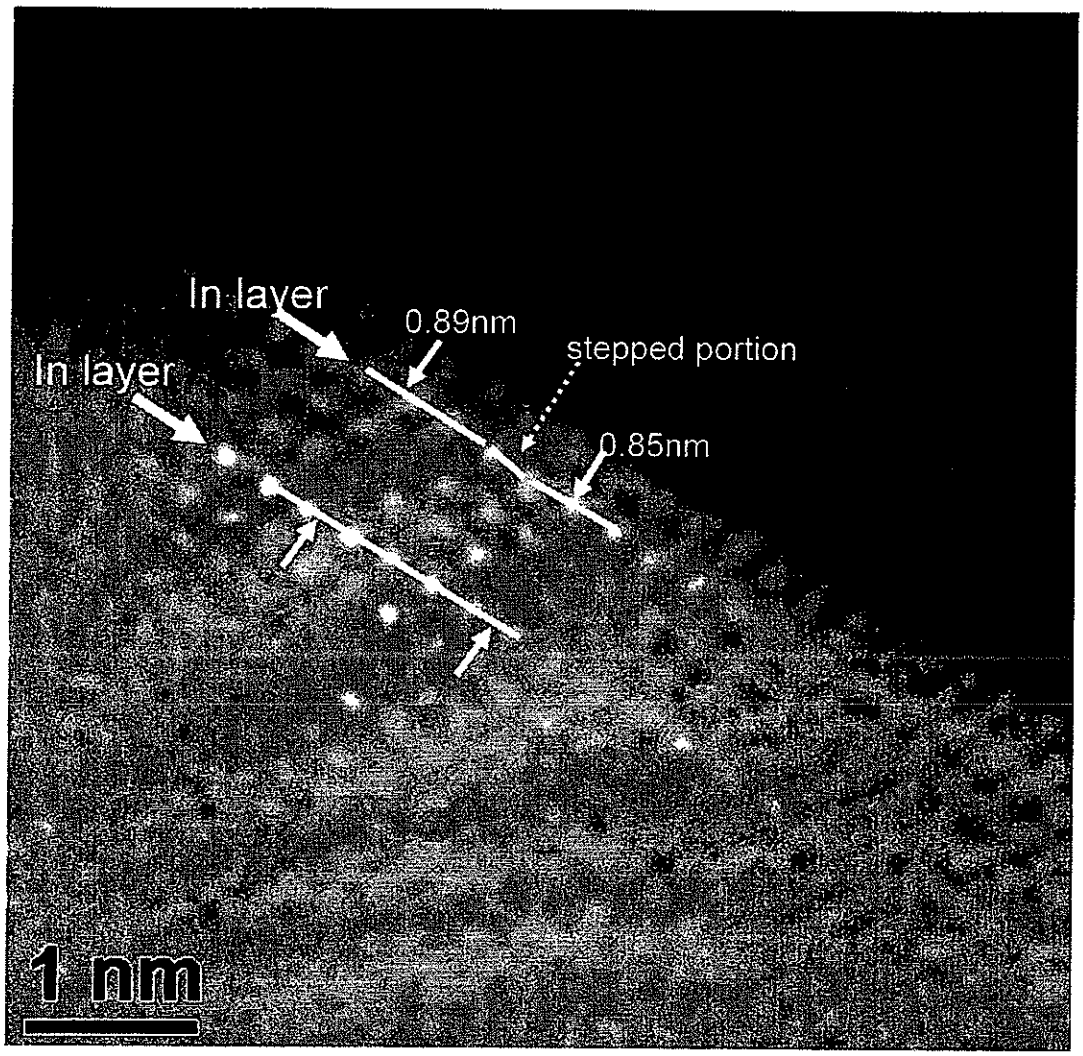


FIG. 11A

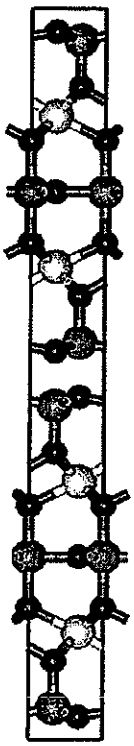


FIG. 11B

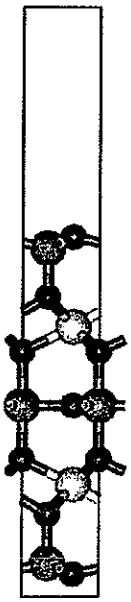


FIG. 11C

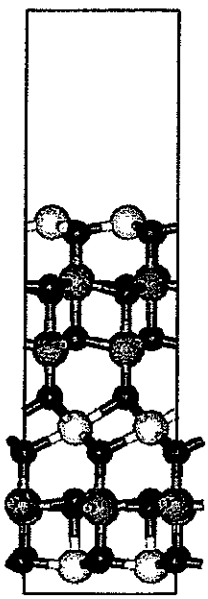


FIG. 11D

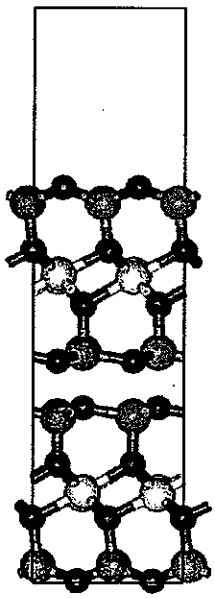


FIG. 12

Functional	GGA-PBE
Pseudopotential	Ultrasoft type
Cutoff energy	300 eV
k point	Crystal structure 8×8×2 (001):O 8×8×1 (001):In 4×4×1 (001):Ga 4×4×1

FIG. 13

Material	Plane struture	Surface energy (J/m^2)
$In_2Ga_2ZnO_7$	(001):(Ga,Zn)O	0.765
	(001):In	2.29
	(001):Ga,Zn	1.09
	(100)	2.16
In_2O_3	(001) In outermost surface	1.77
	(001) O outermost surface	3.43
Ga_2O_3	(001) Ga outermost surface	1.69
	(001) O outermost surface	3.69
ZnO	(001)	2.99
	(100)	4.53
	(110)	1.62

FIG. 14A

FIG. 14B

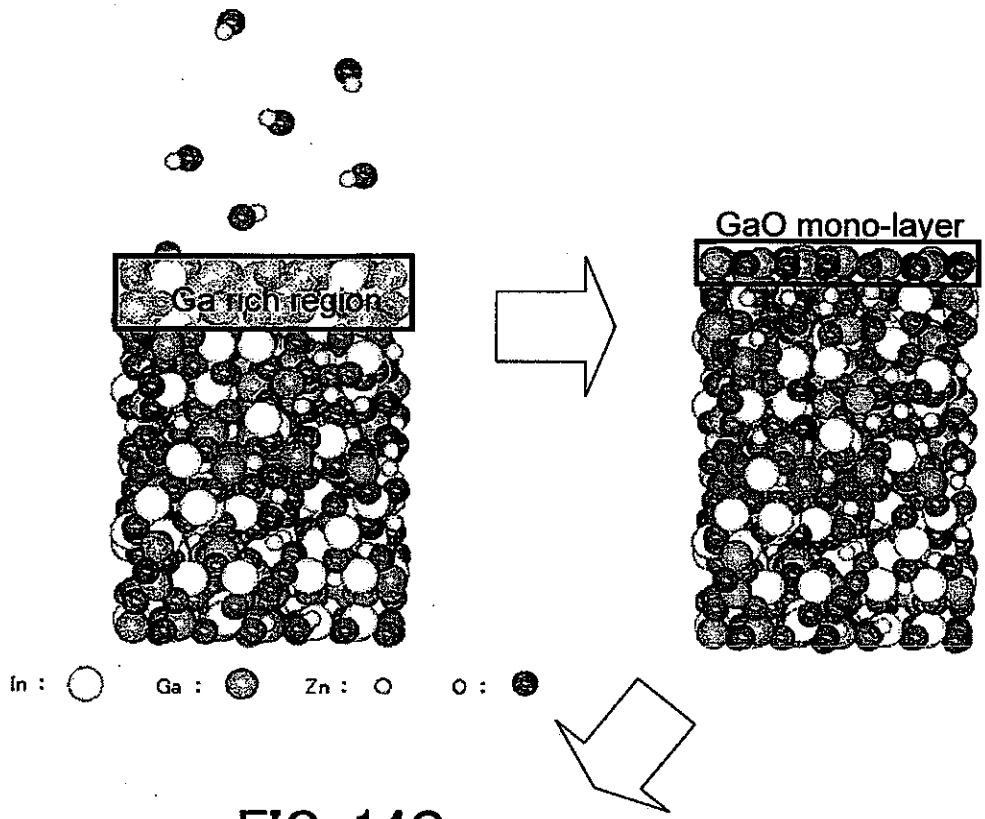


FIG. 14C

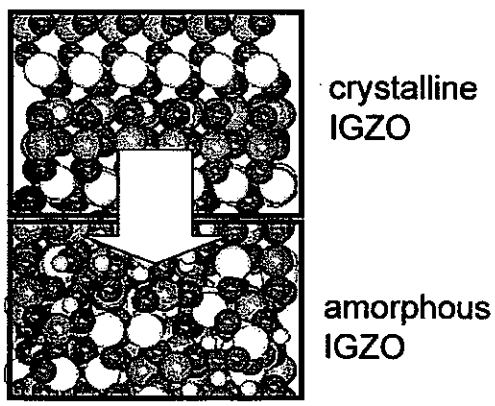


FIG. 15A

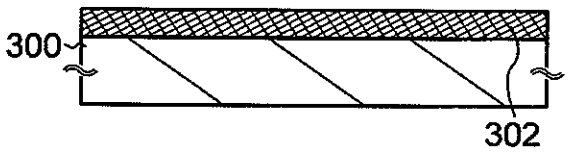


FIG. 15B

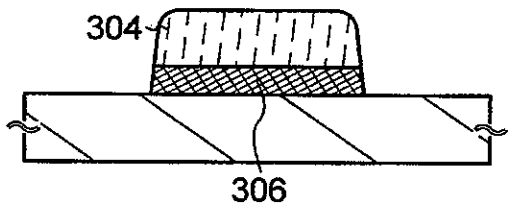


FIG. 15C

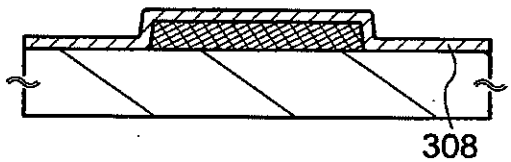


FIG. 15D

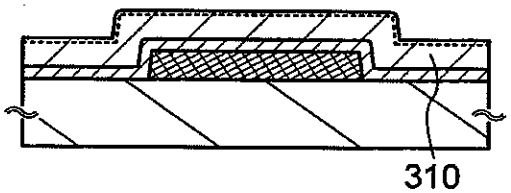


FIG. 16A

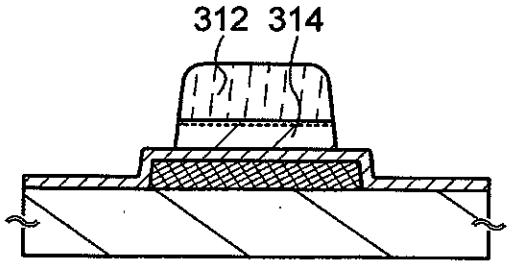


FIG. 16B

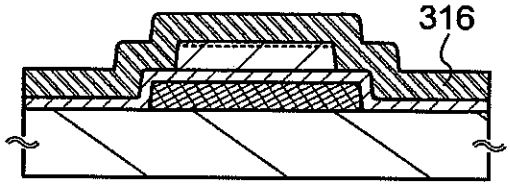


FIG. 16C

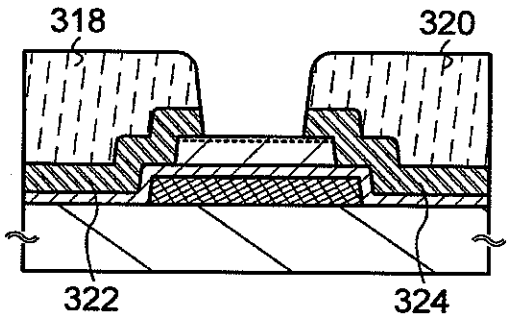


FIG. 16D

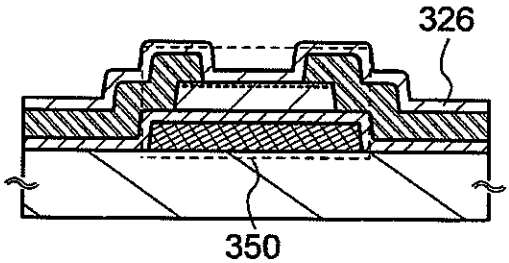


FIG. 17A

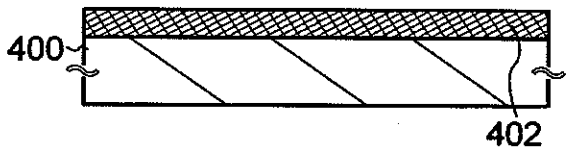


FIG. 17B

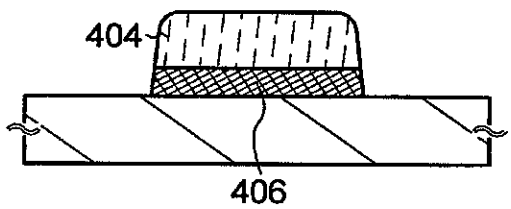


FIG. 17C

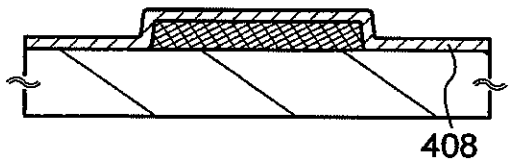


FIG. 17D

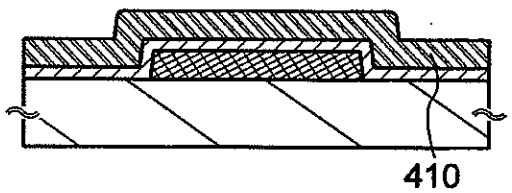


FIG. 18A

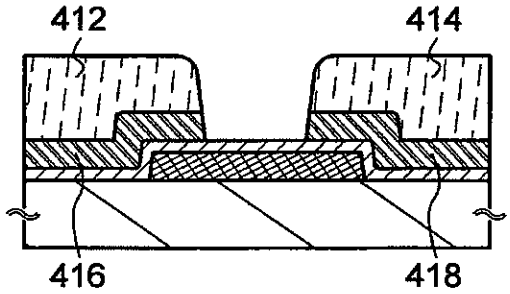


FIG. 18B

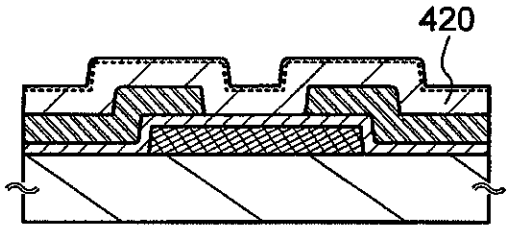


FIG. 18C

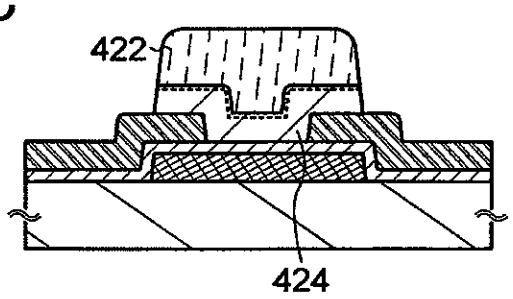


FIG. 18D

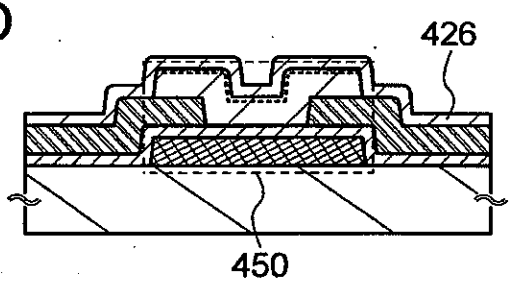


FIG. 19A

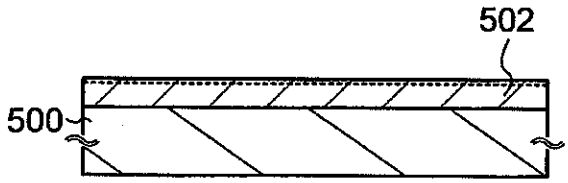


FIG. 19B

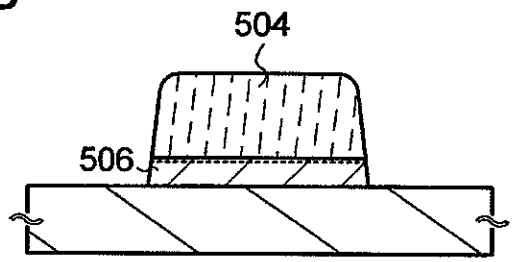


FIG. 19C

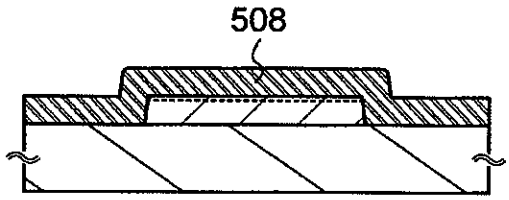


FIG. 19D

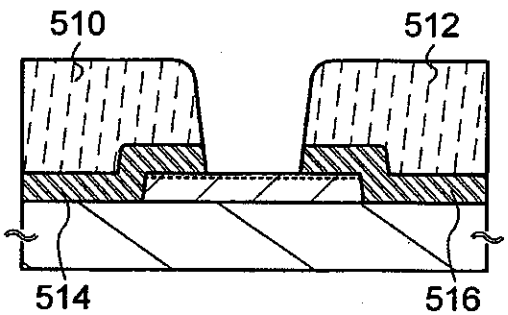


FIG. 20A

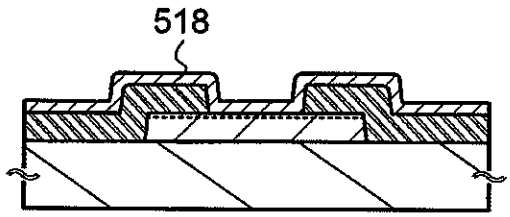


FIG. 20B

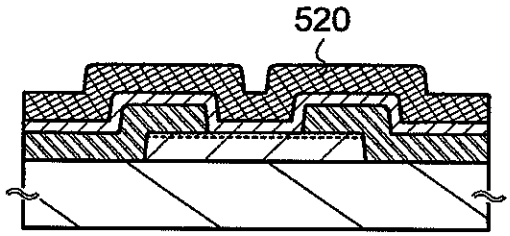


FIG. 20C

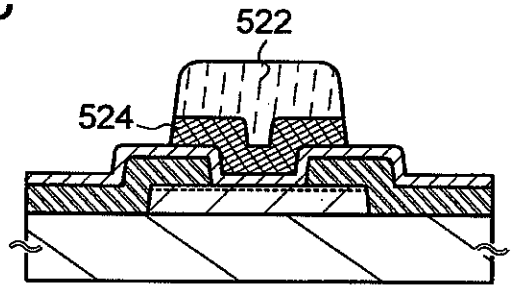


FIG. 20D

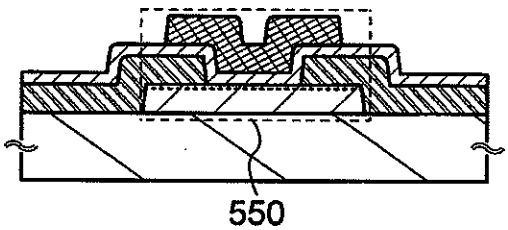


FIG. 21A

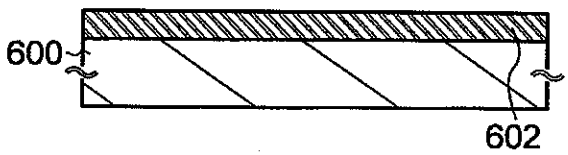


FIG. 21B

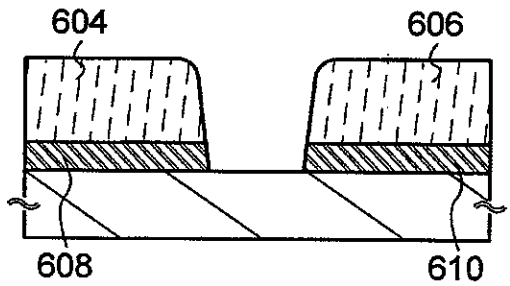


FIG. 21C

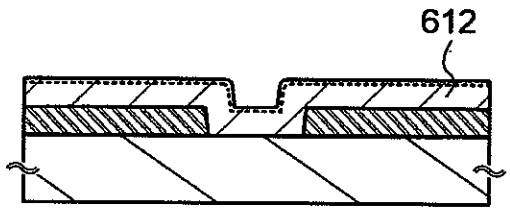


FIG. 21D

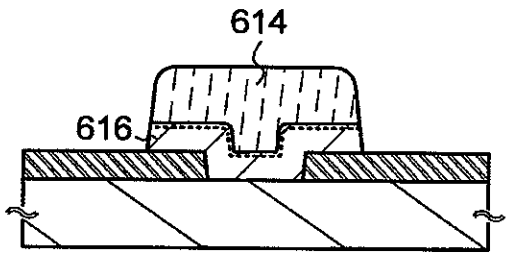


FIG. 22A

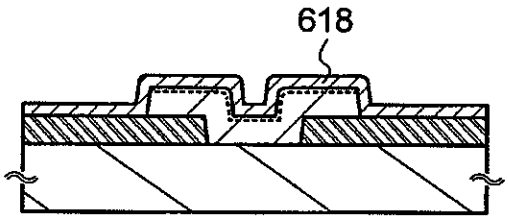


FIG. 22B

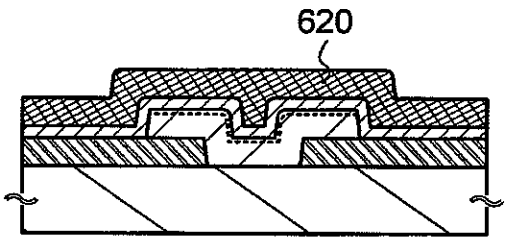


FIG. 22C

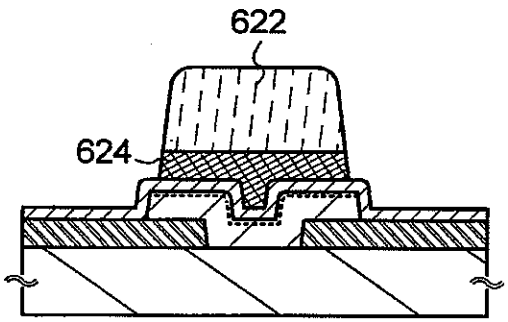


FIG. 22D

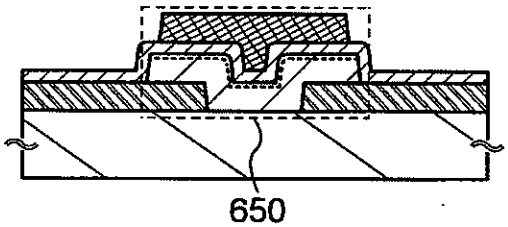


FIG. 23A

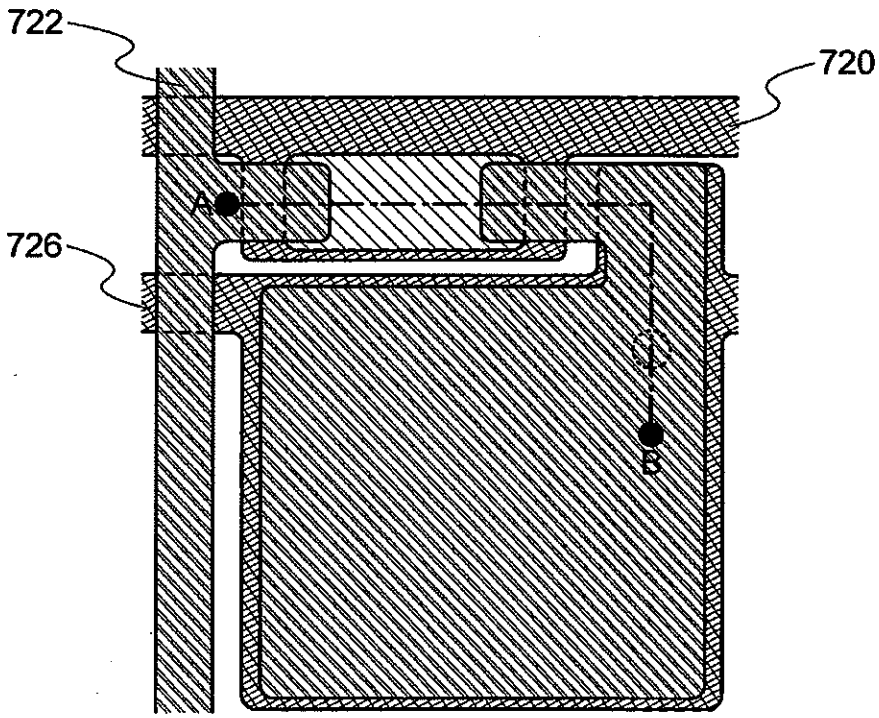


FIG. 23B

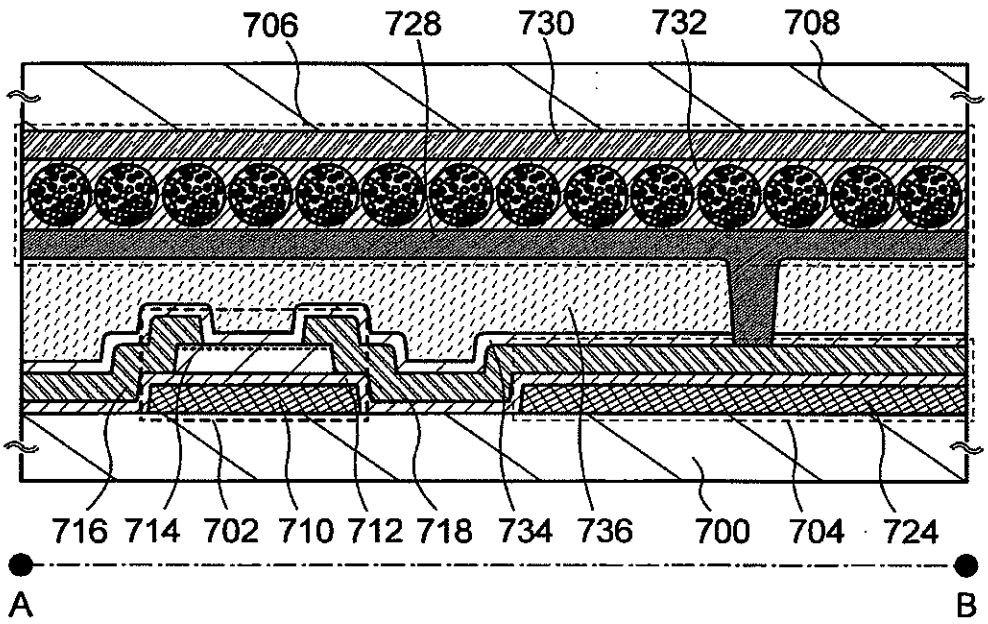


FIG. 24A

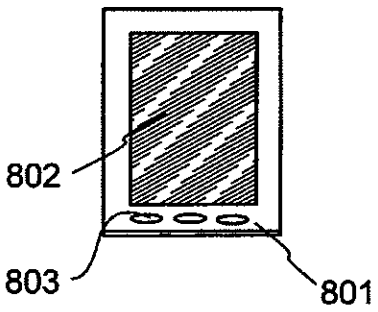


FIG. 24B

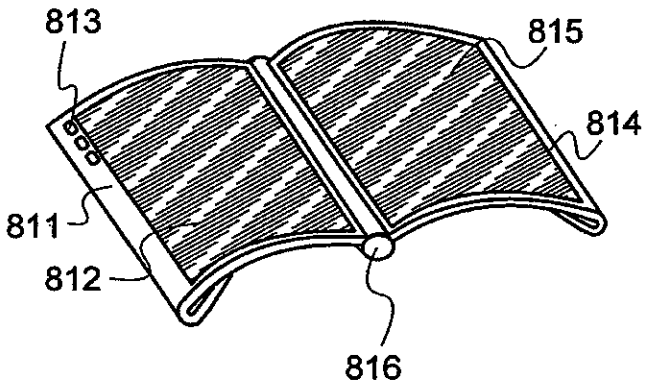


FIG. 24C

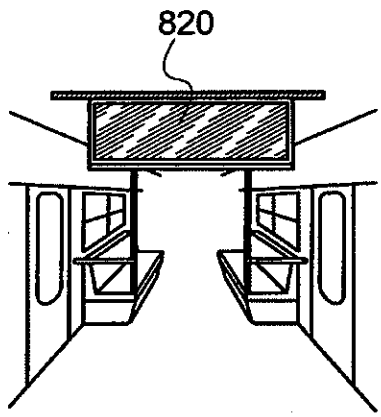


FIG. 24D

