

FIG. 1A

1/57

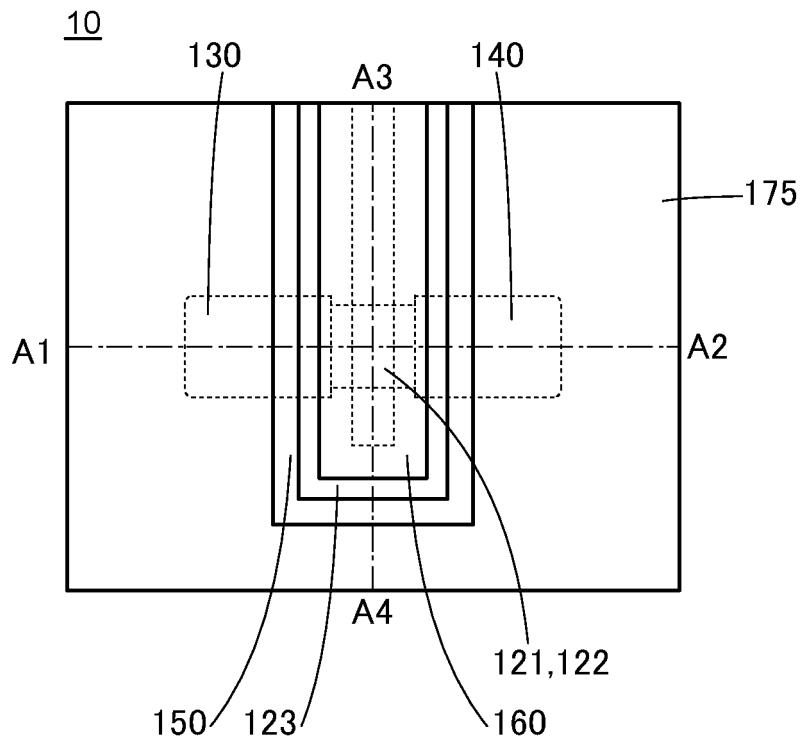


FIG. 1B

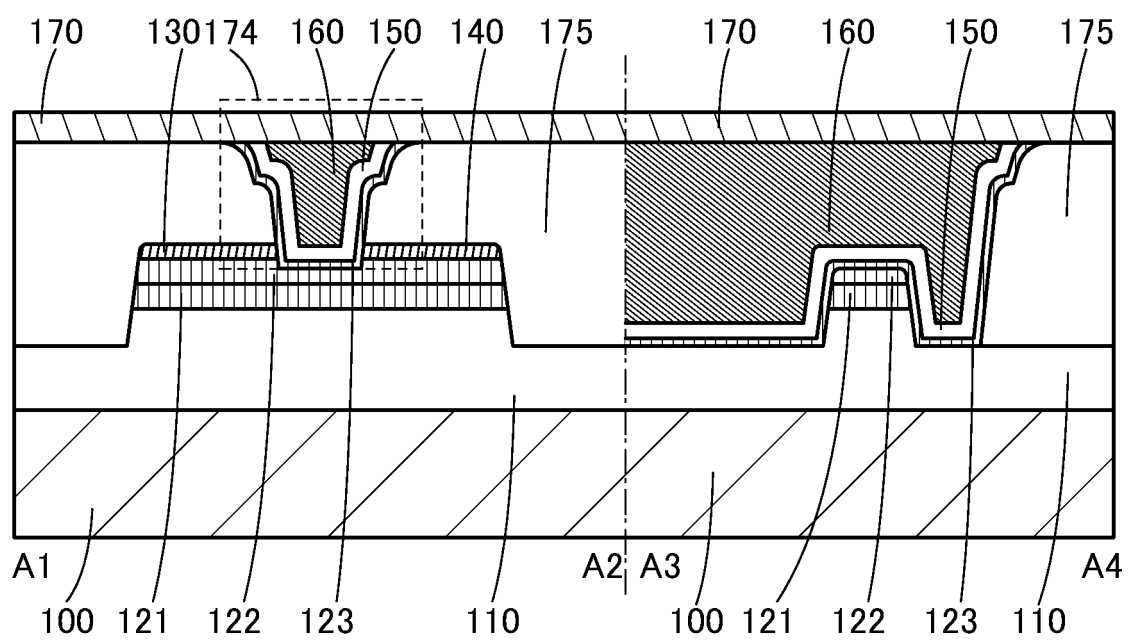


FIG. 2

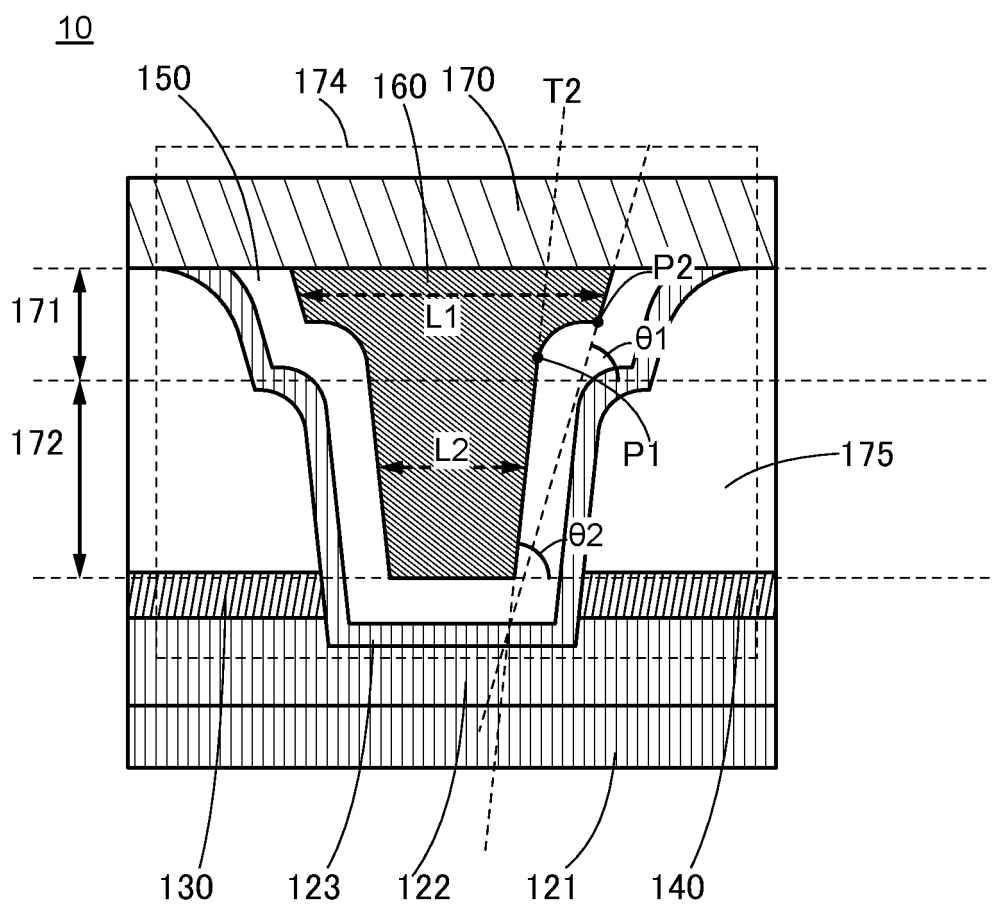


FIG. 3A

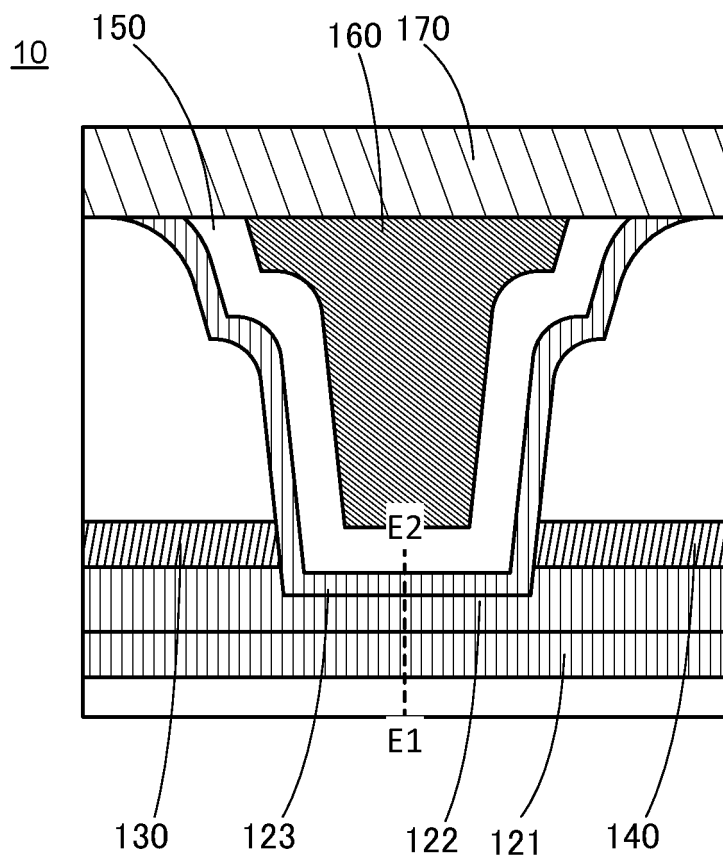
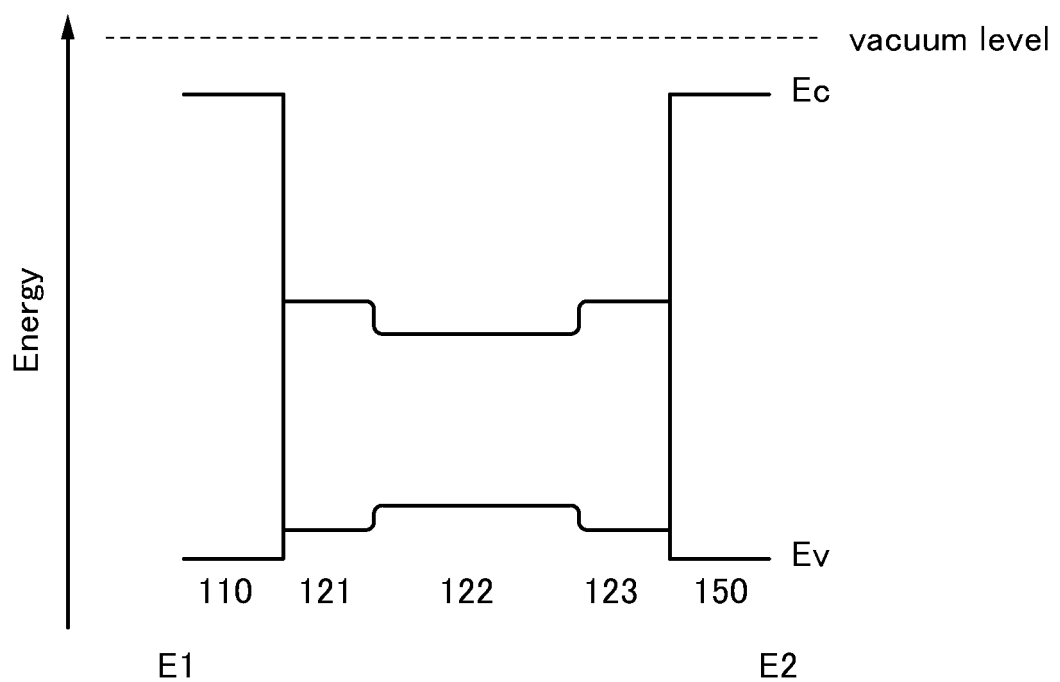


FIG. 3B



4/57

FIG. 4A

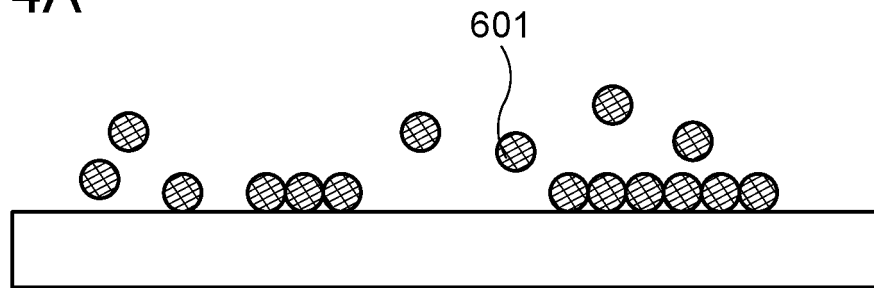


FIG. 4B

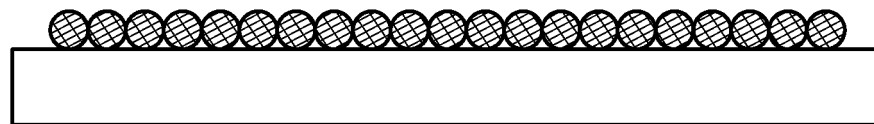


FIG. 4C

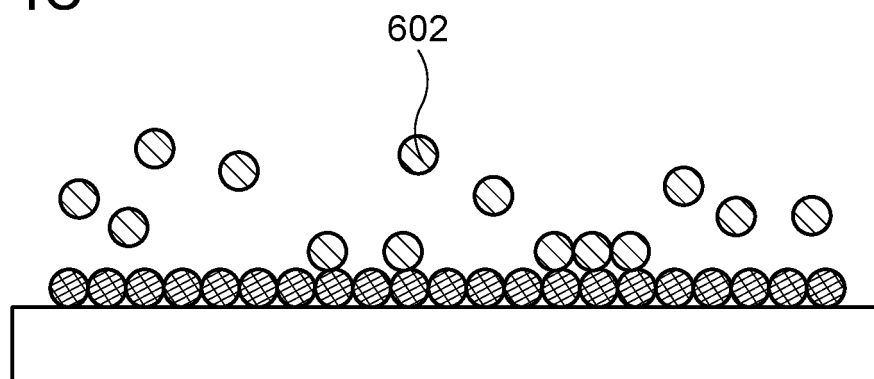


FIG. 4D

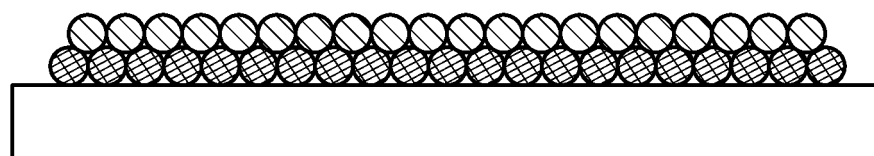


FIG. 5A

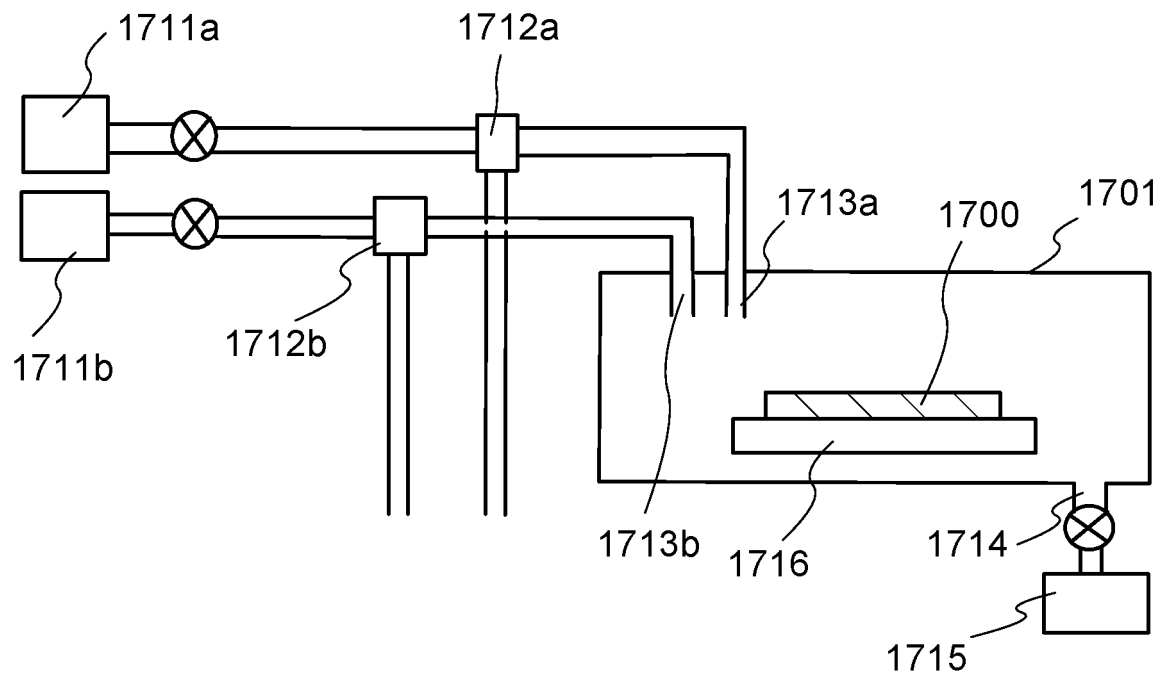


FIG. 5B

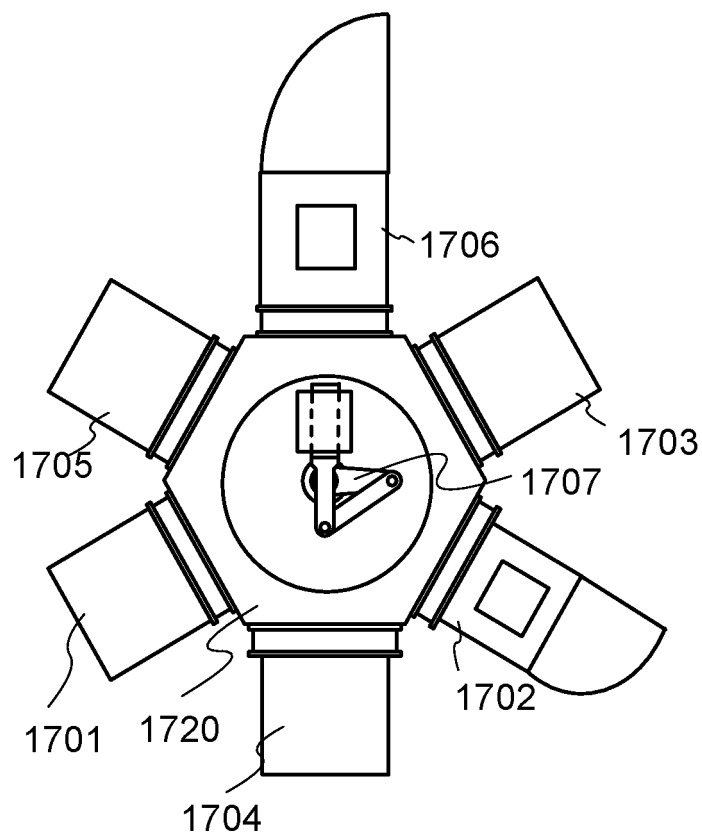


FIG. 6A

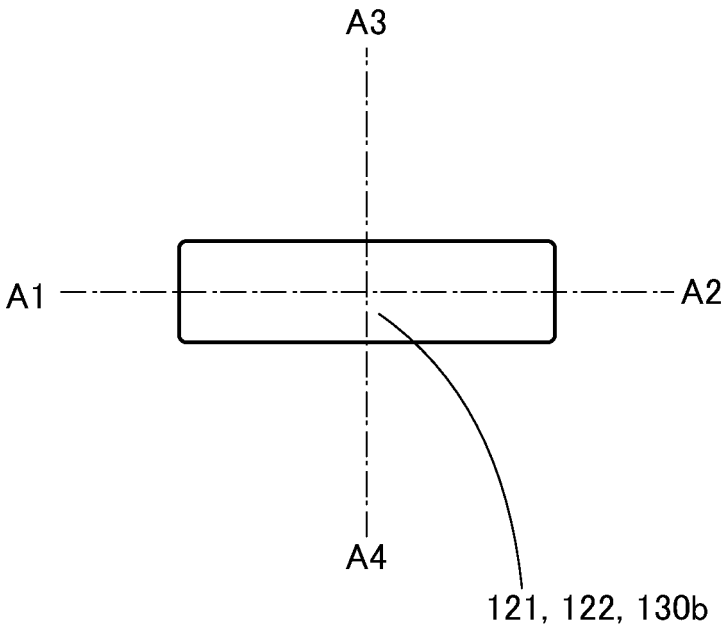


FIG. 6B

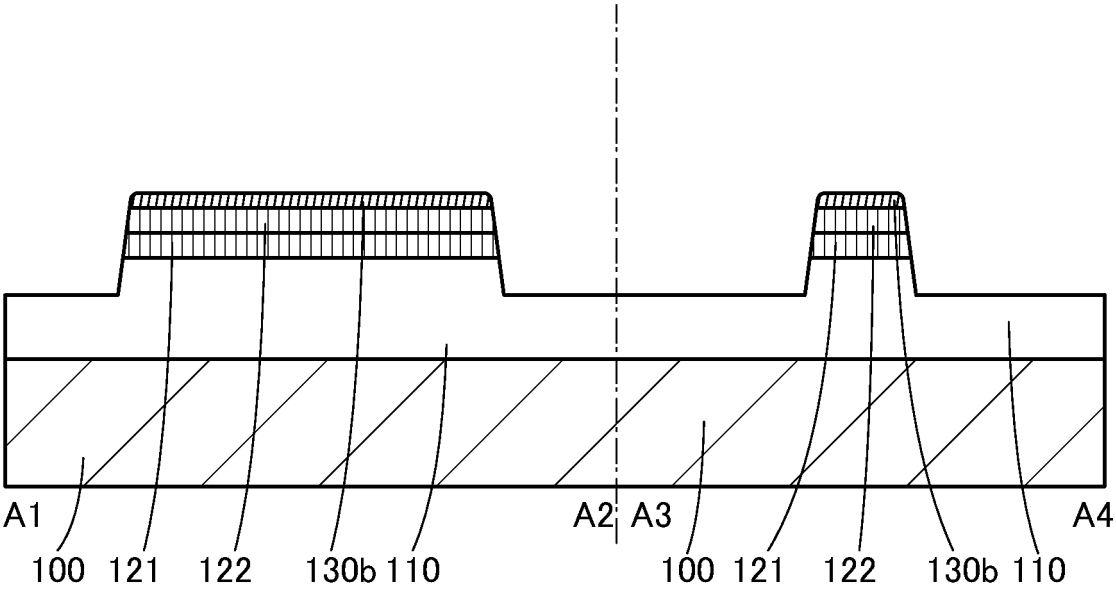


FIG. 7A

7/57

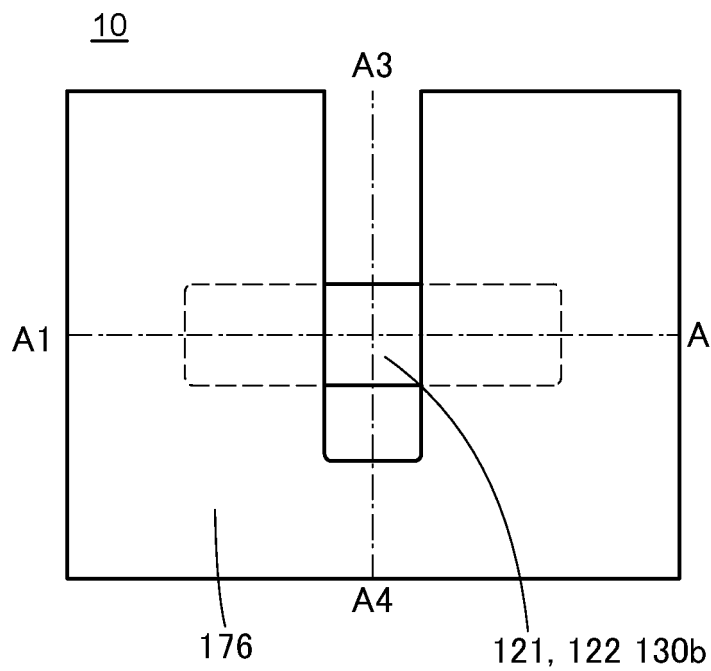


FIG. 7B

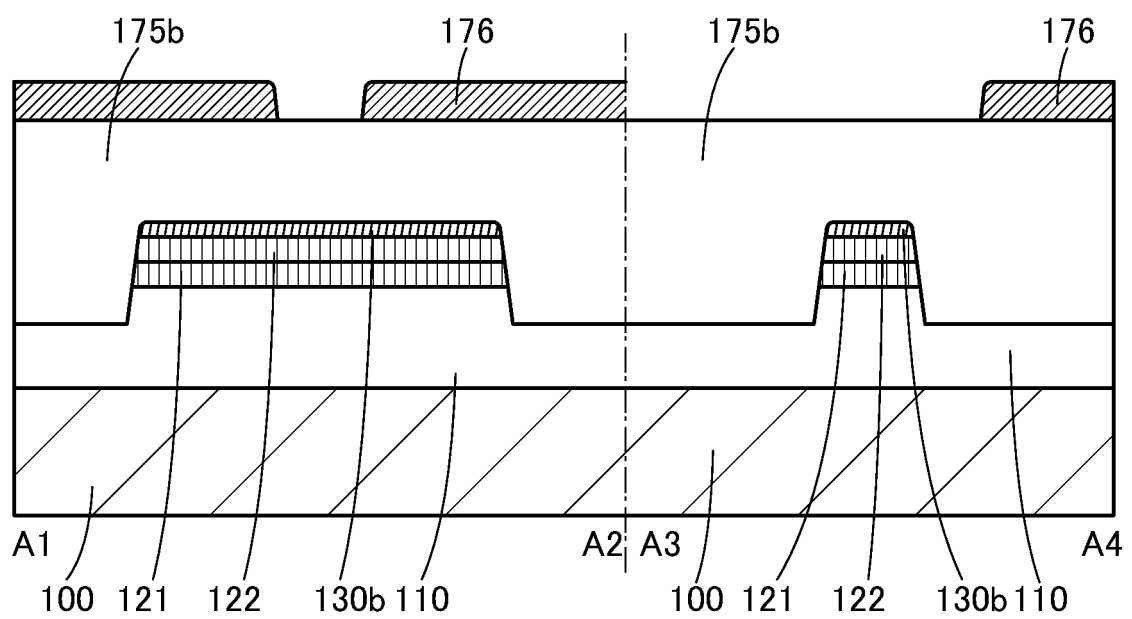


FIG. 8A

8/57

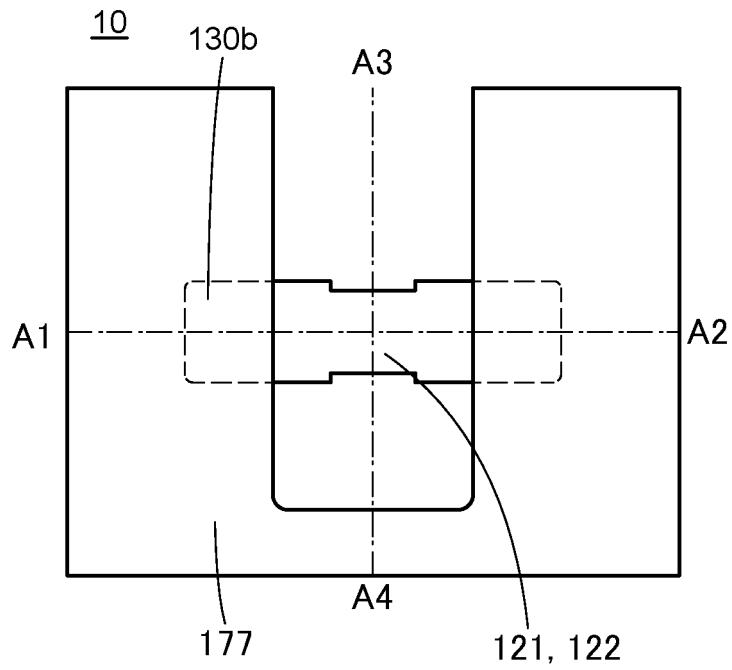


FIG. 8B

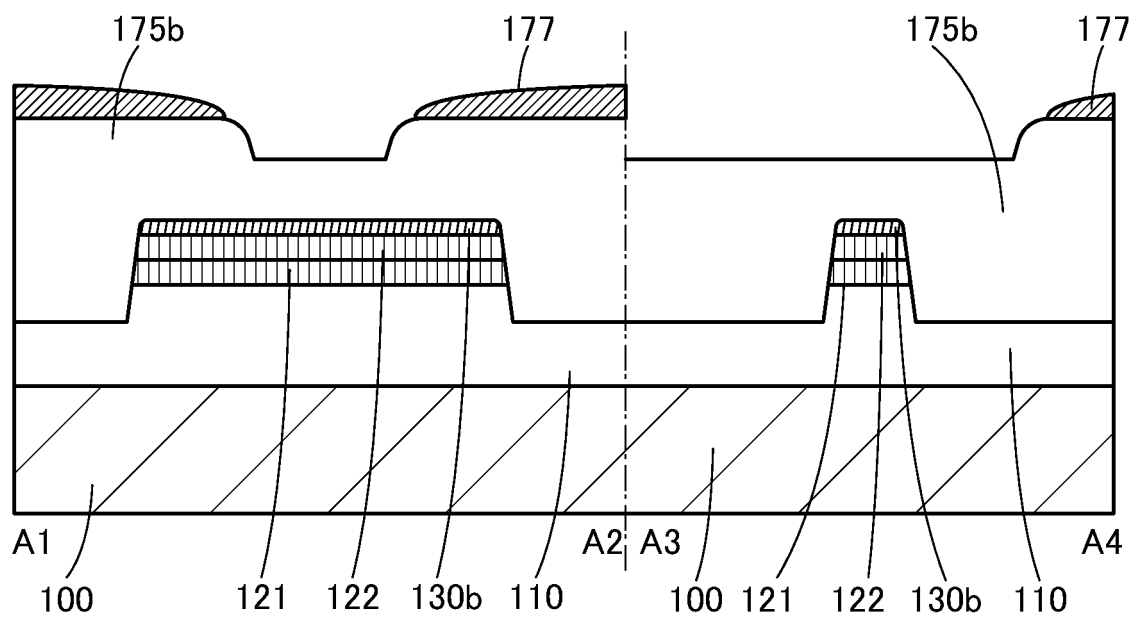


FIG. 9A

9/57

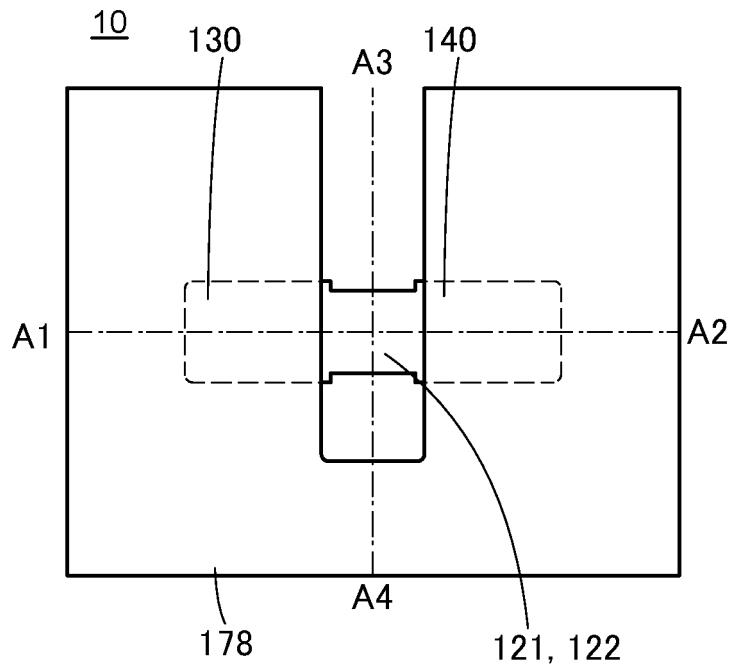


FIG. 9B

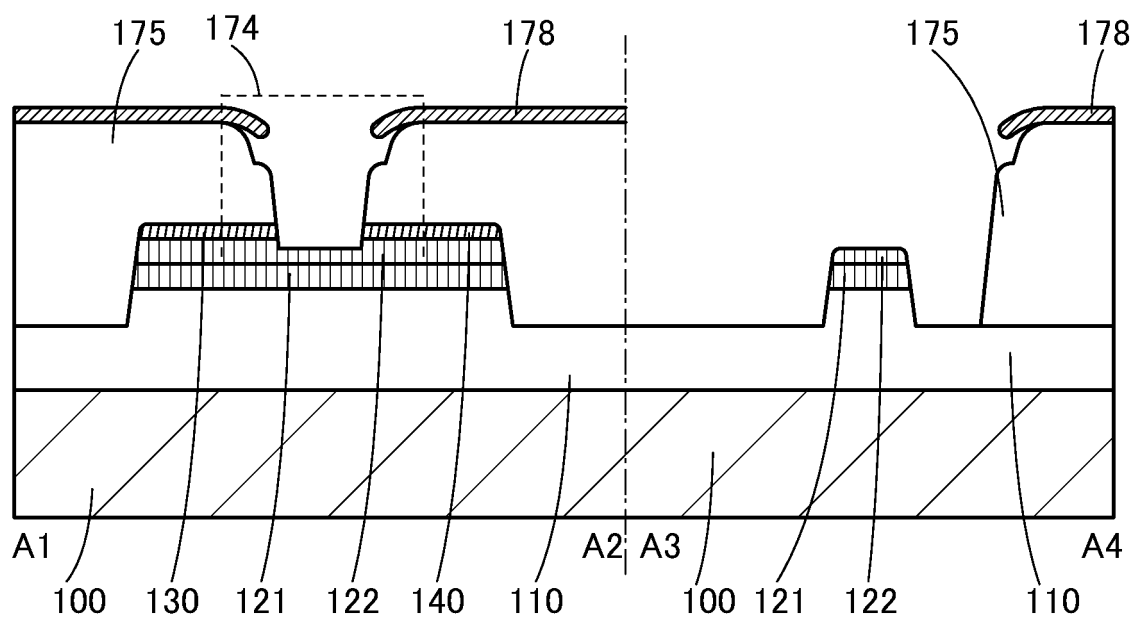


FIG. 10A

10/57

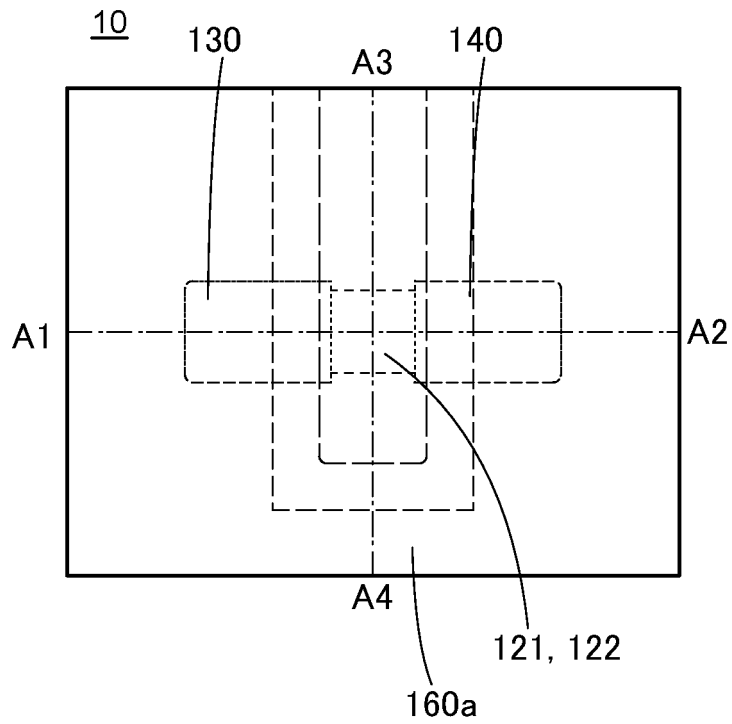


FIG. 10B

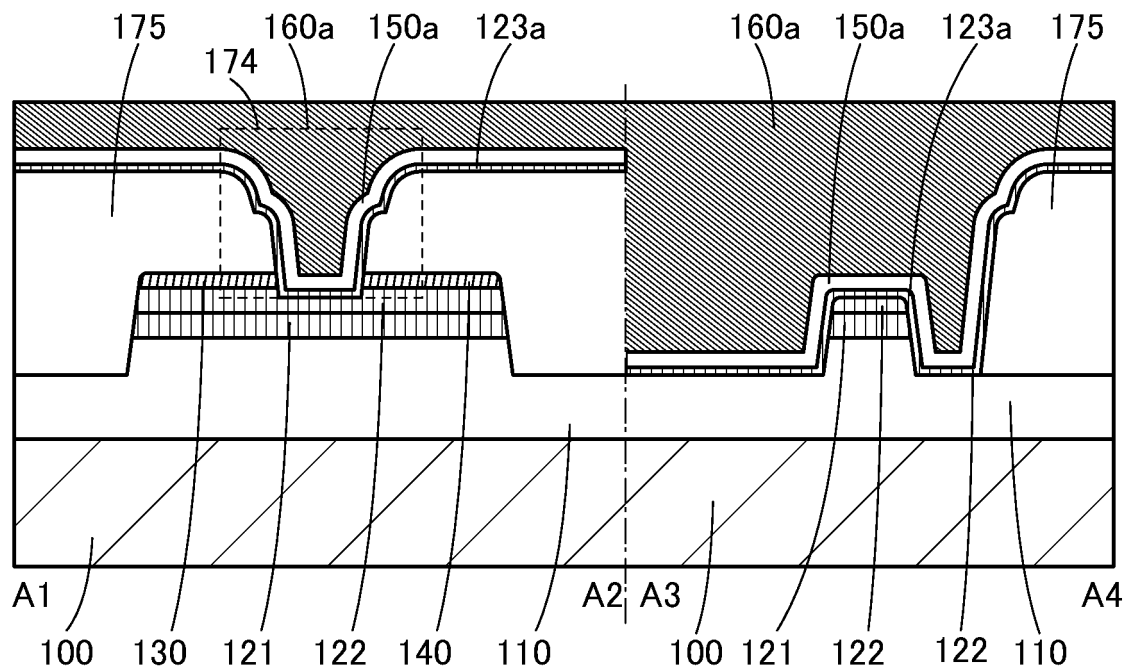


FIG. 11A

11/57

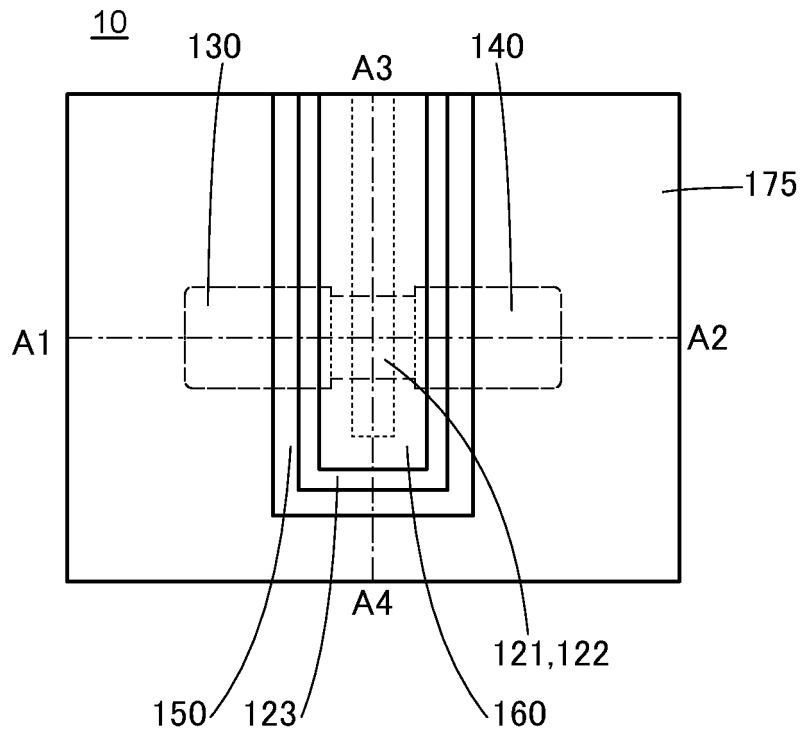


FIG. 11B

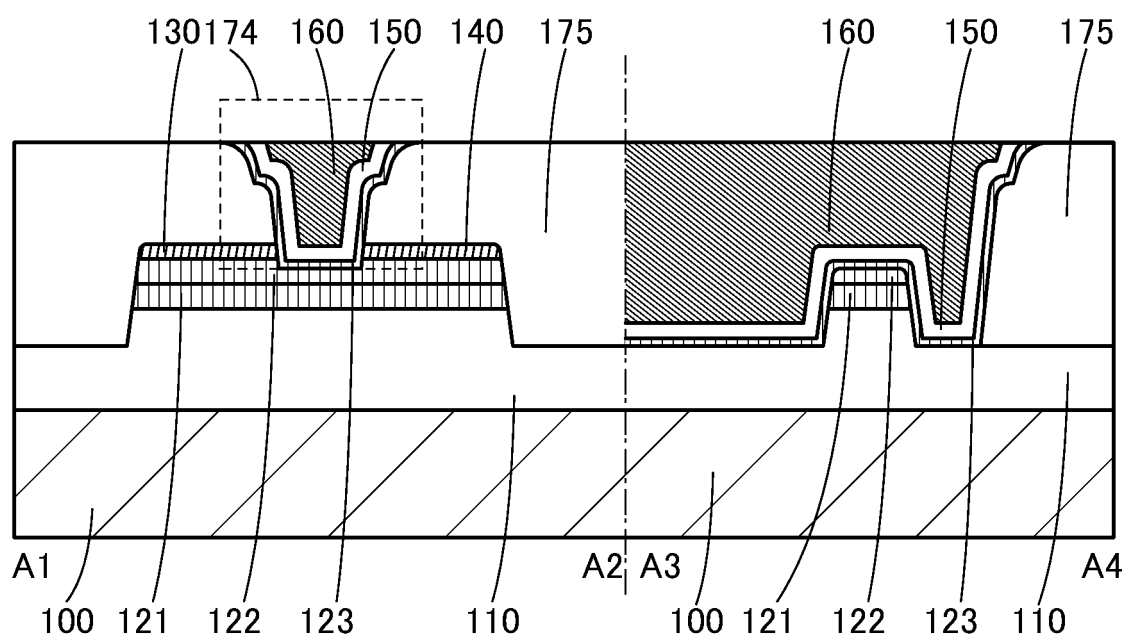


FIG. 12A

12/57

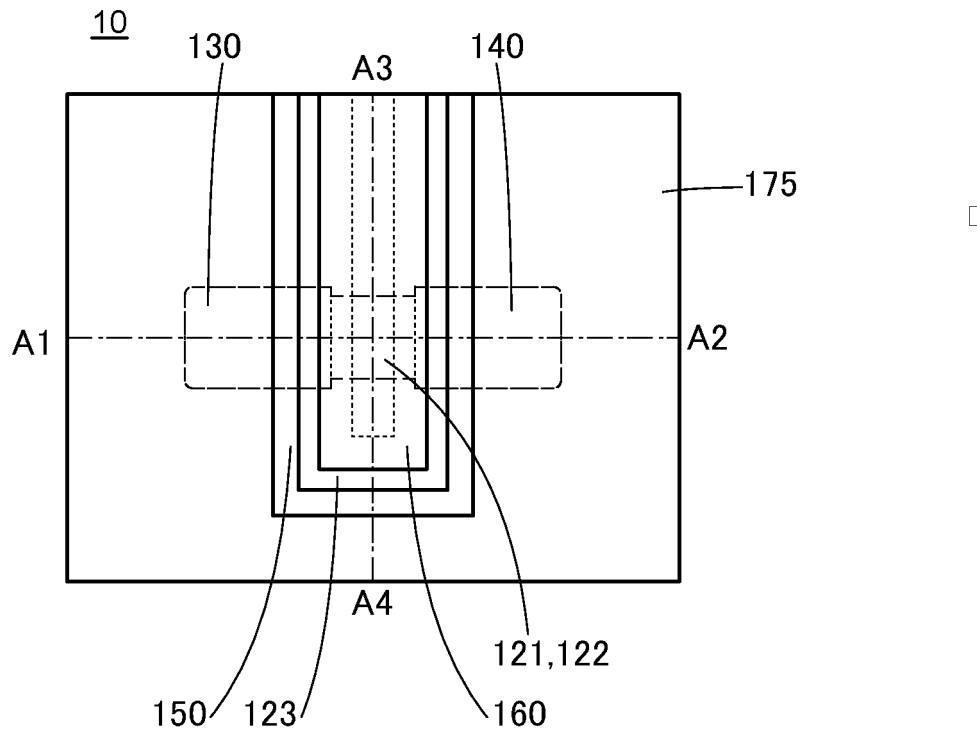


FIG. 12B

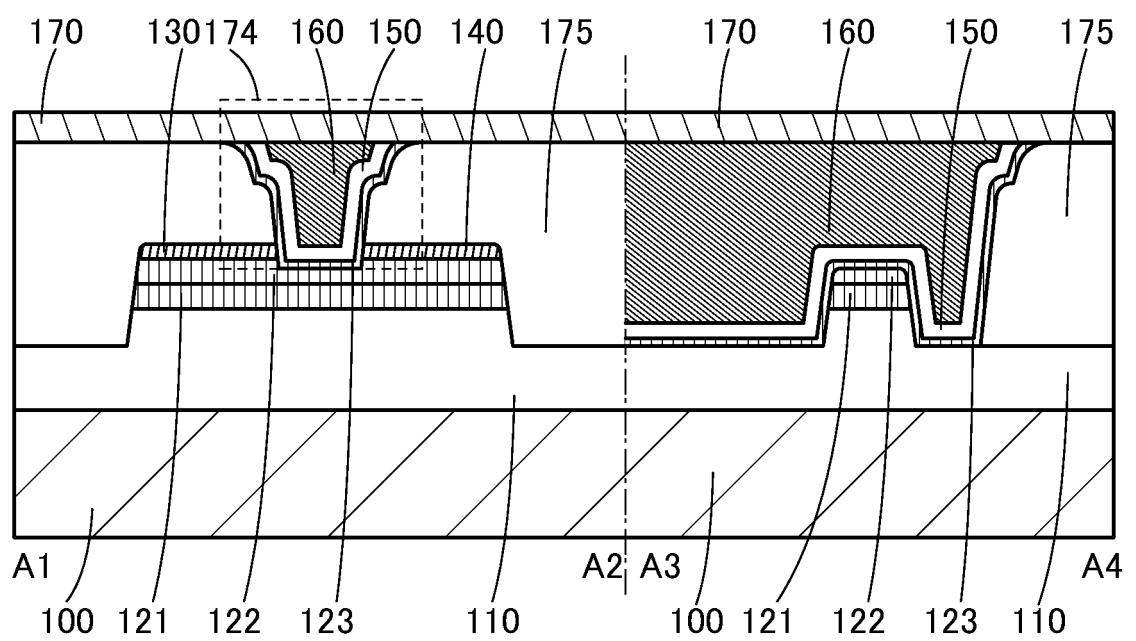


FIG. 13A

13/57

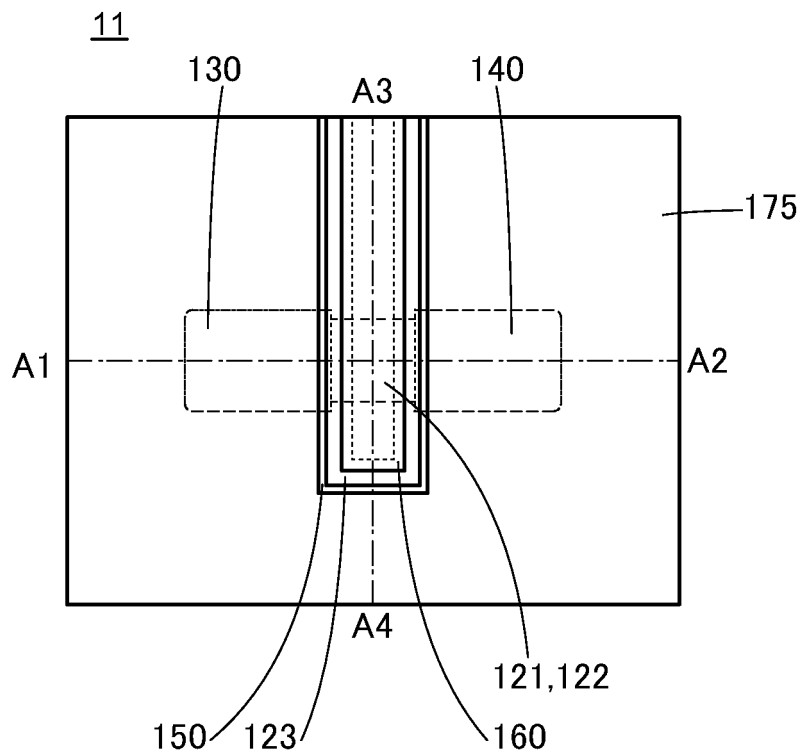


FIG. 13B

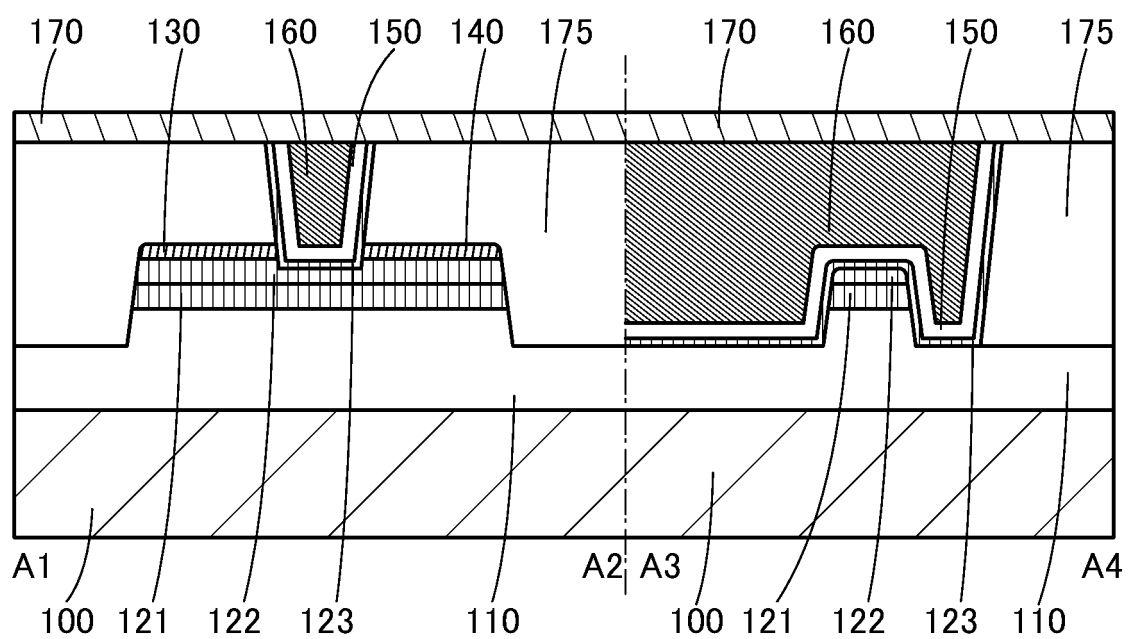


FIG. 14A

14/57

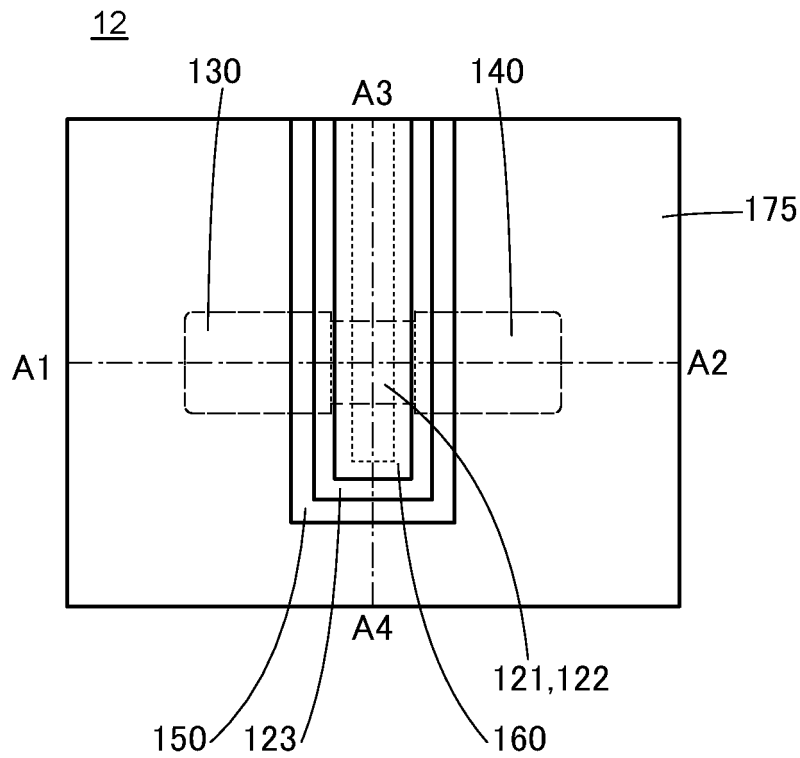


FIG. 14B

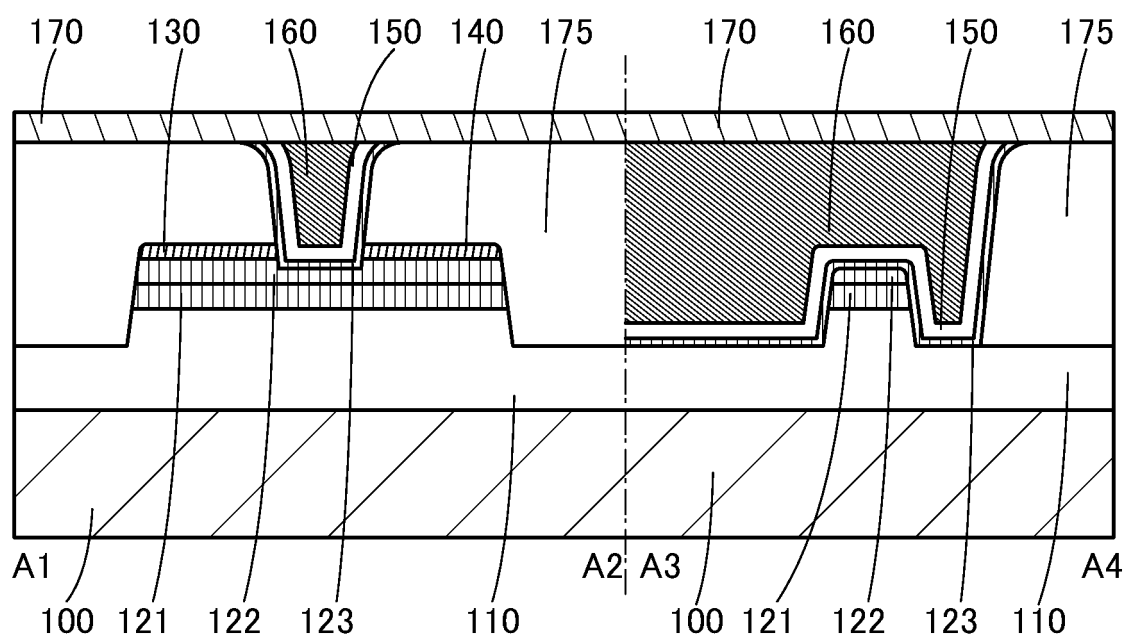


FIG. 15A

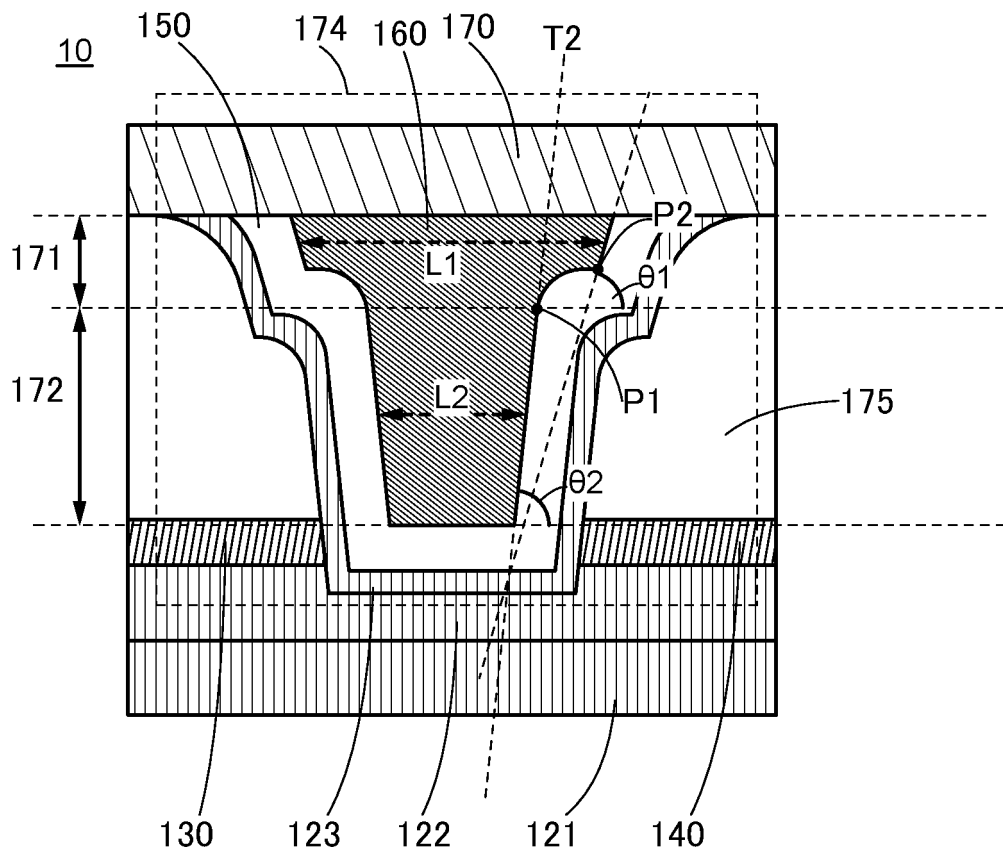


FIG. 15B

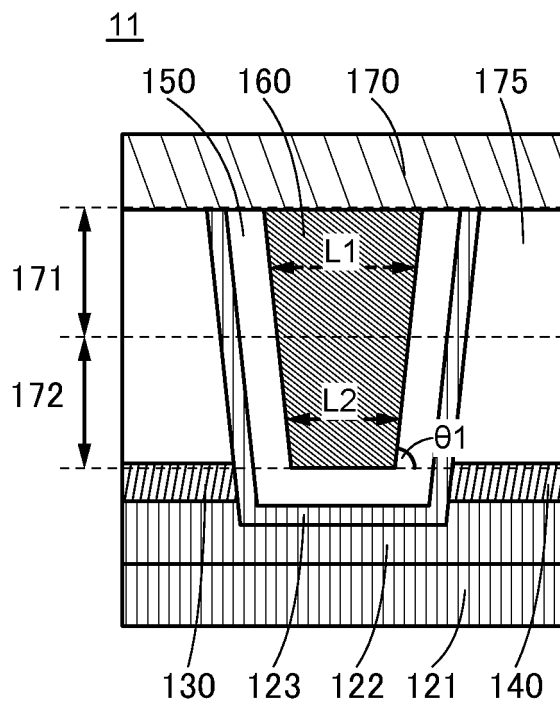


FIG. 15C

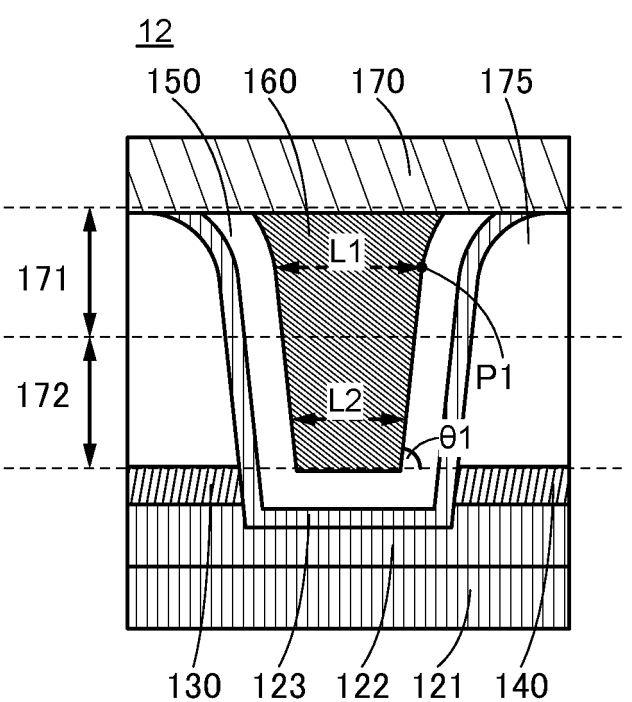


FIG. 16A

16/57

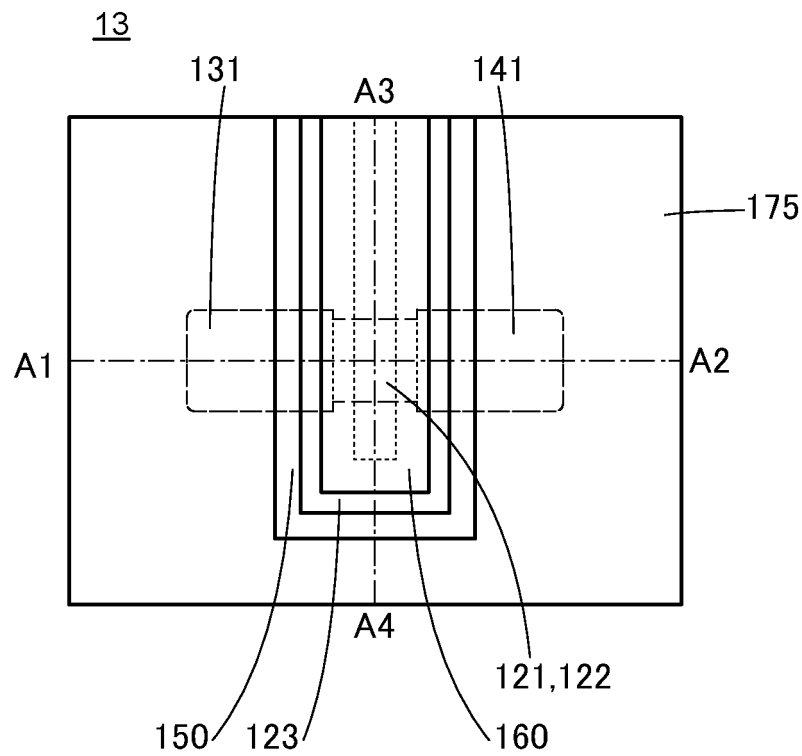


FIG. 16B

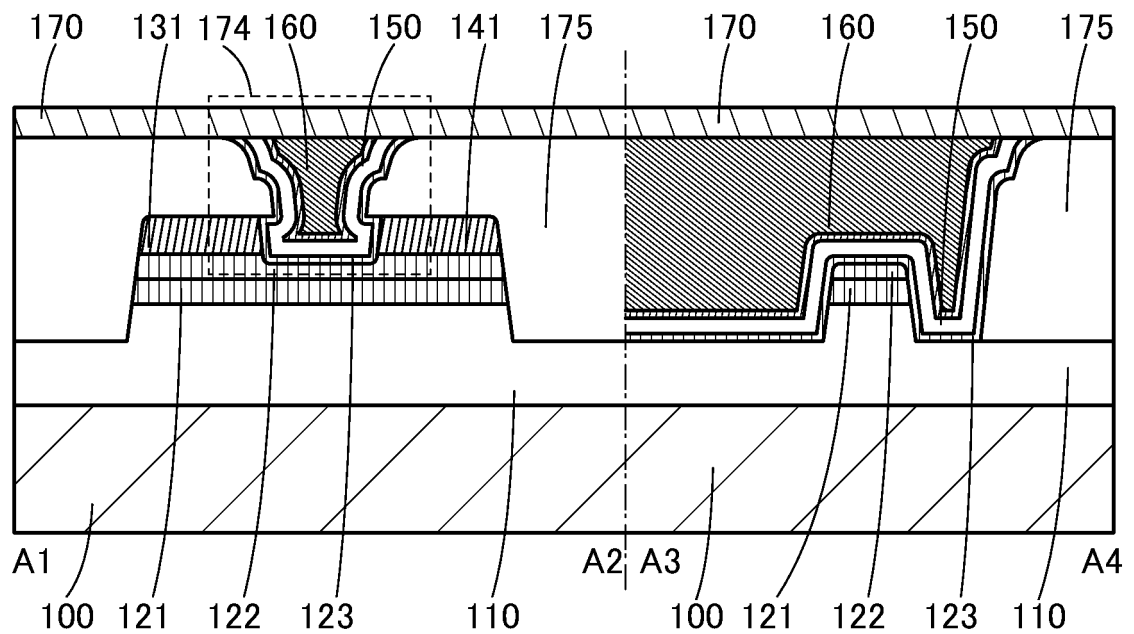


FIG. 18A

18/57

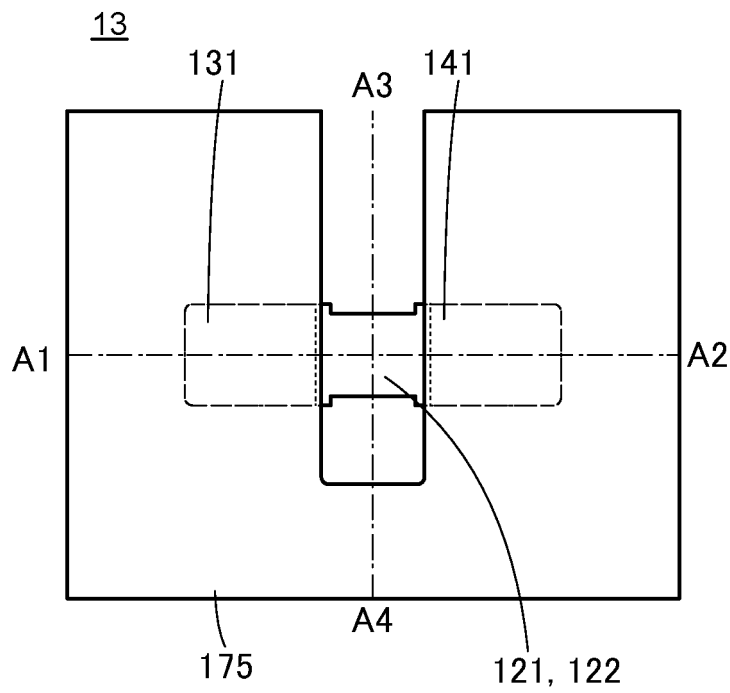


FIG. 18B

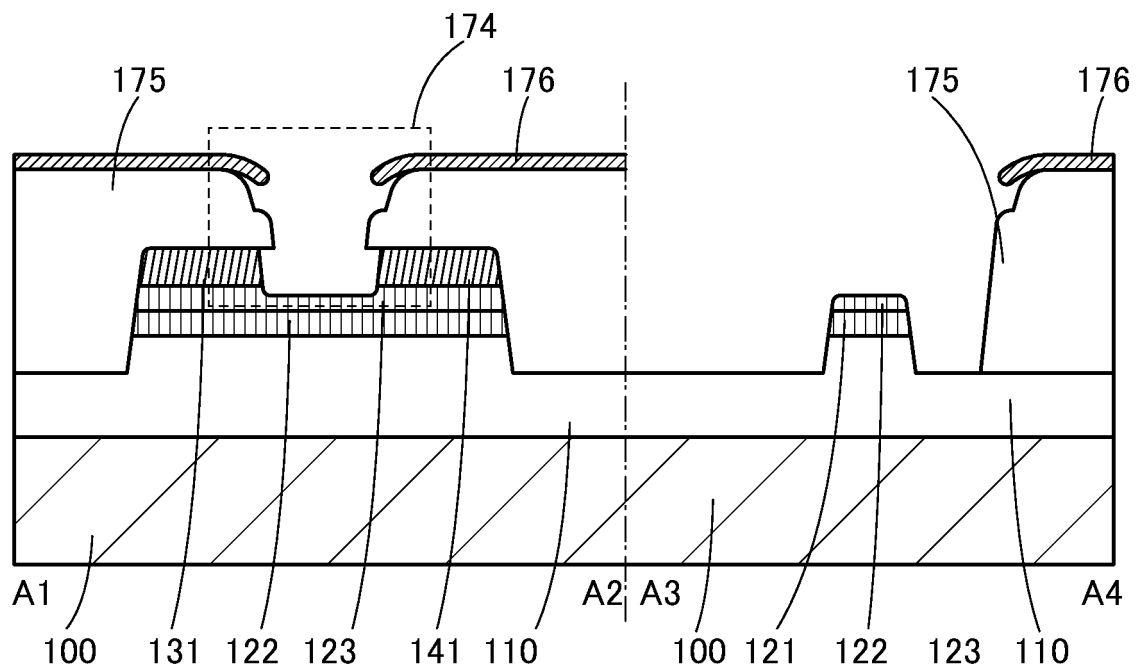


FIG. 19A

19/57

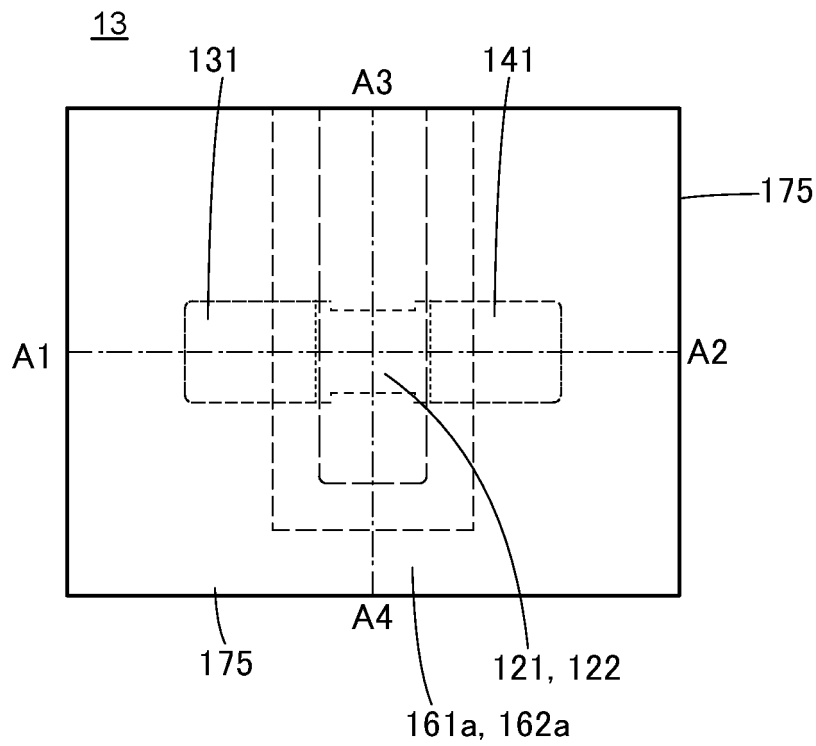


FIG. 19B

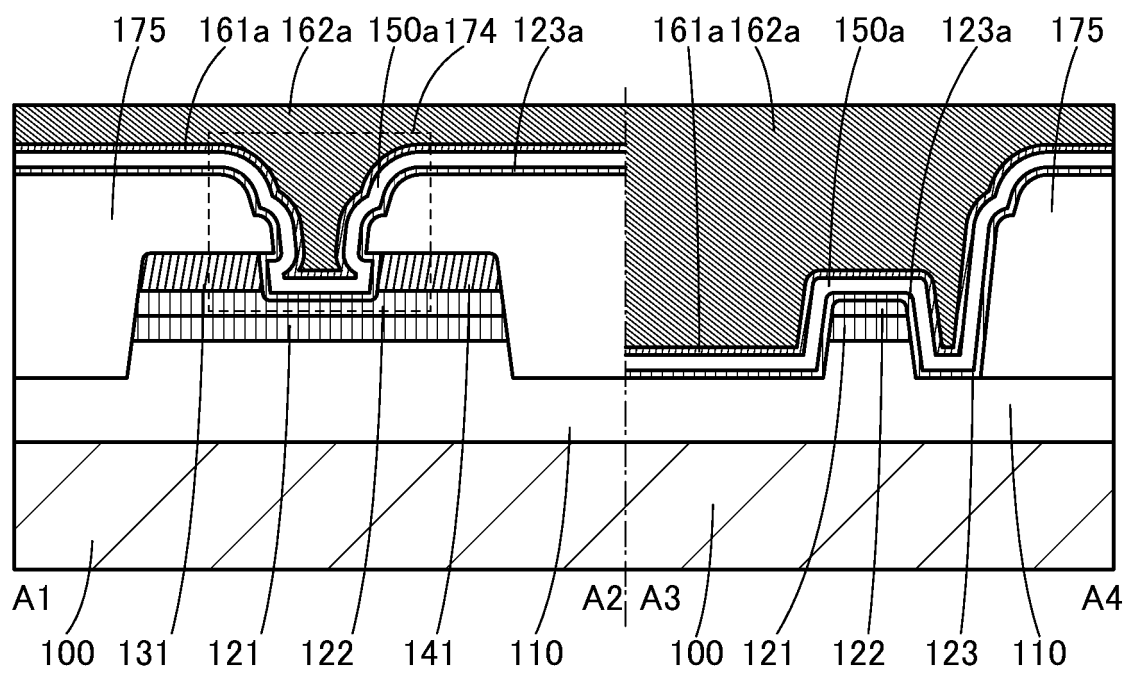


FIG. 20A

20/57

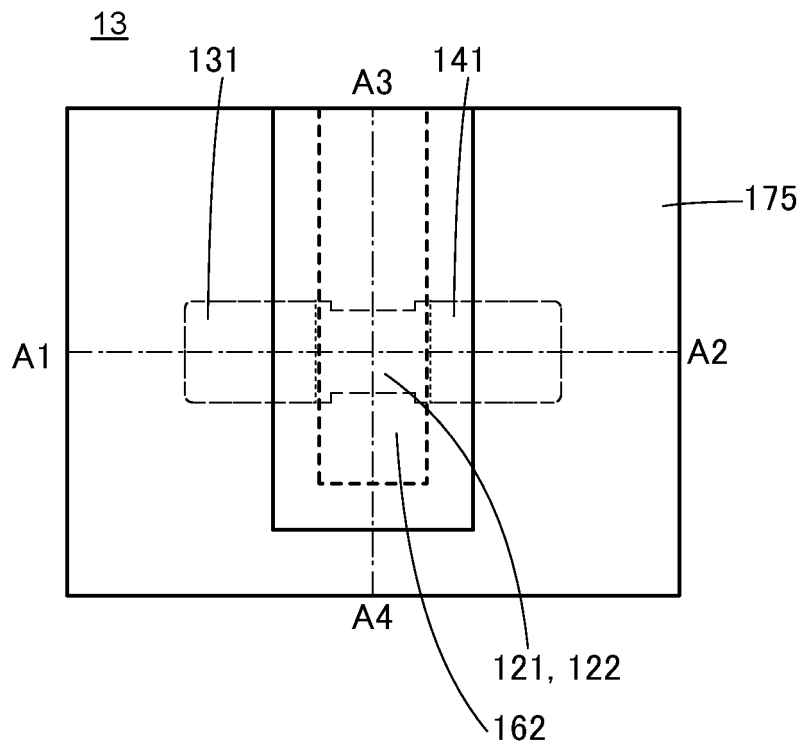


FIG. 20B

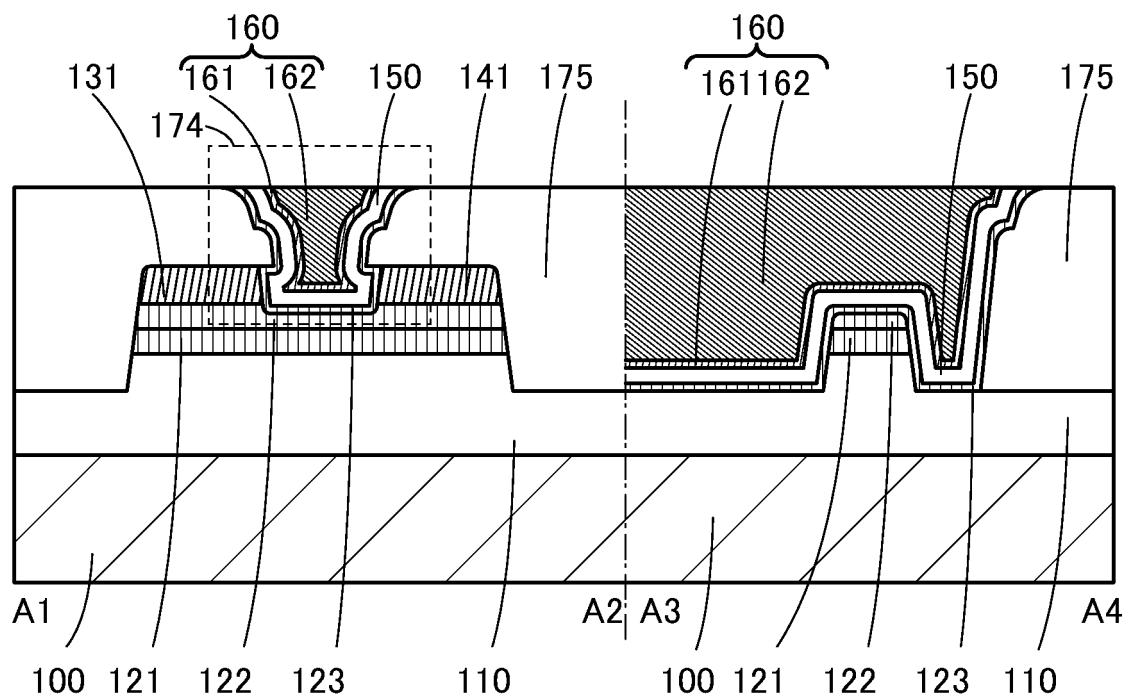


FIG. 21A

21/57

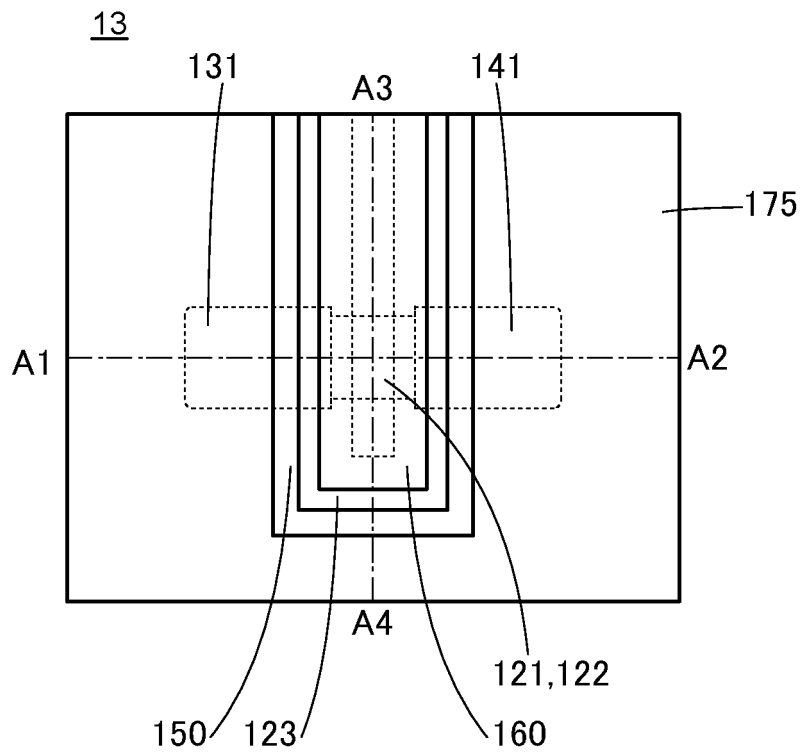
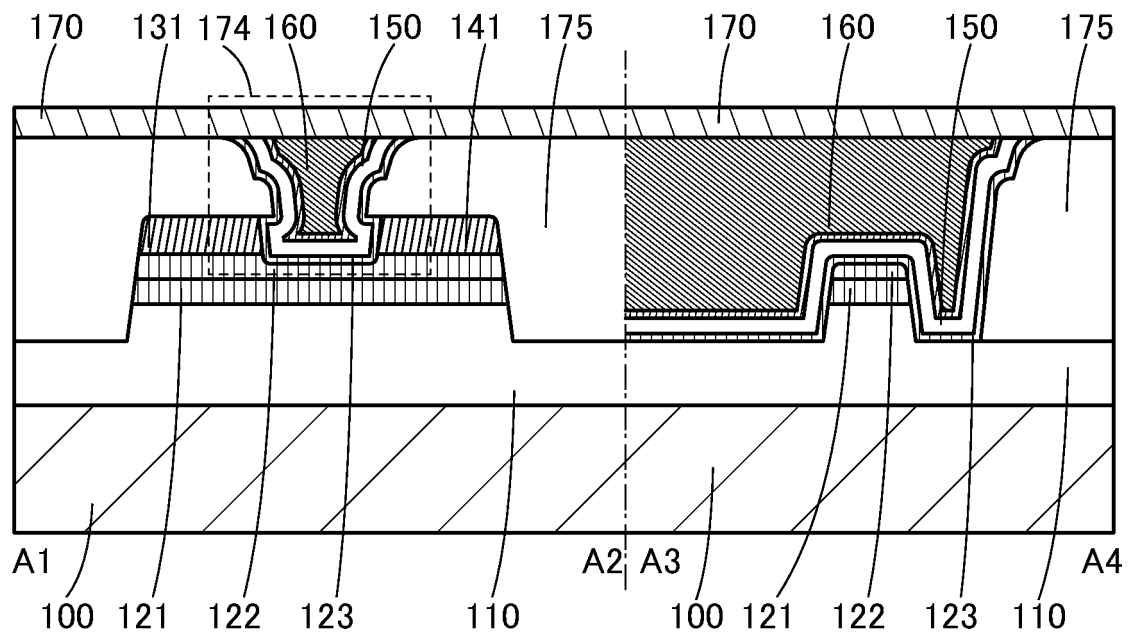


FIG. 21B



22/57

FIG. 22A

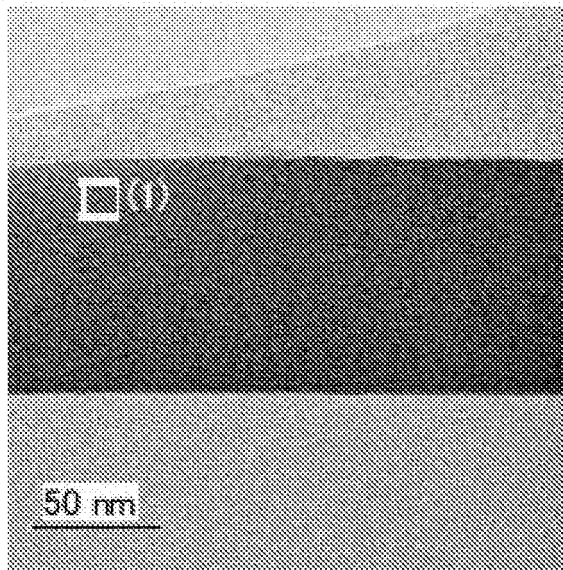


FIG. 22B

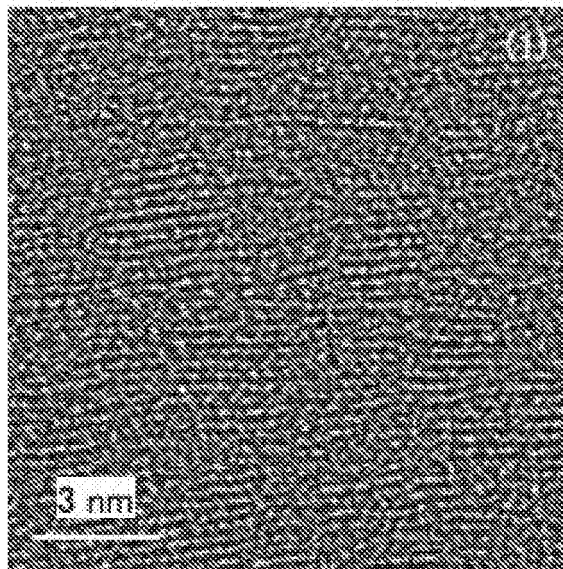


FIG. 22C

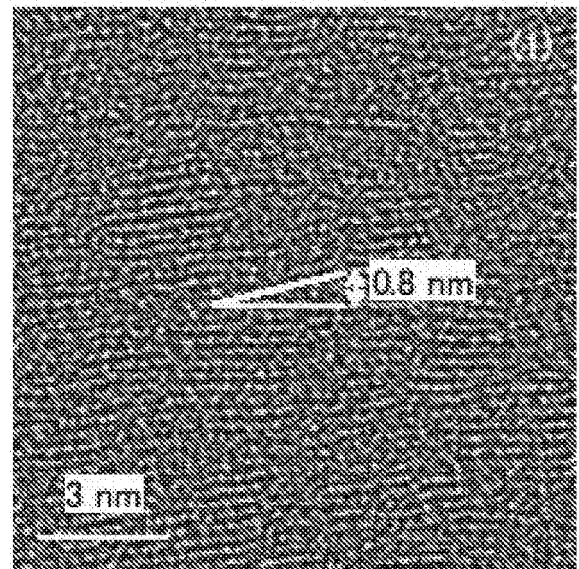
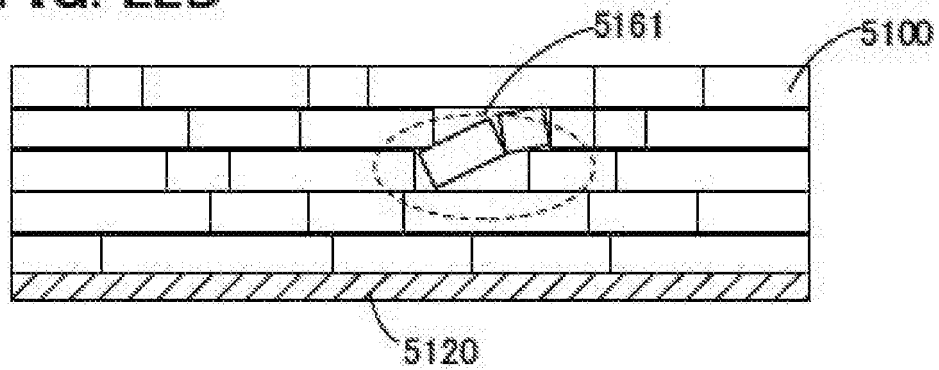


FIG. 22D



23/57

FIG. 23A

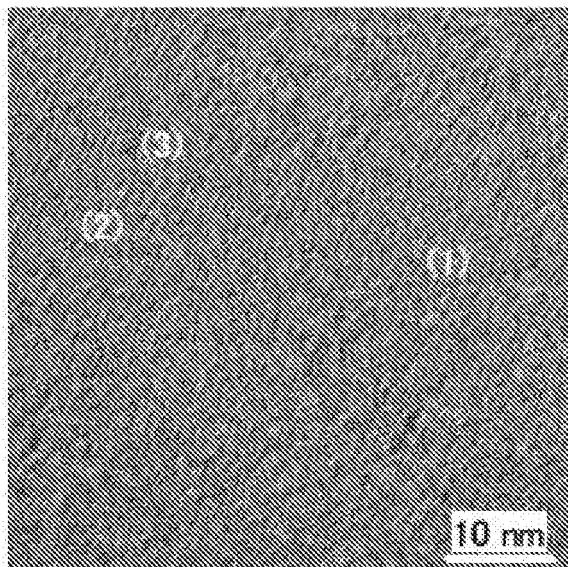


FIG. 23B

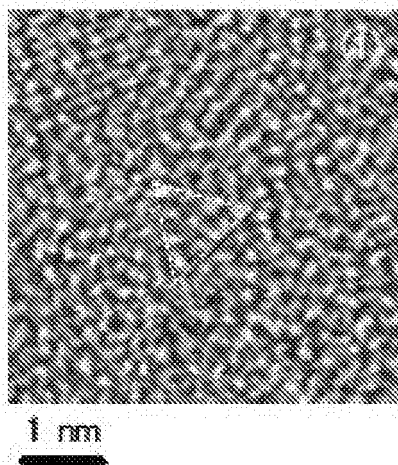


FIG. 23C

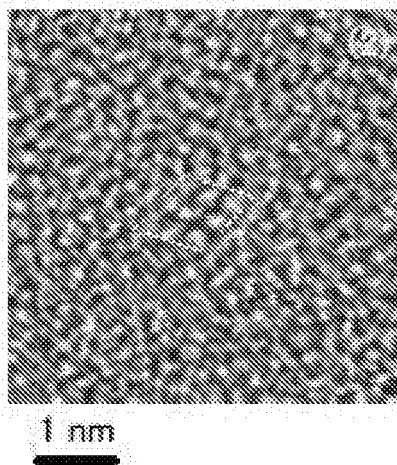
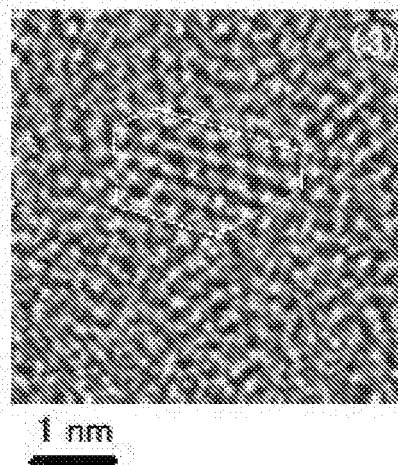
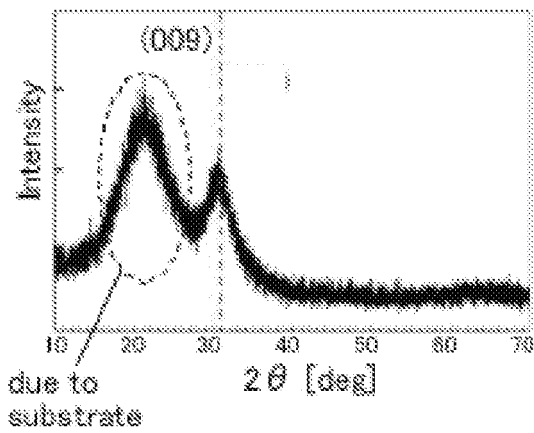
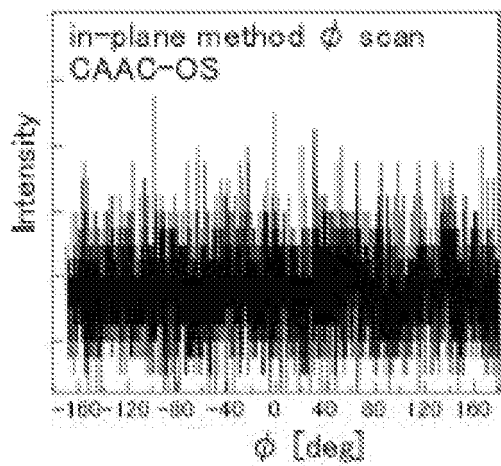
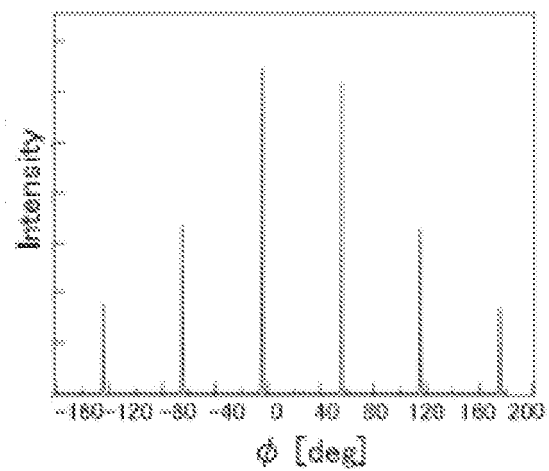


FIG. 23D

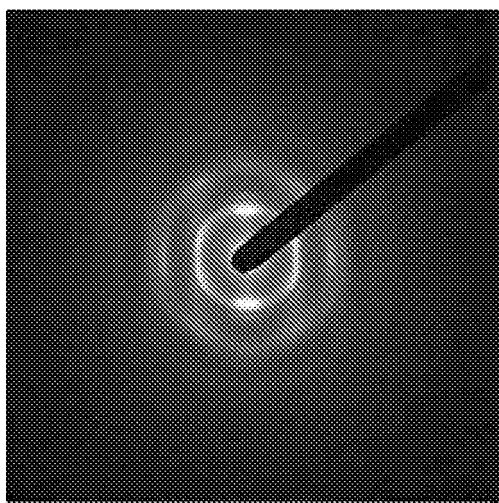


24/57

FIG. 24A out-of-plane method
CAAC-OS**FIG. 24B****FIG. 24C** in-plane method ϕ scan
single crystal OS

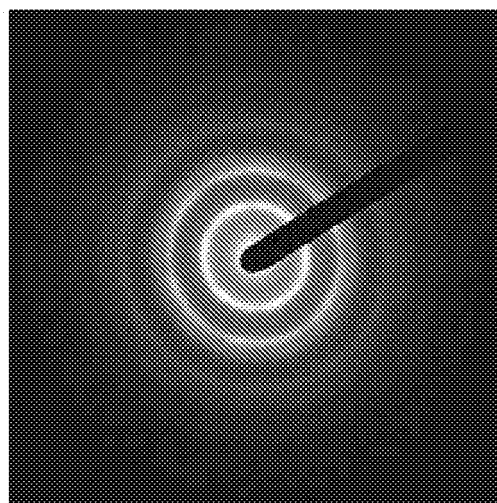
25/57

FIG. 25A



electron beam is incident on
CAAC-OS in direction
parallel
to sample surface

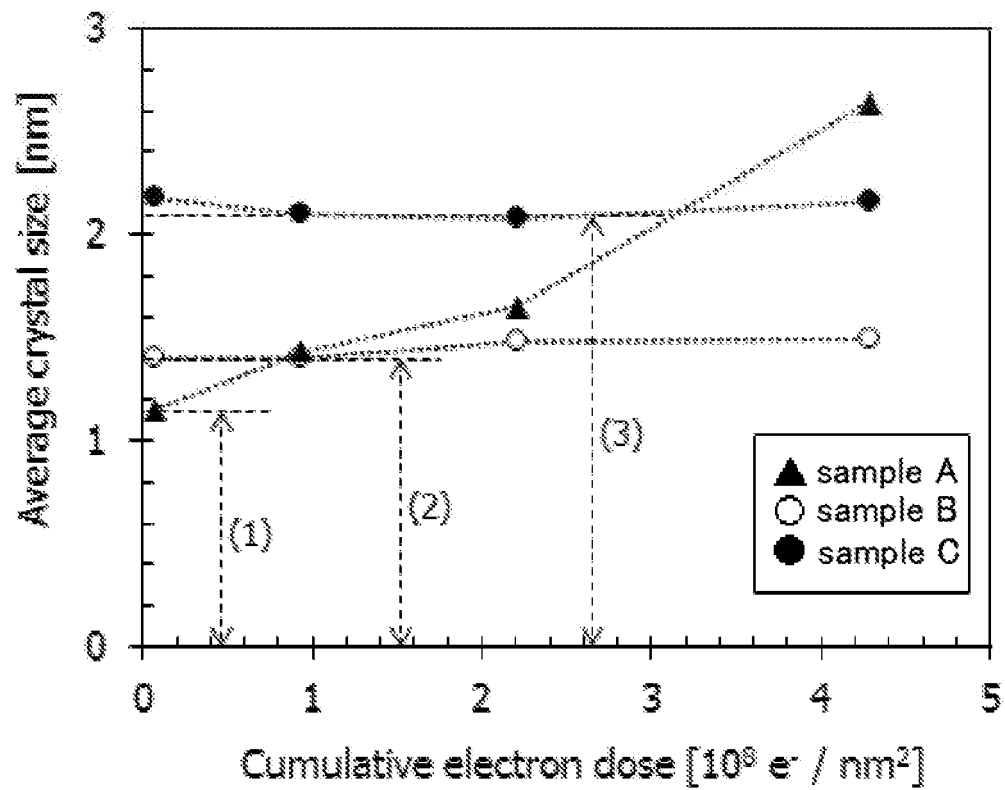
FIG. 25B



electron beam is incident on
CAAC-OS in direction
perpendicular
to sample surface

26/57

FIG. 26



27/57

FIG. 27A

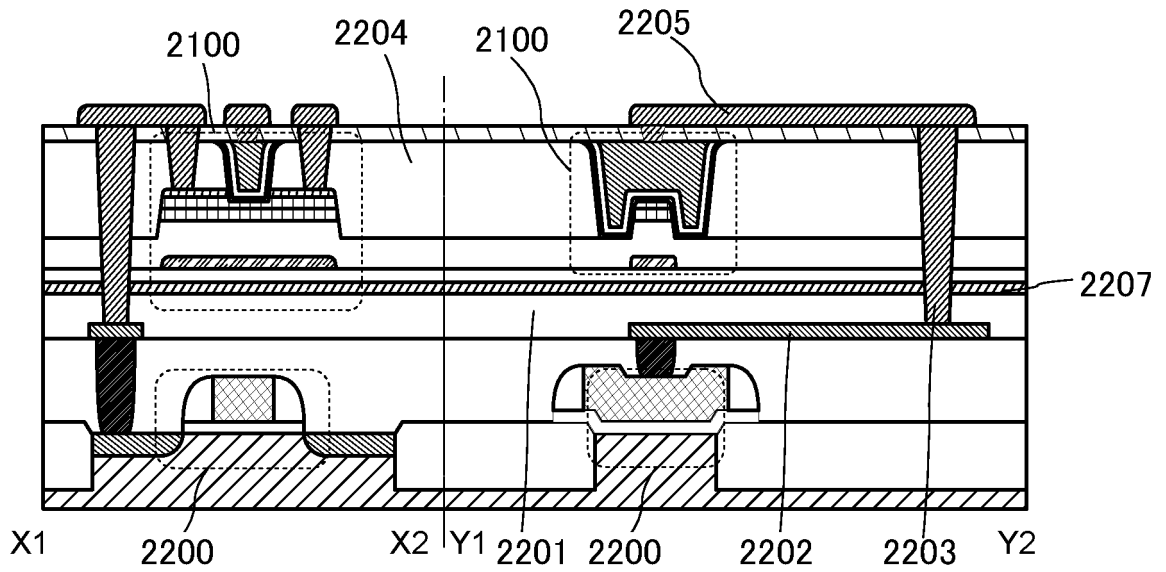


FIG. 27B

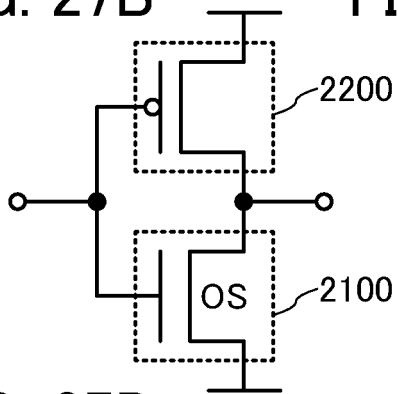


FIG. 27C

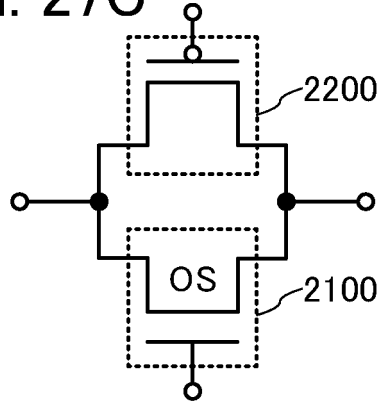


FIG. 27D

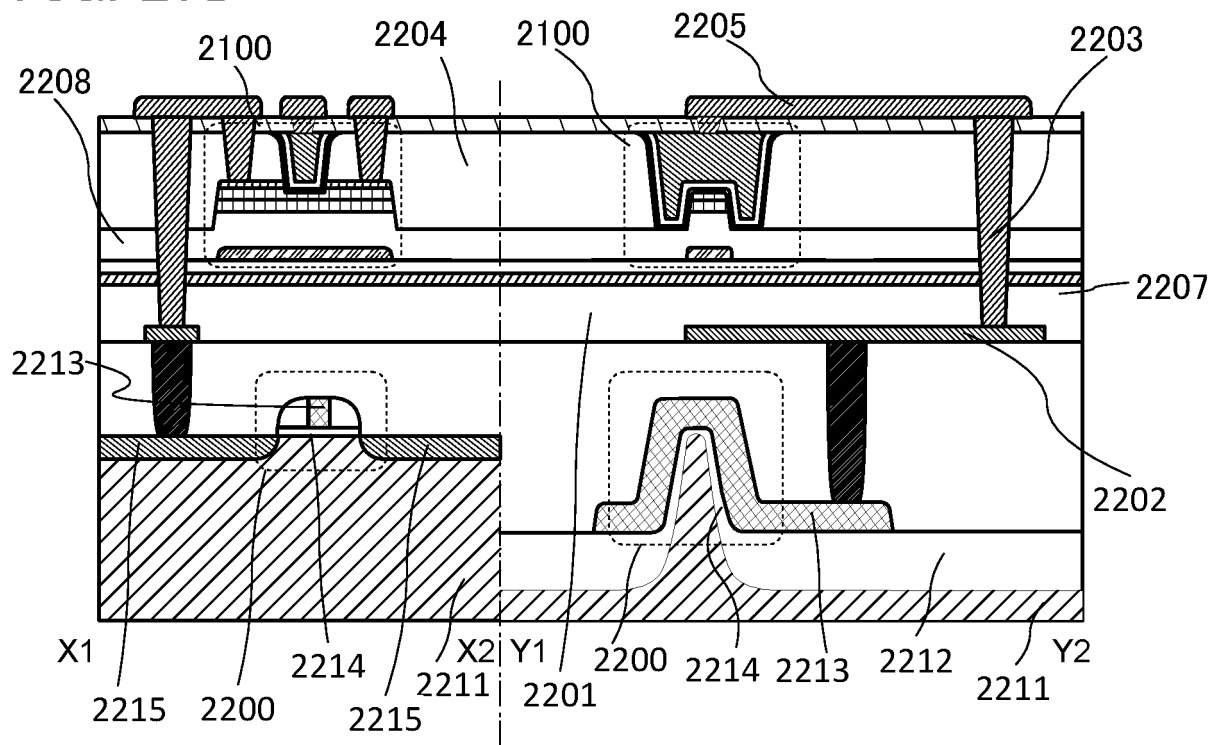


FIG. 28A

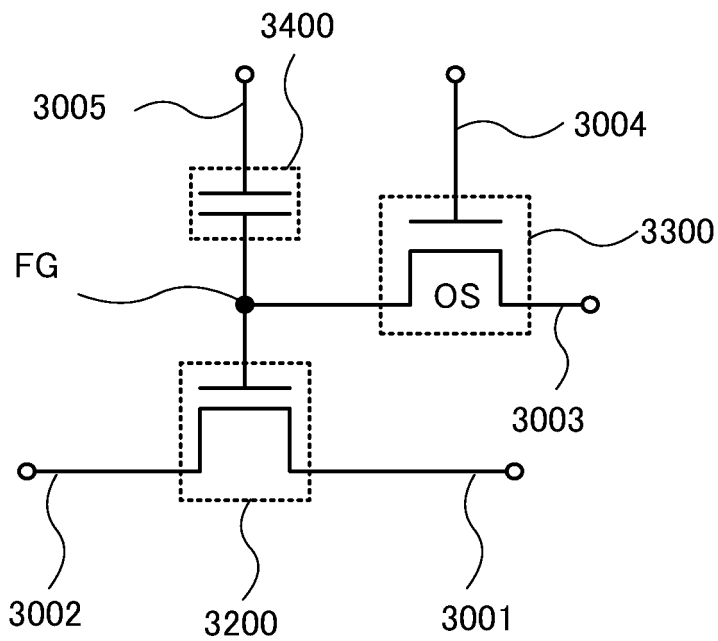


FIG. 28B

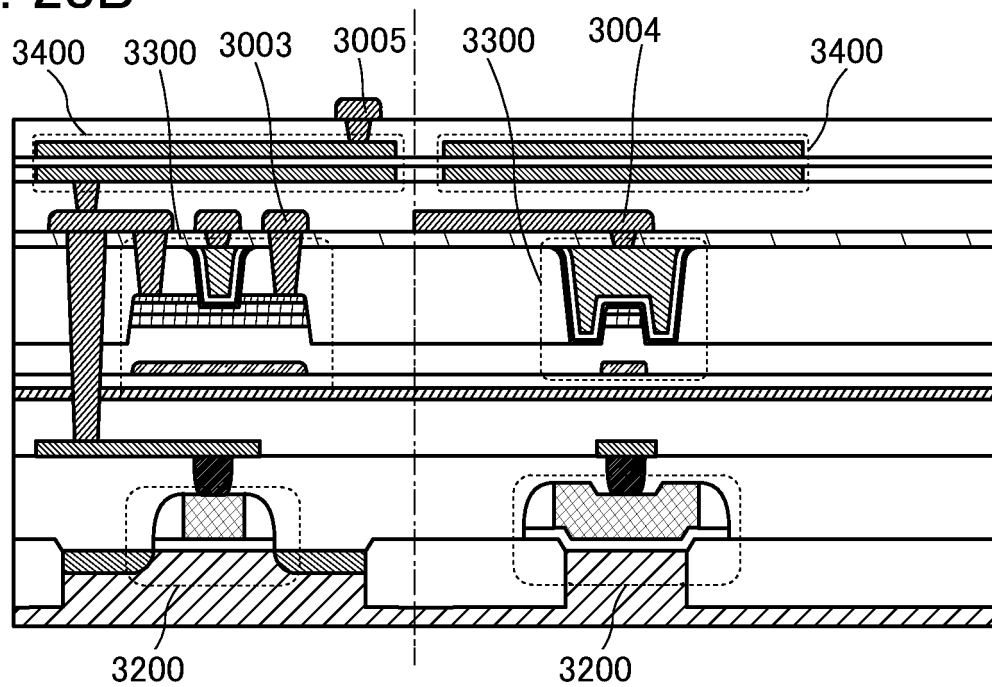


FIG. 28C

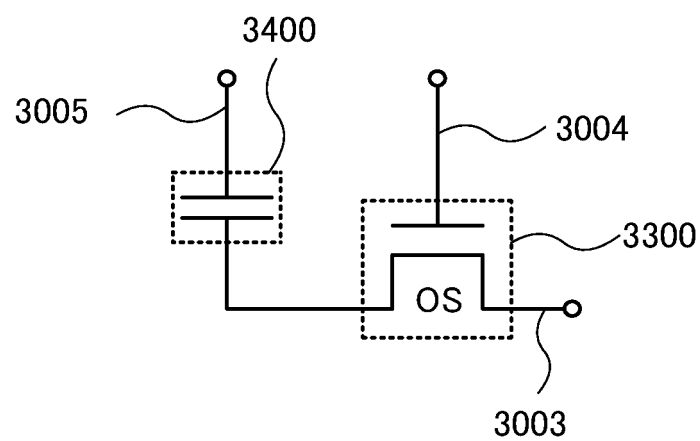


FIG. 29A

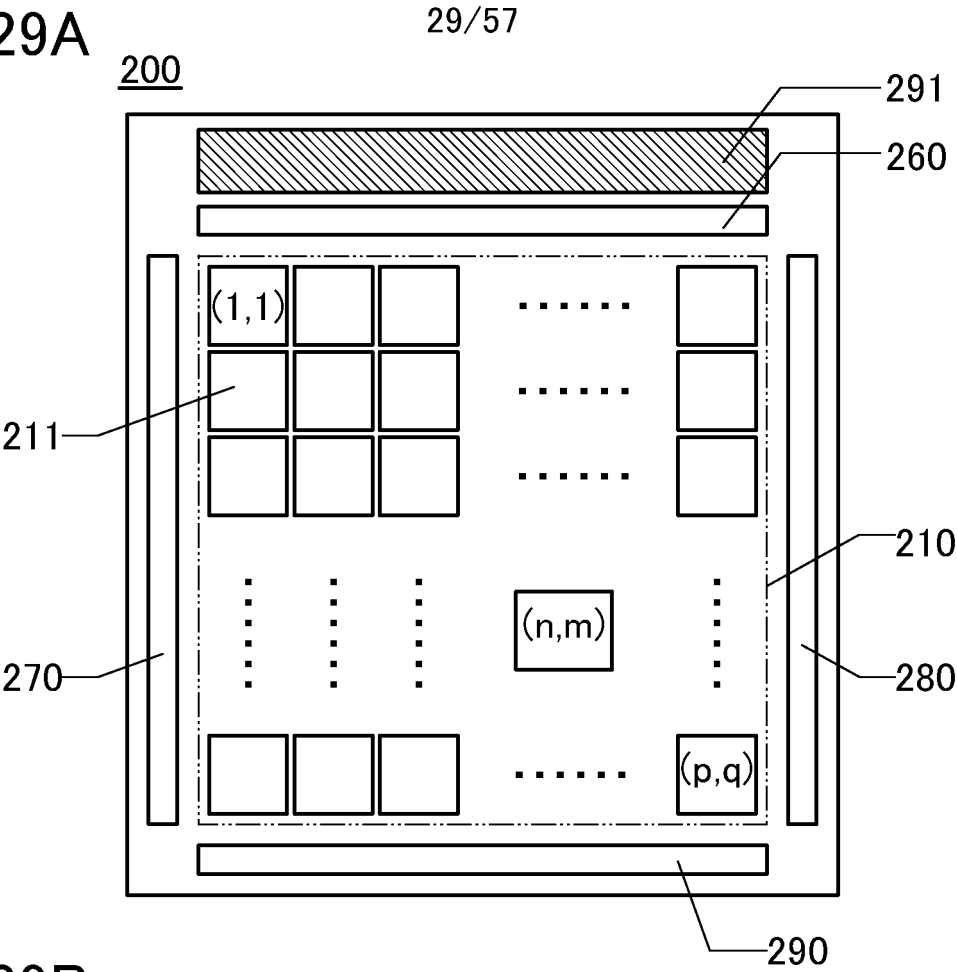


FIG. 29B

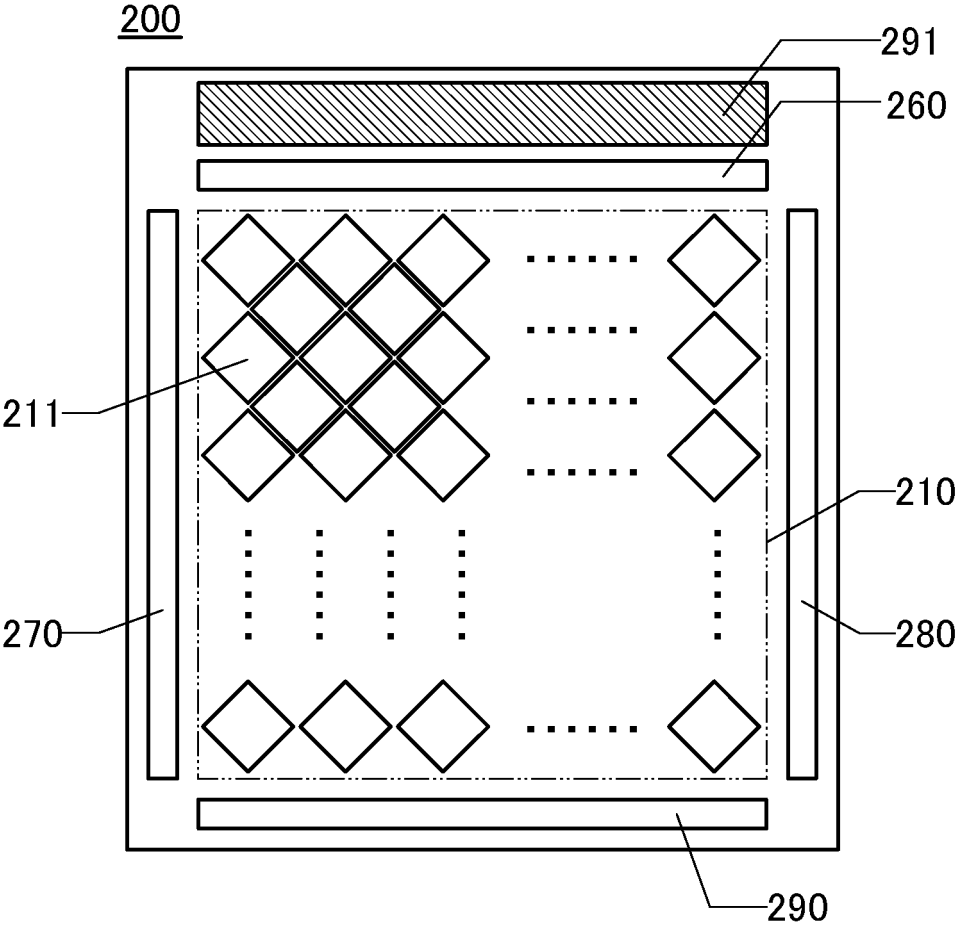


FIG. 31A

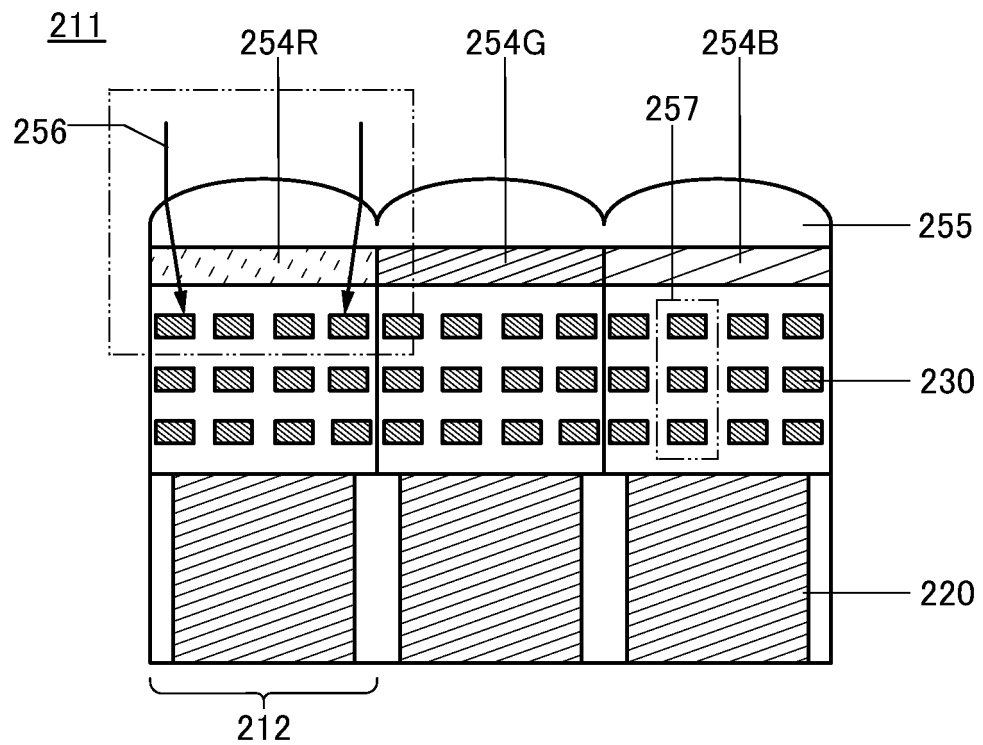


FIG. 31B

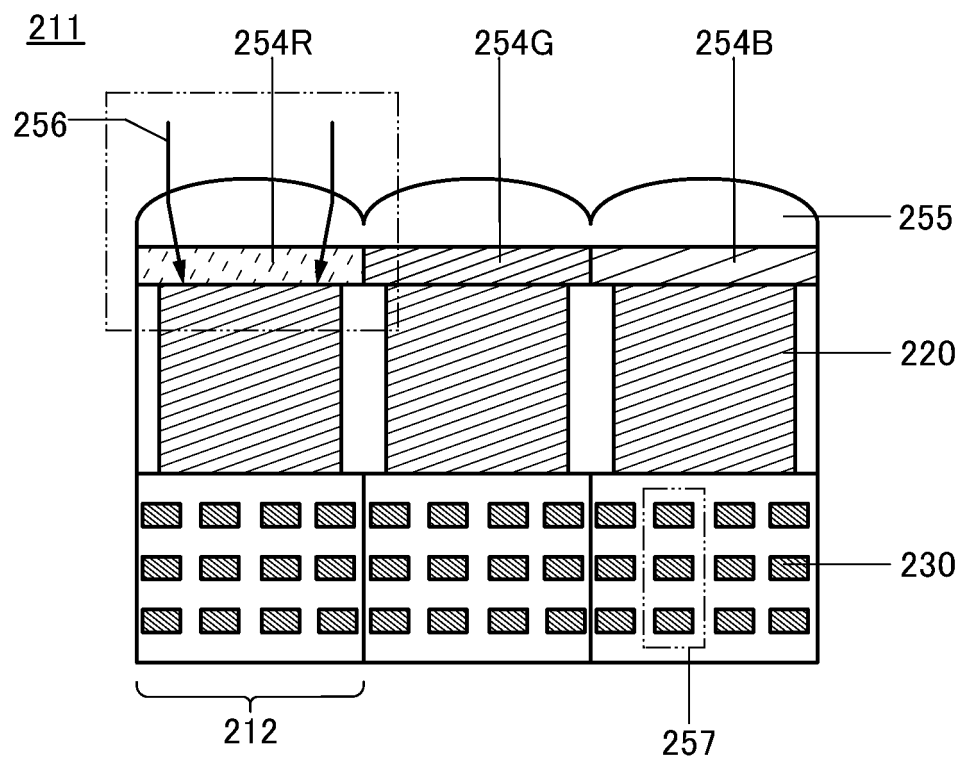


FIG. 32A

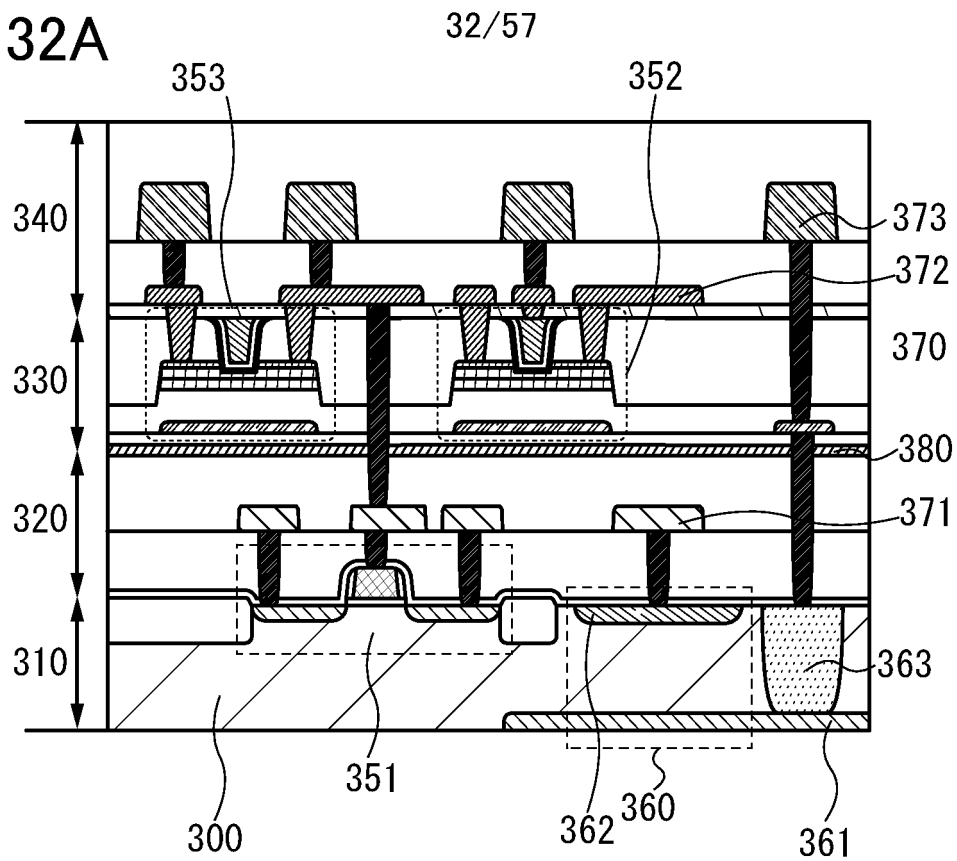


FIG. 32B

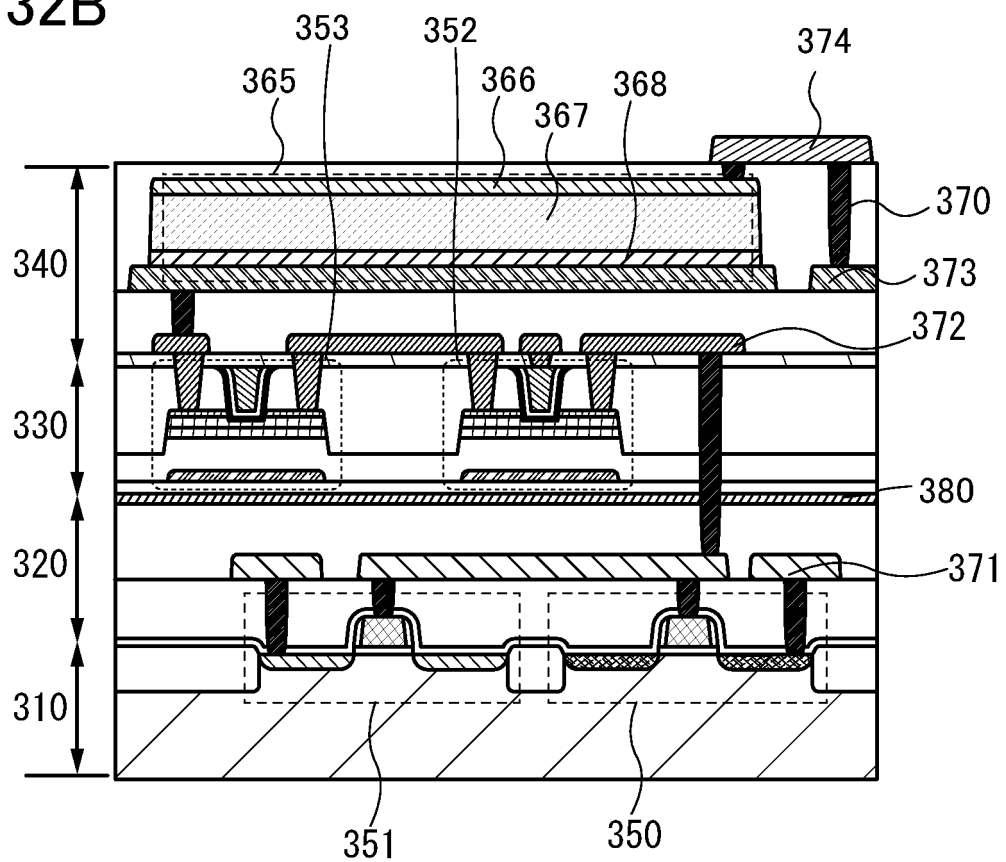


FIG. 33

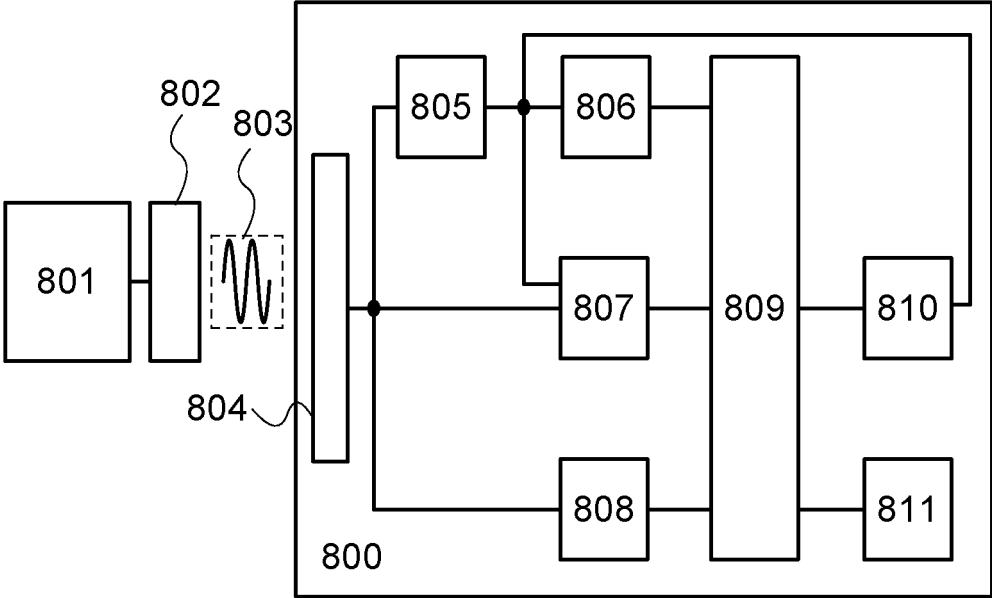


FIG. 34

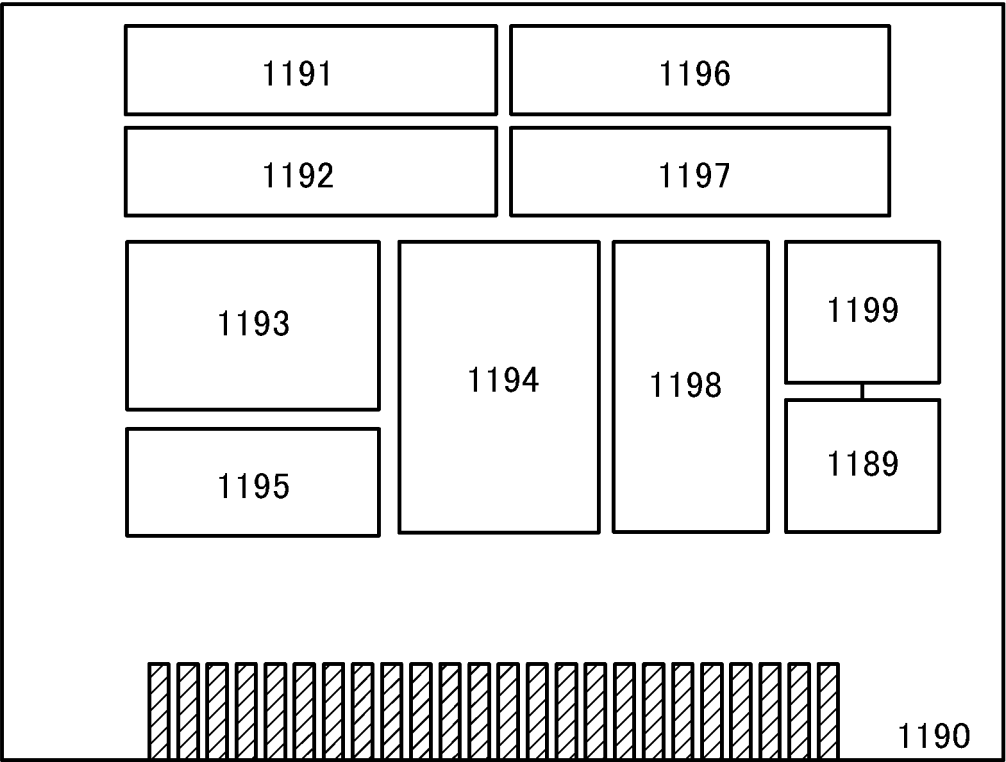
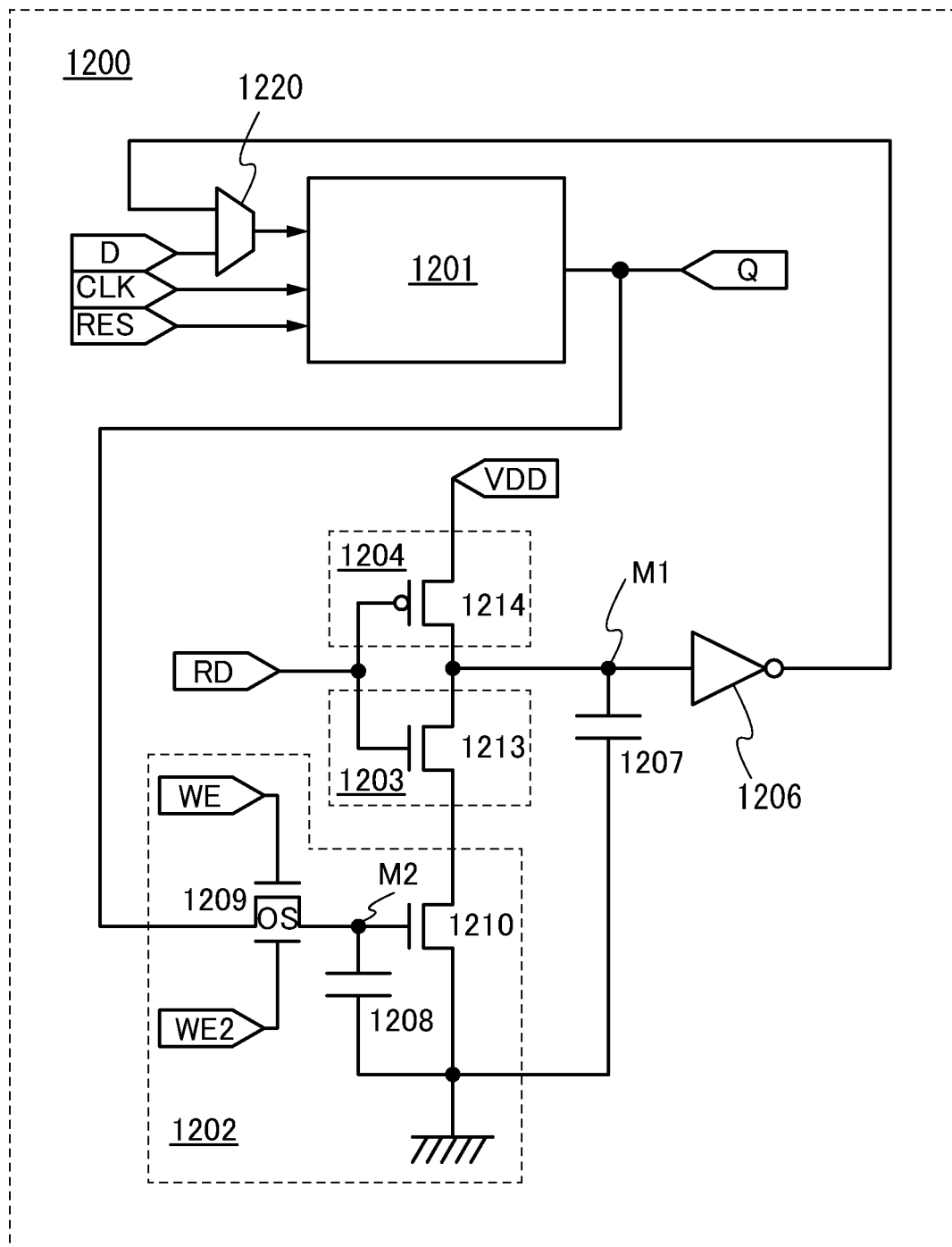


FIG. 35



36/57

FIG. 36A

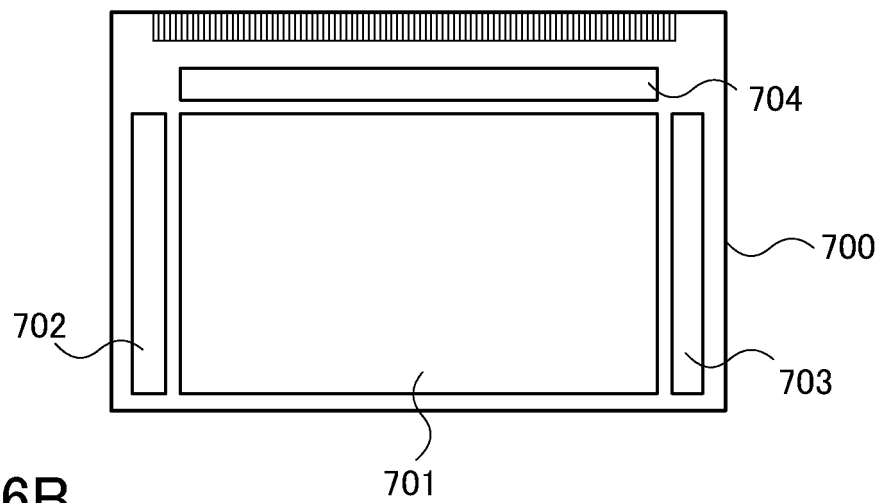


FIG. 36B

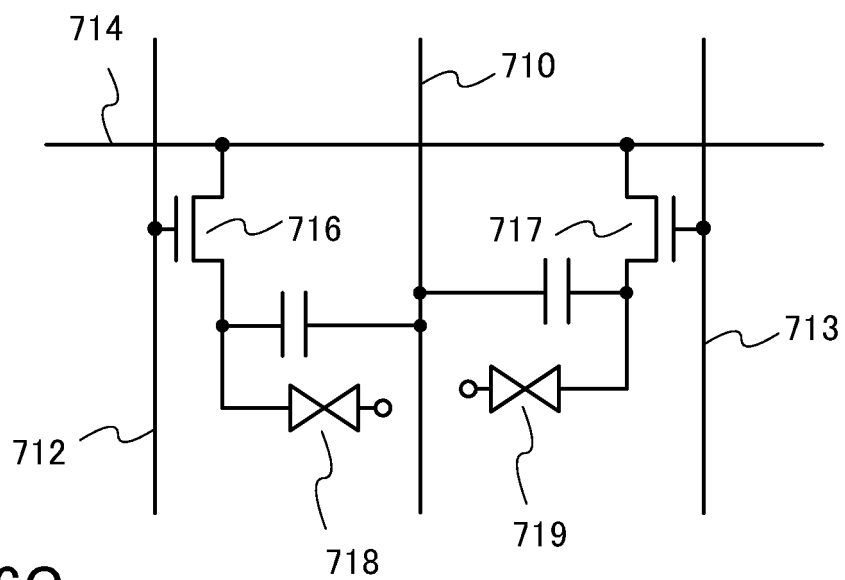


FIG. 36C

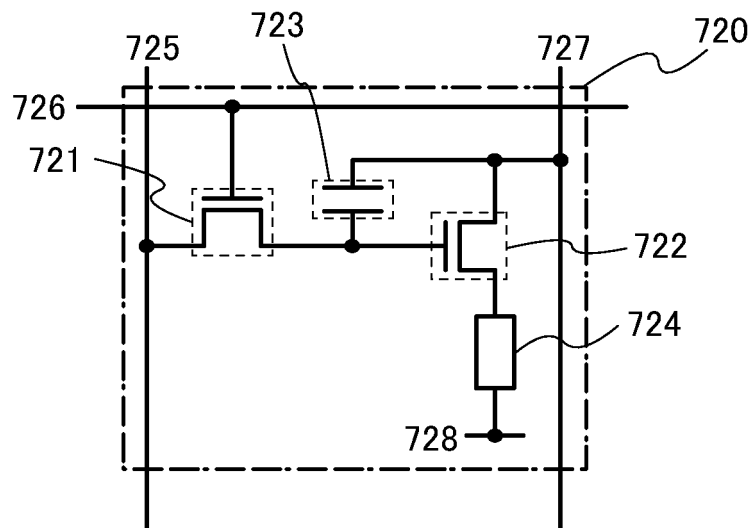
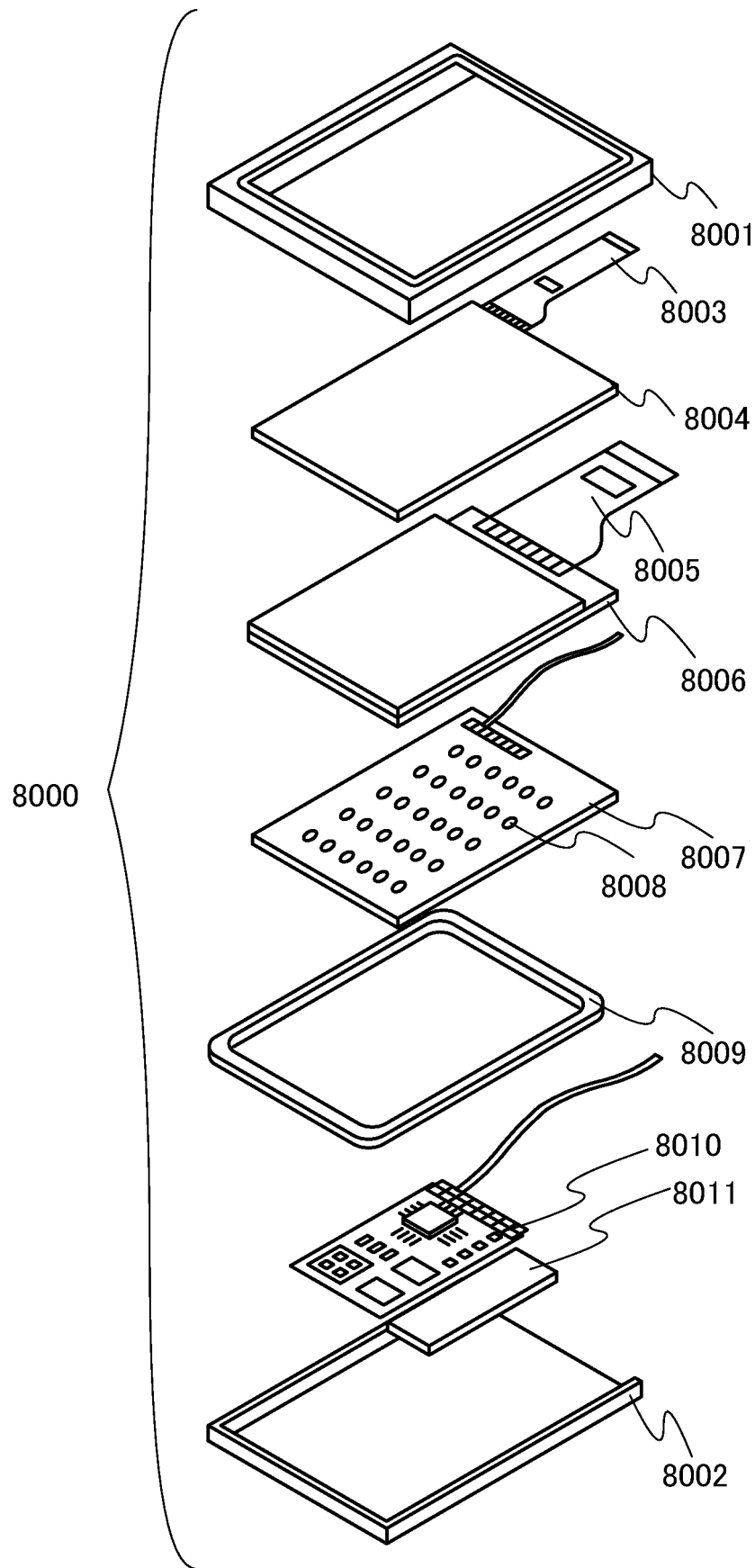


FIG. 37

37/57



38/57

FIG. 38A

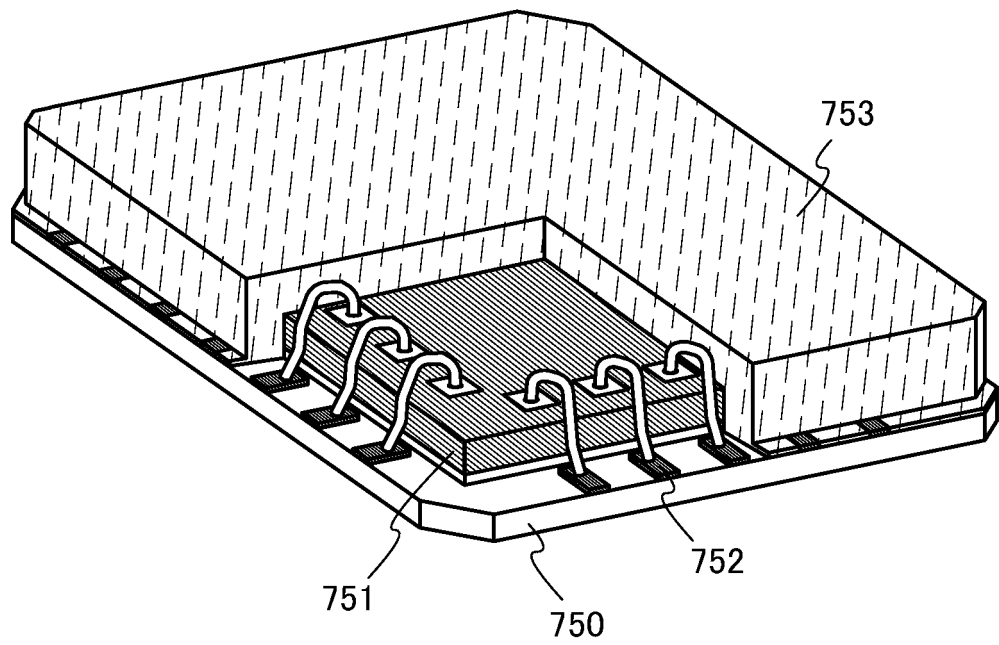


FIG. 38B

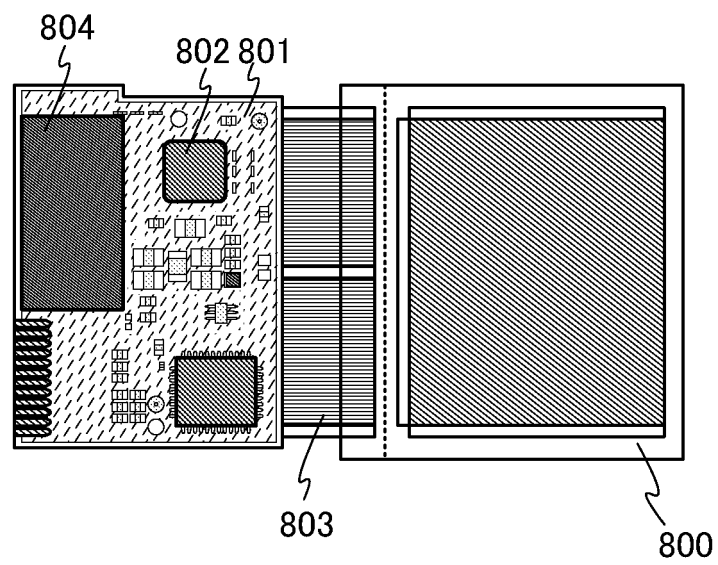


FIG. 39A

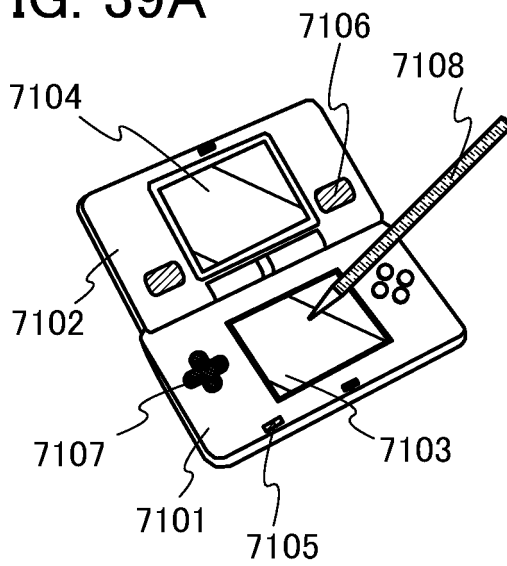


FIG. 39B

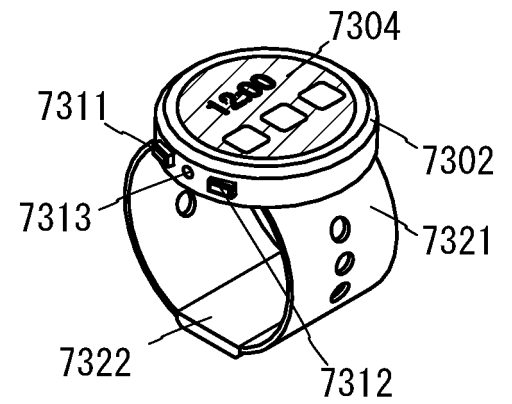


FIG. 39C

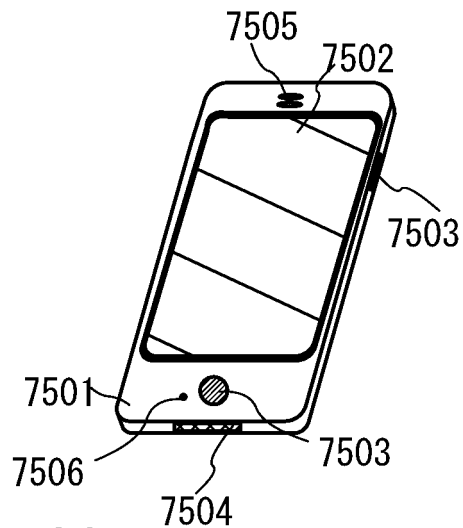


FIG. 39D

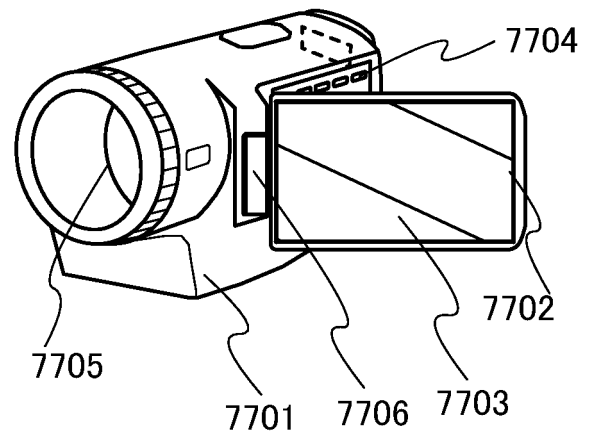


FIG. 39E

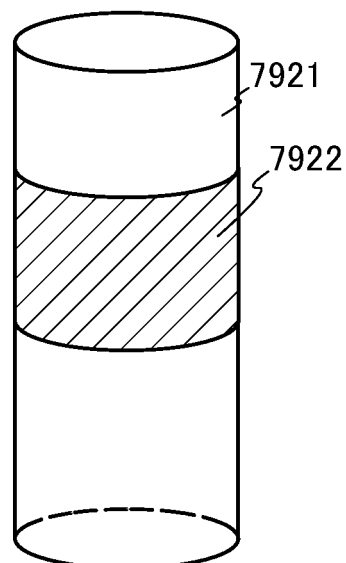
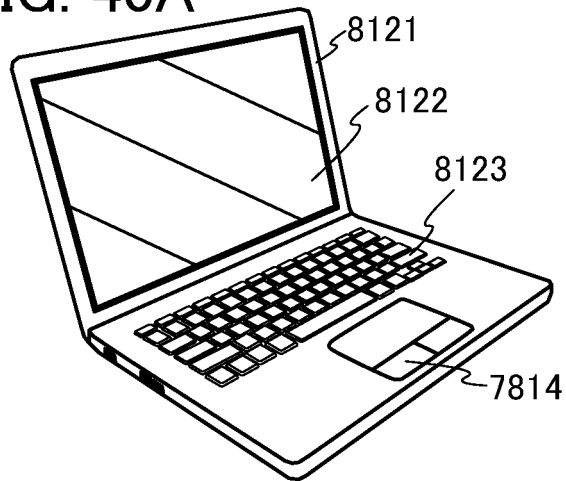


FIG. 40A



40/57

FIG. 40B

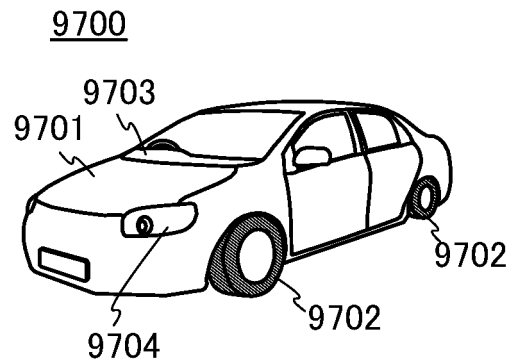


FIG. 40C

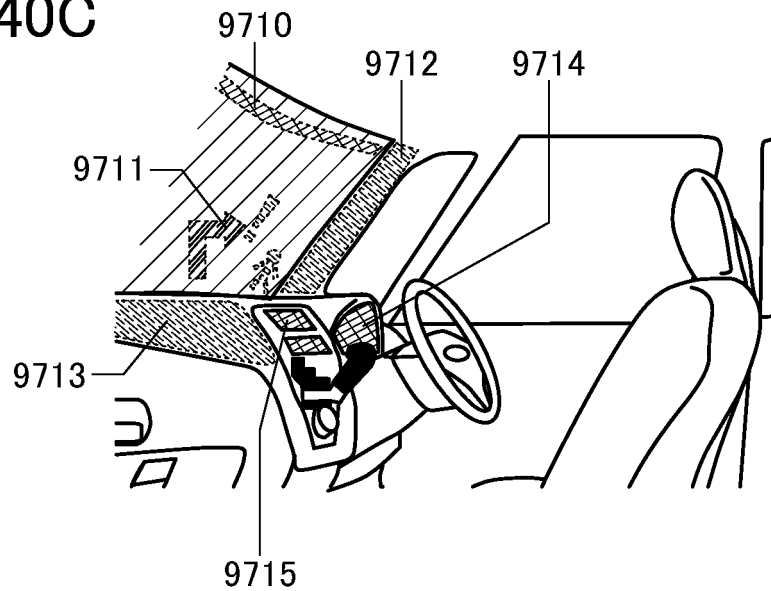
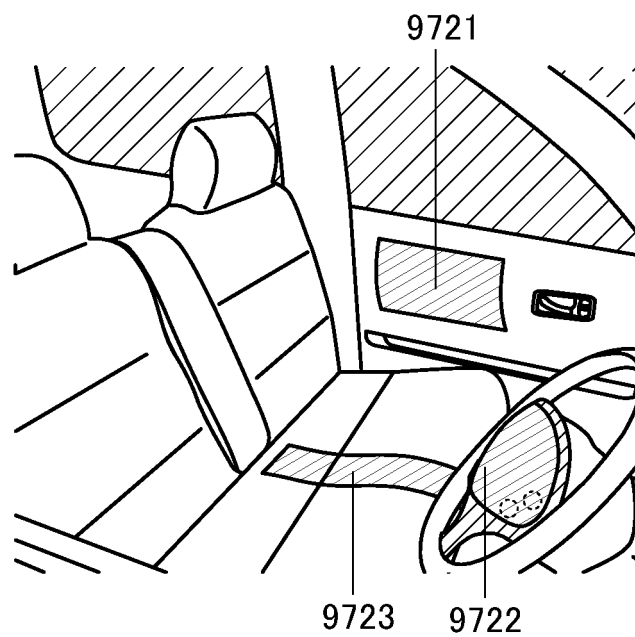


FIG. 40D



41/57

FIG. 41A

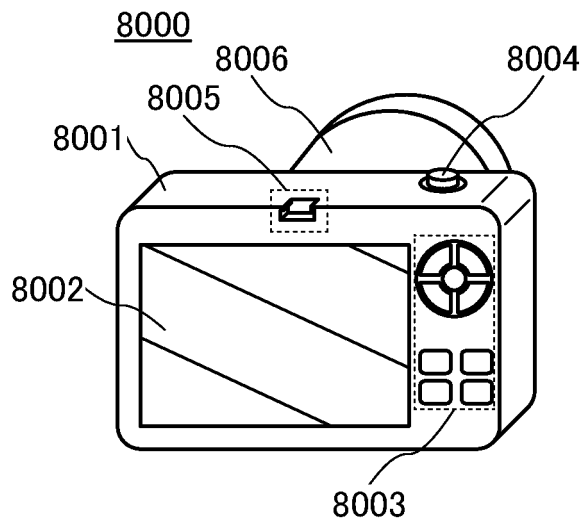


FIG. 41B

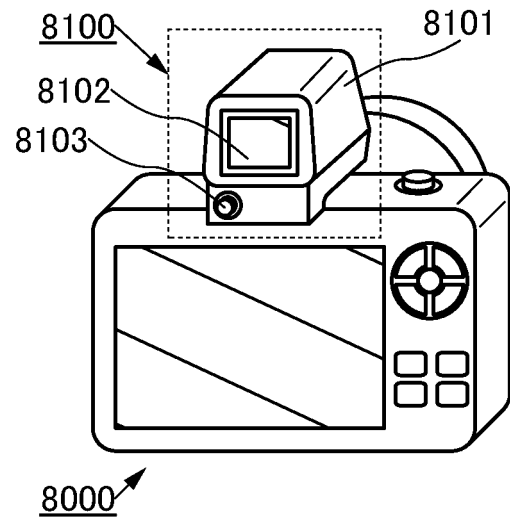
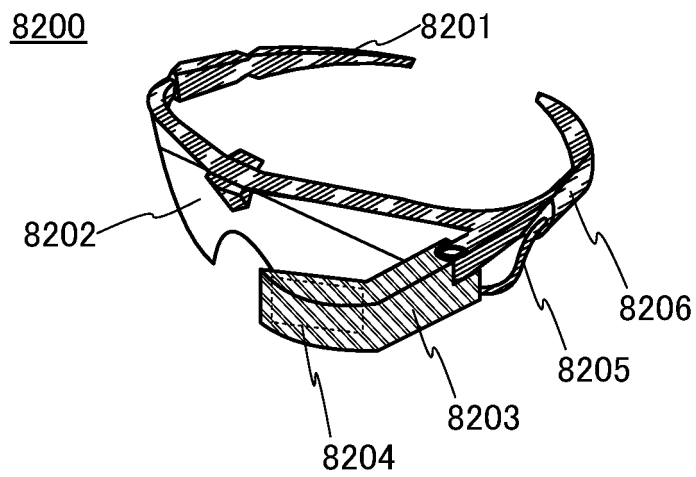


FIG. 41C



42/57

FIG. 42A

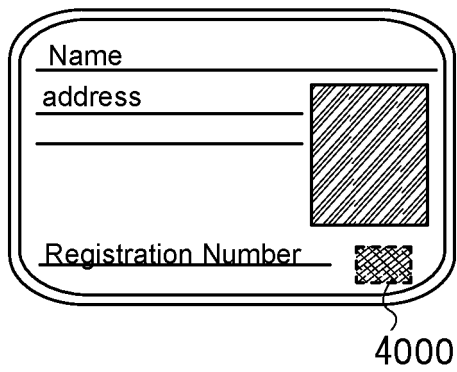


FIG. 42B

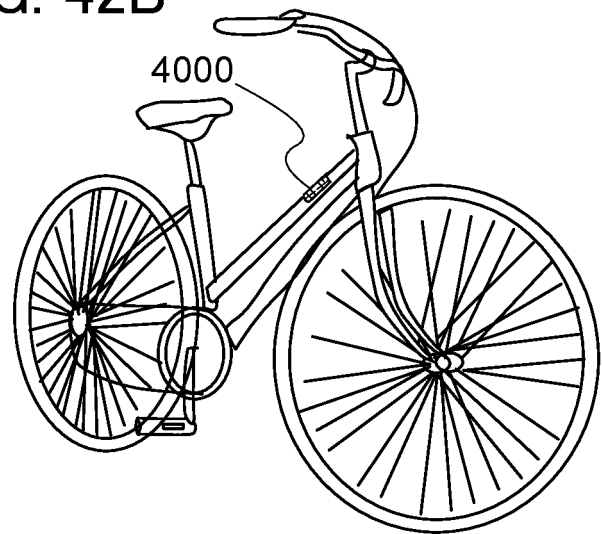


FIG. 42C

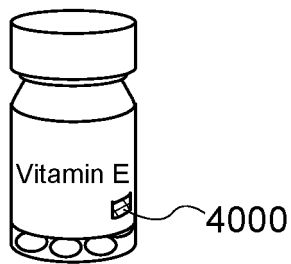


FIG. 42D

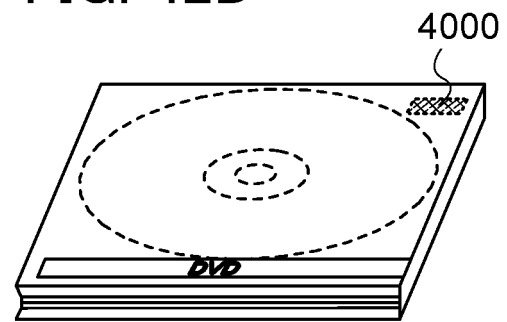


FIG. 42E



FIG. 42F

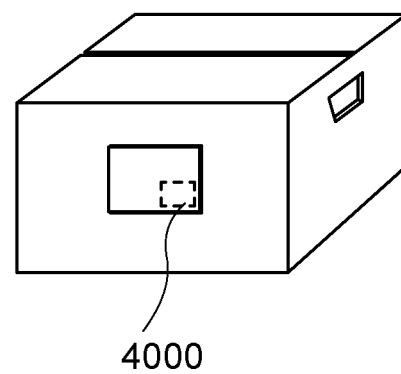


FIG. 43

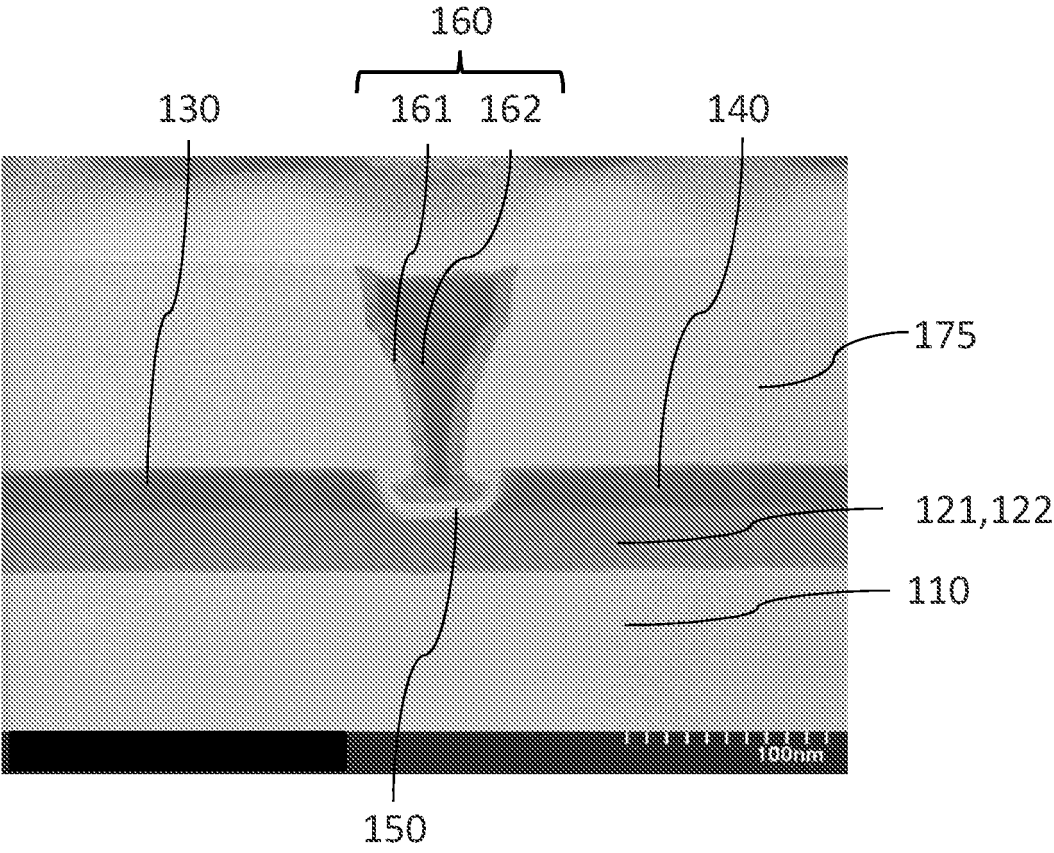


FIG. 44A

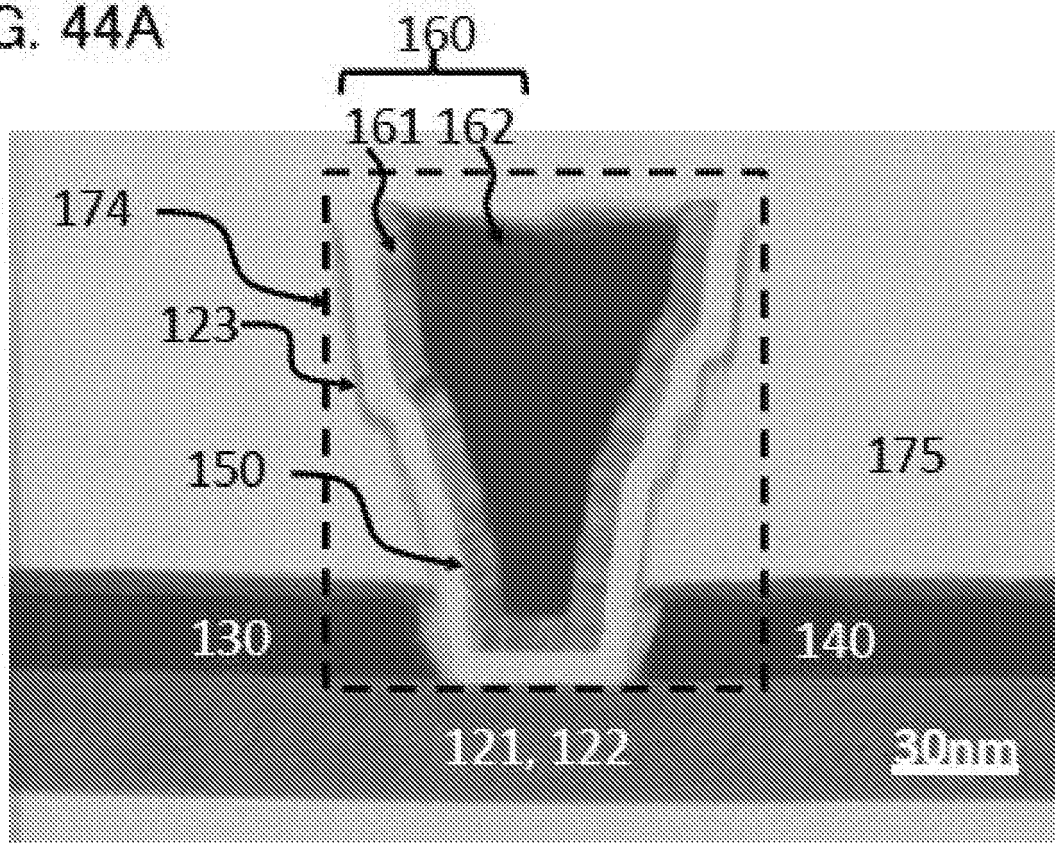


FIG. 44B

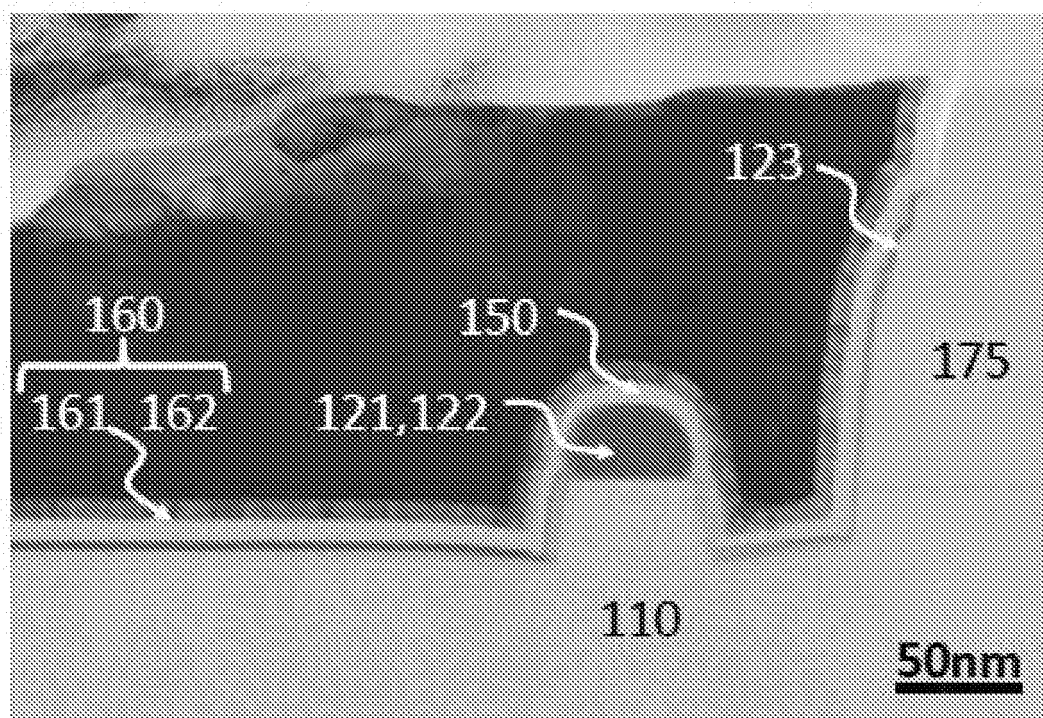
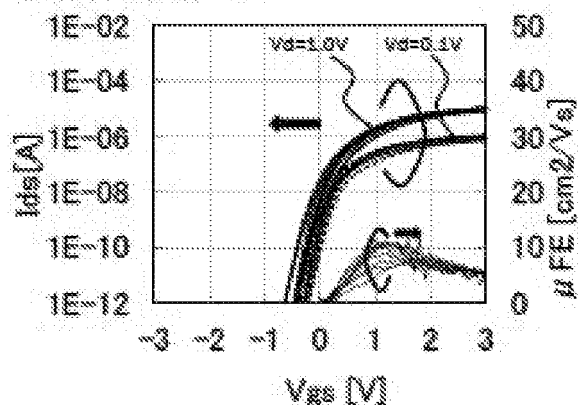
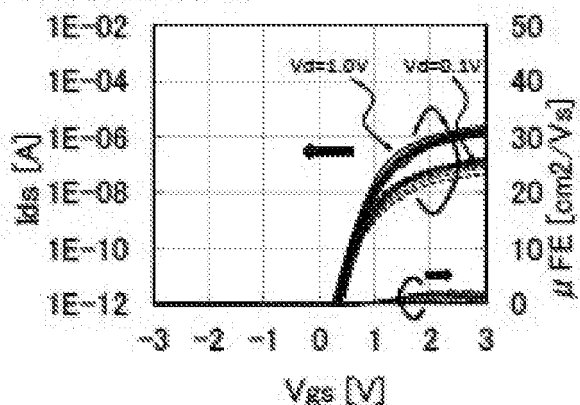


FIG. 45

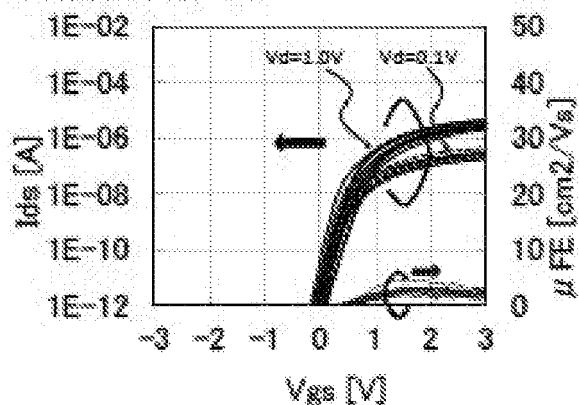
Condition 1



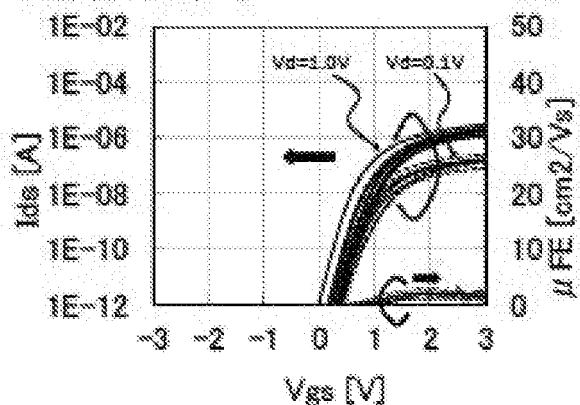
Condition 4



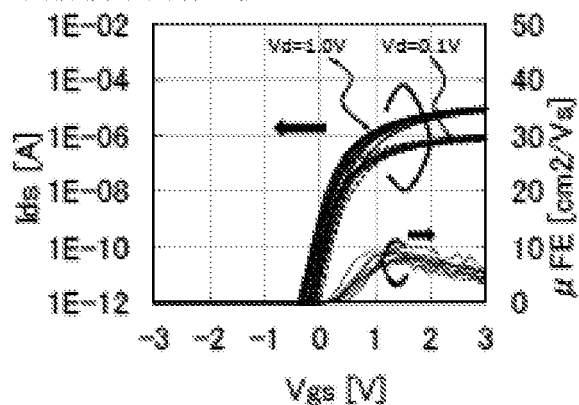
Condition 2



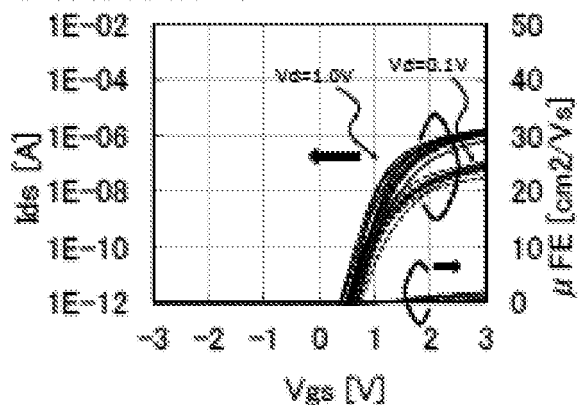
Condition 5



Condition 3

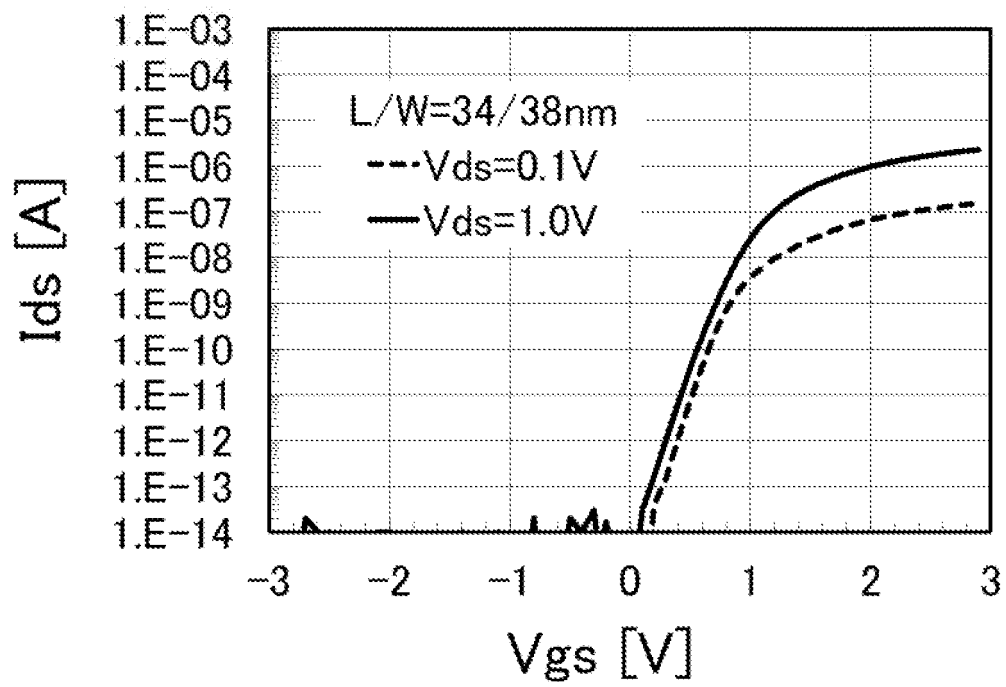


Condition 6



46/57

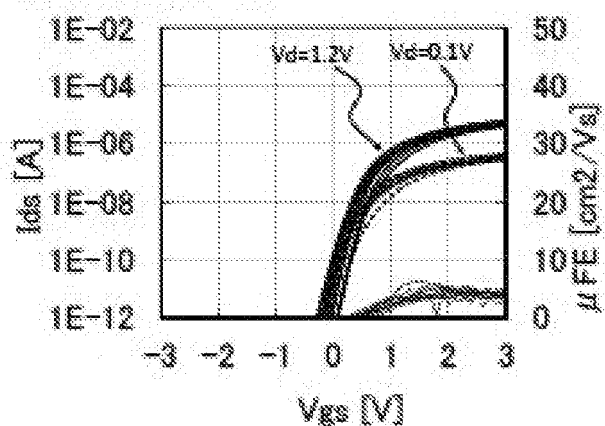
FIG. 46



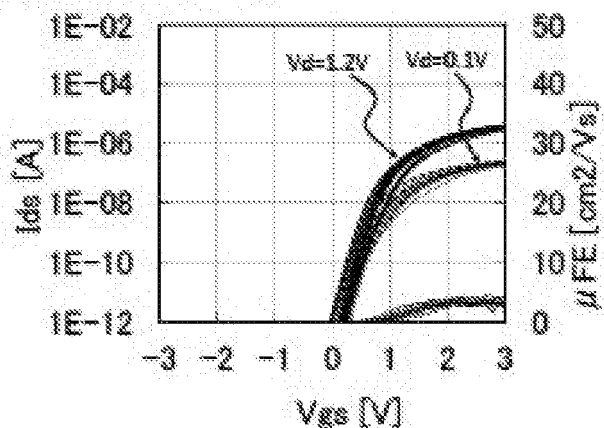
47/57

FIG. 47

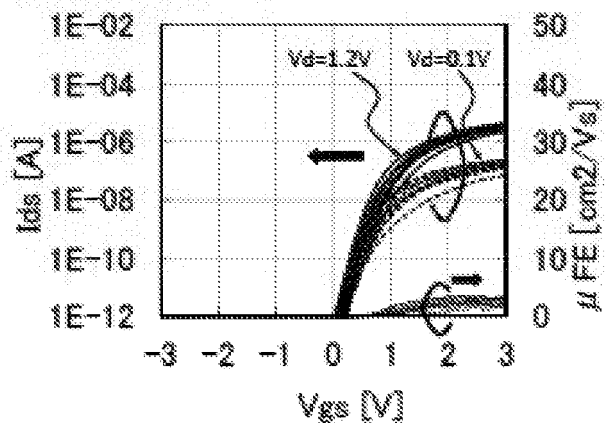
Condition 2



Condition 5



Condition 4



Condition 6

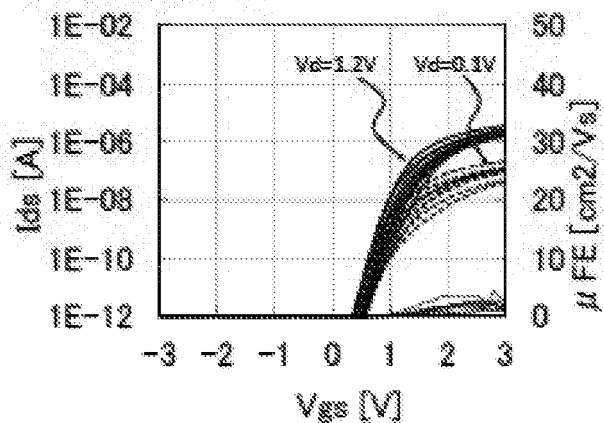


FIG. 48

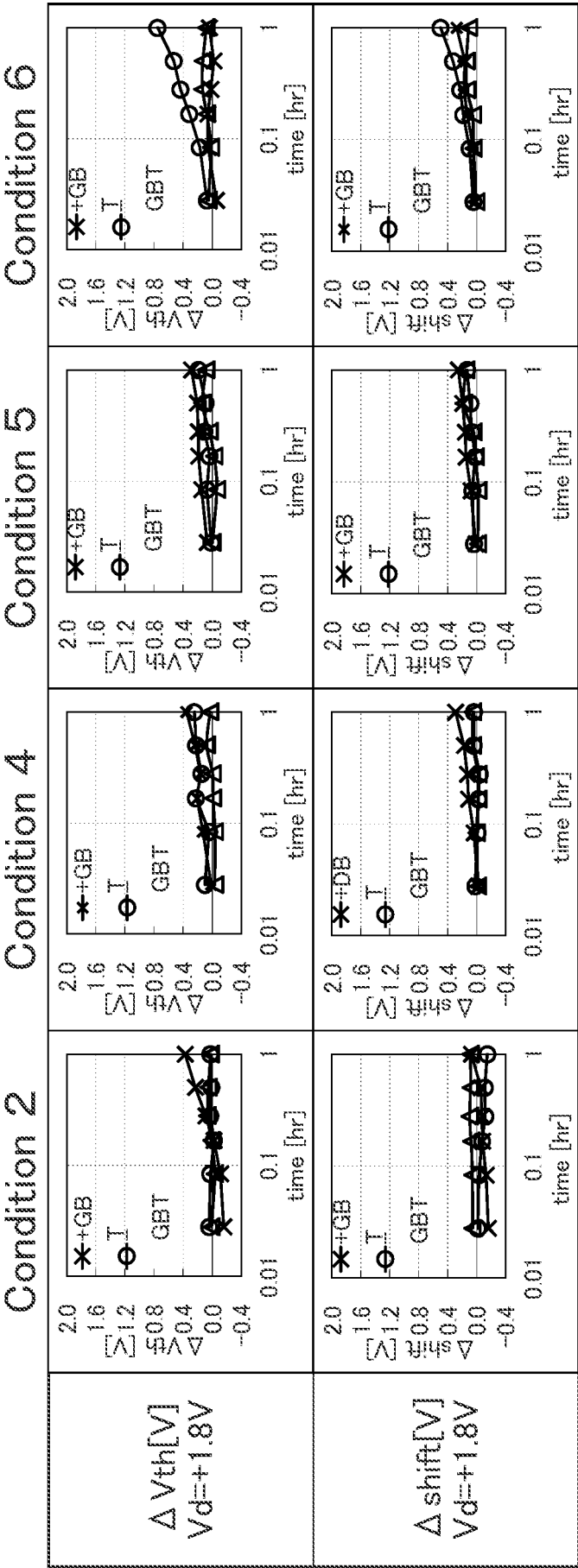


FIG. 49

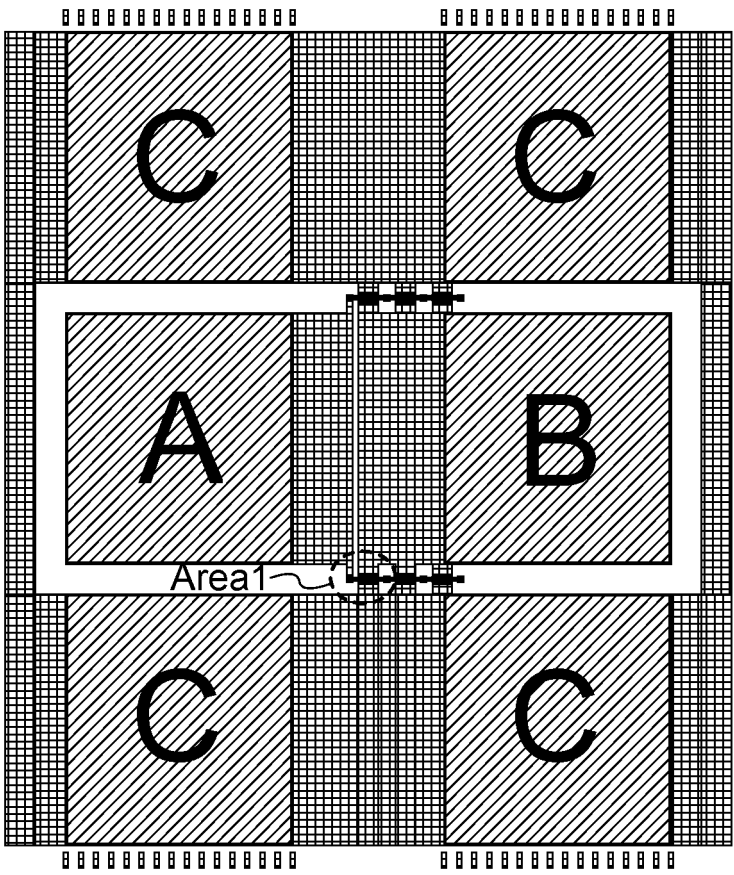
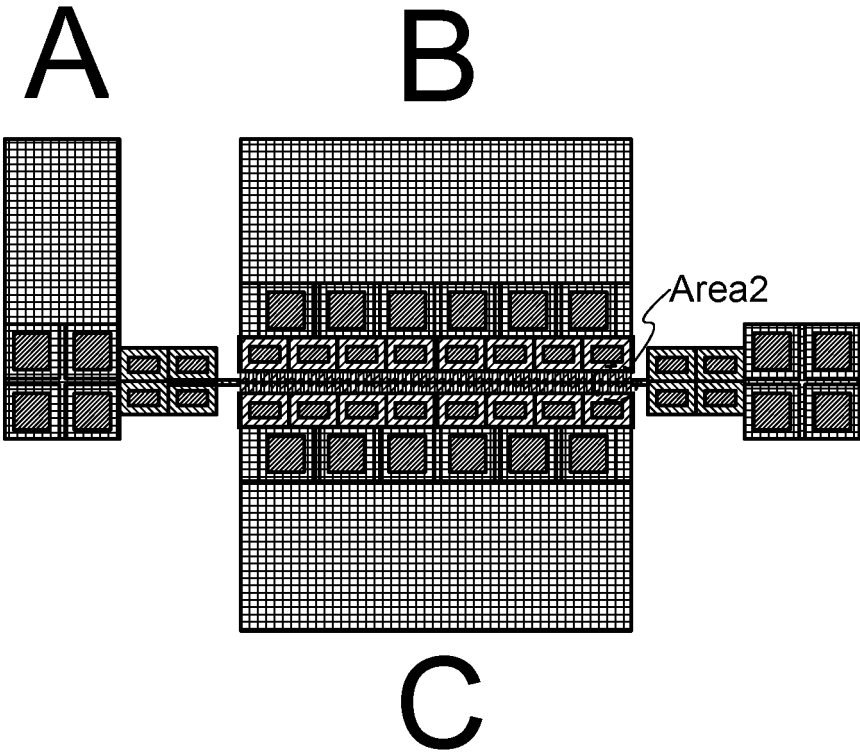


FIG. 50



51/57

FIG. 51

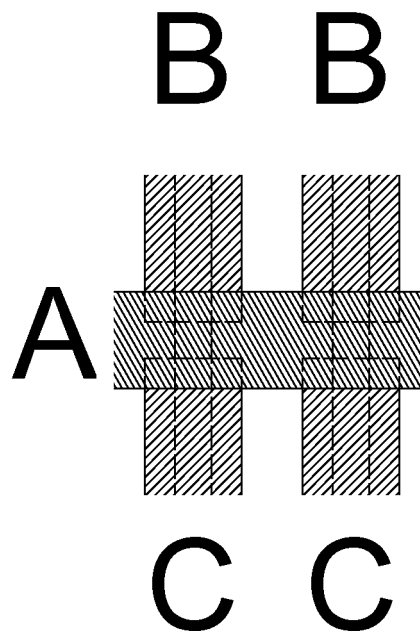


FIG. 52

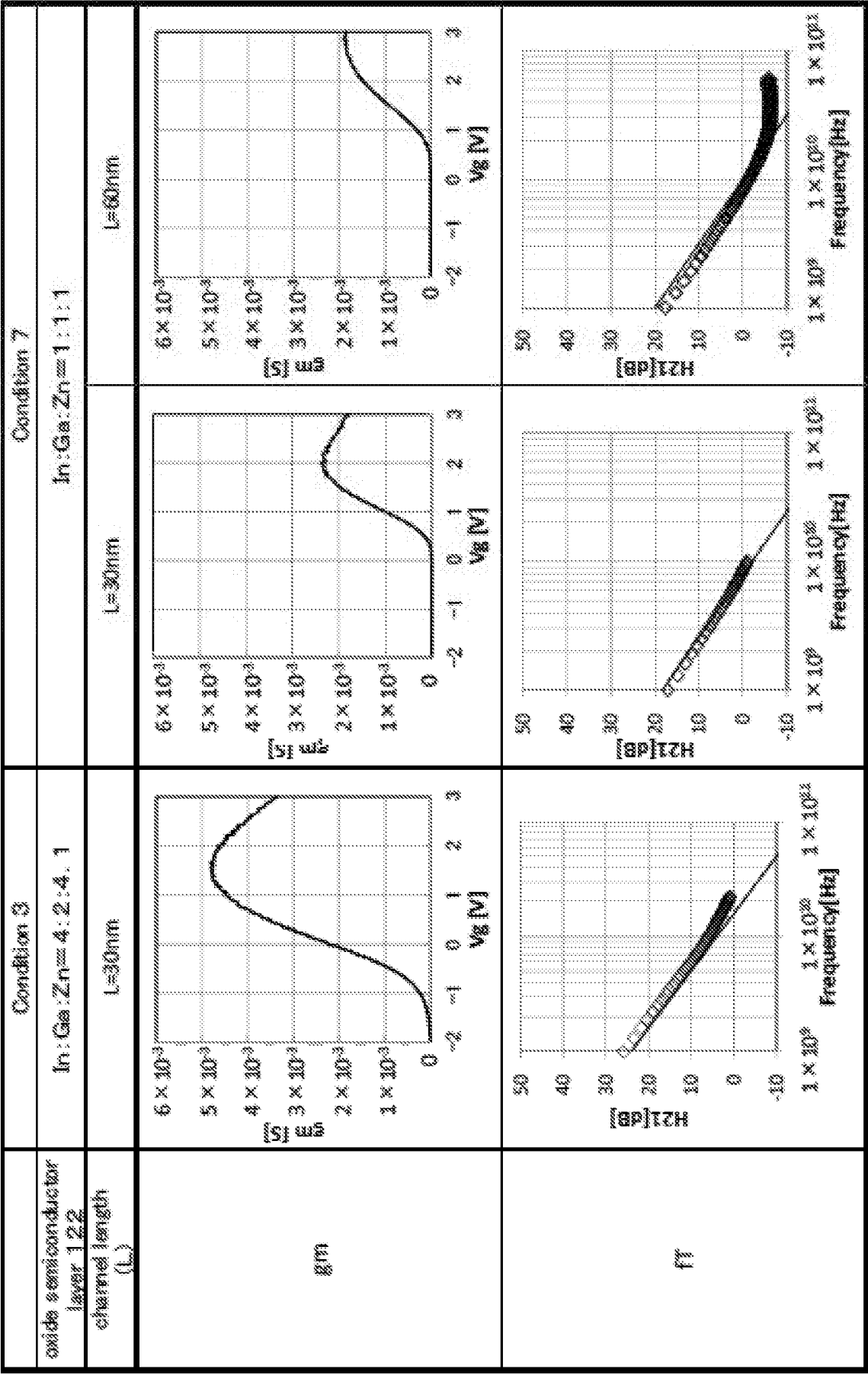


FIG. 53A

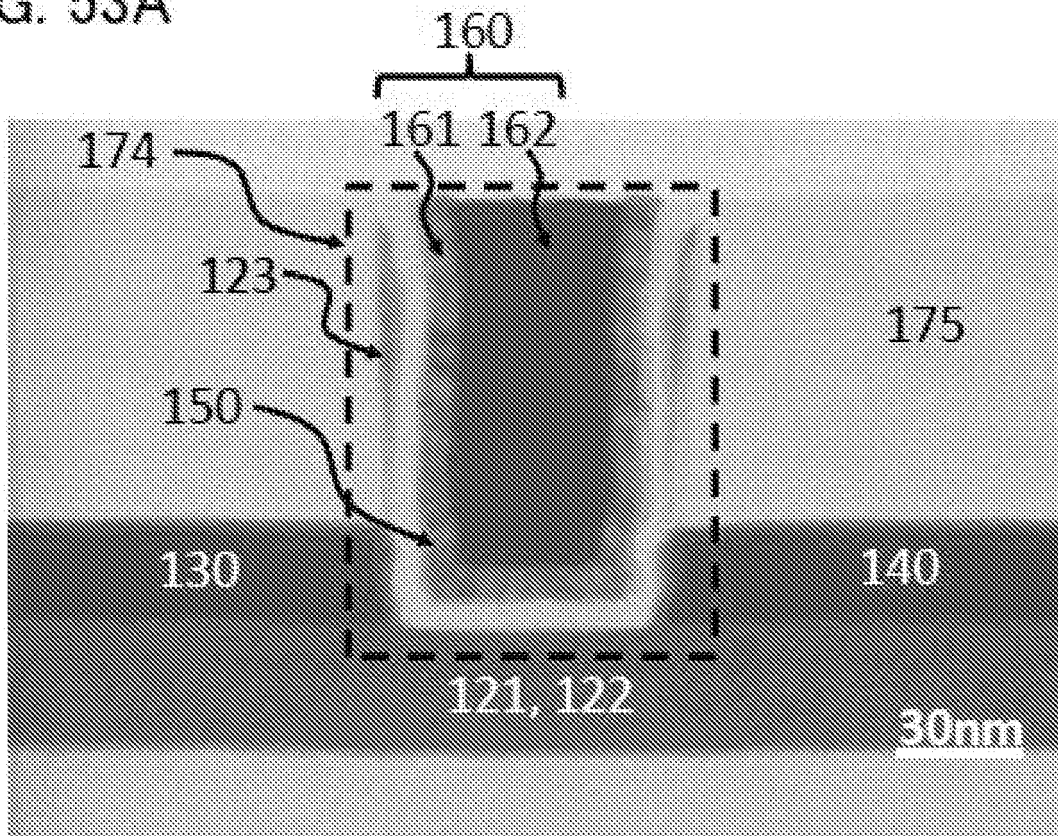


FIG. 53B

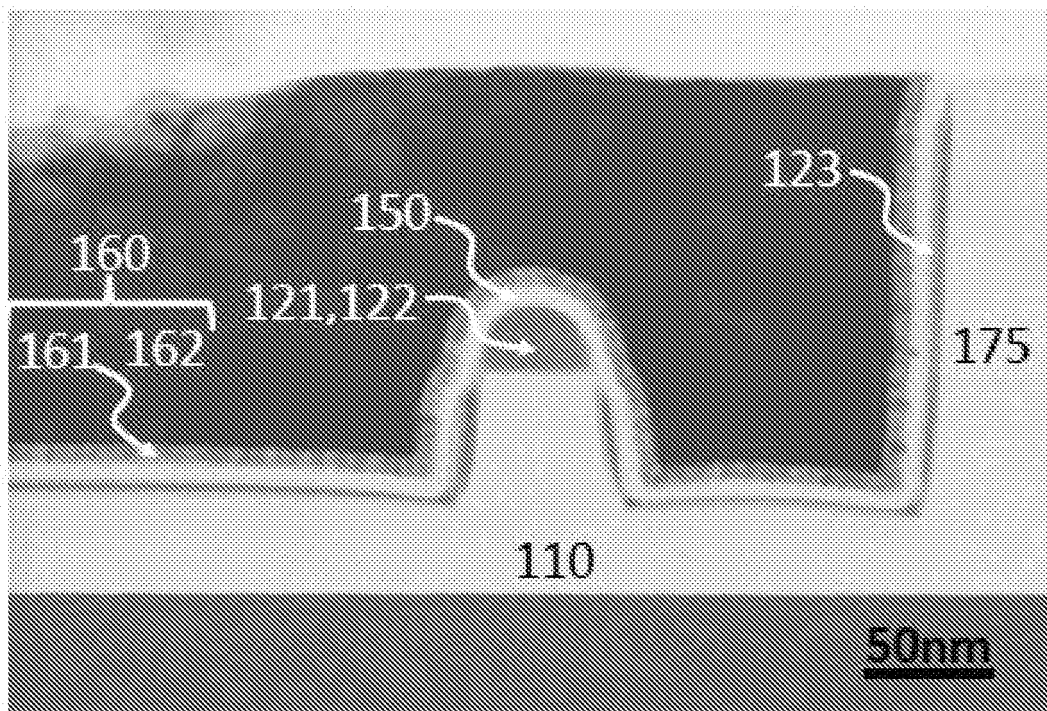


FIG. 54

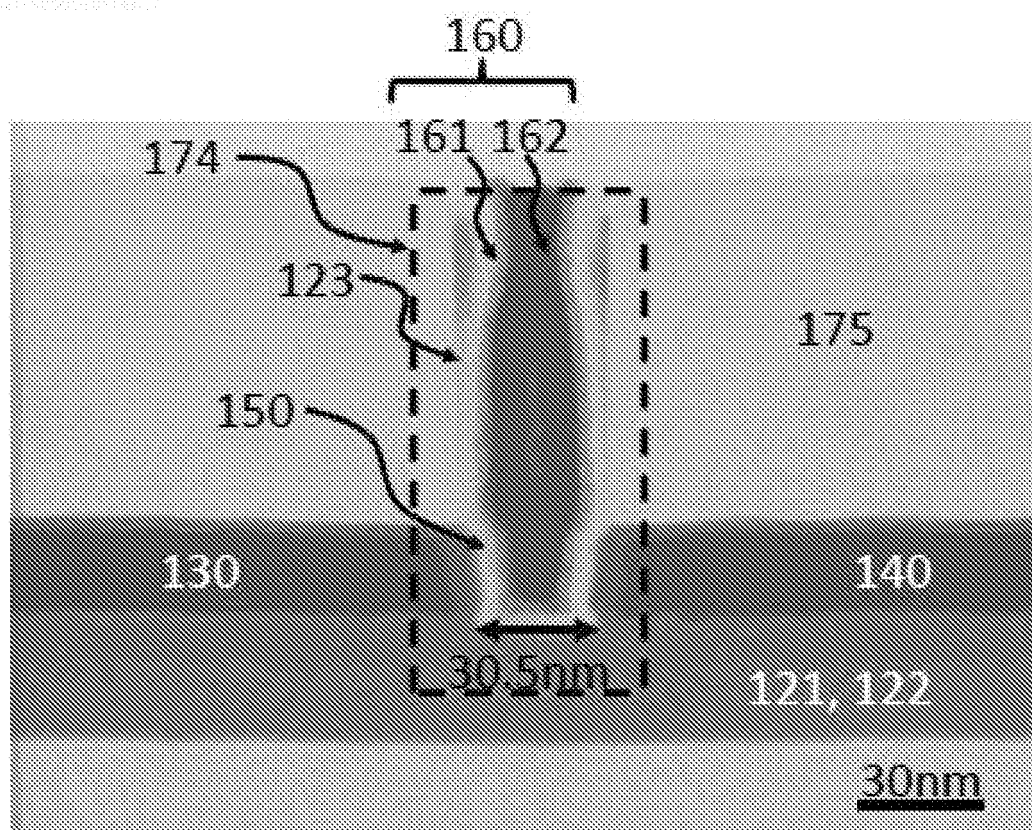


FIG. 55

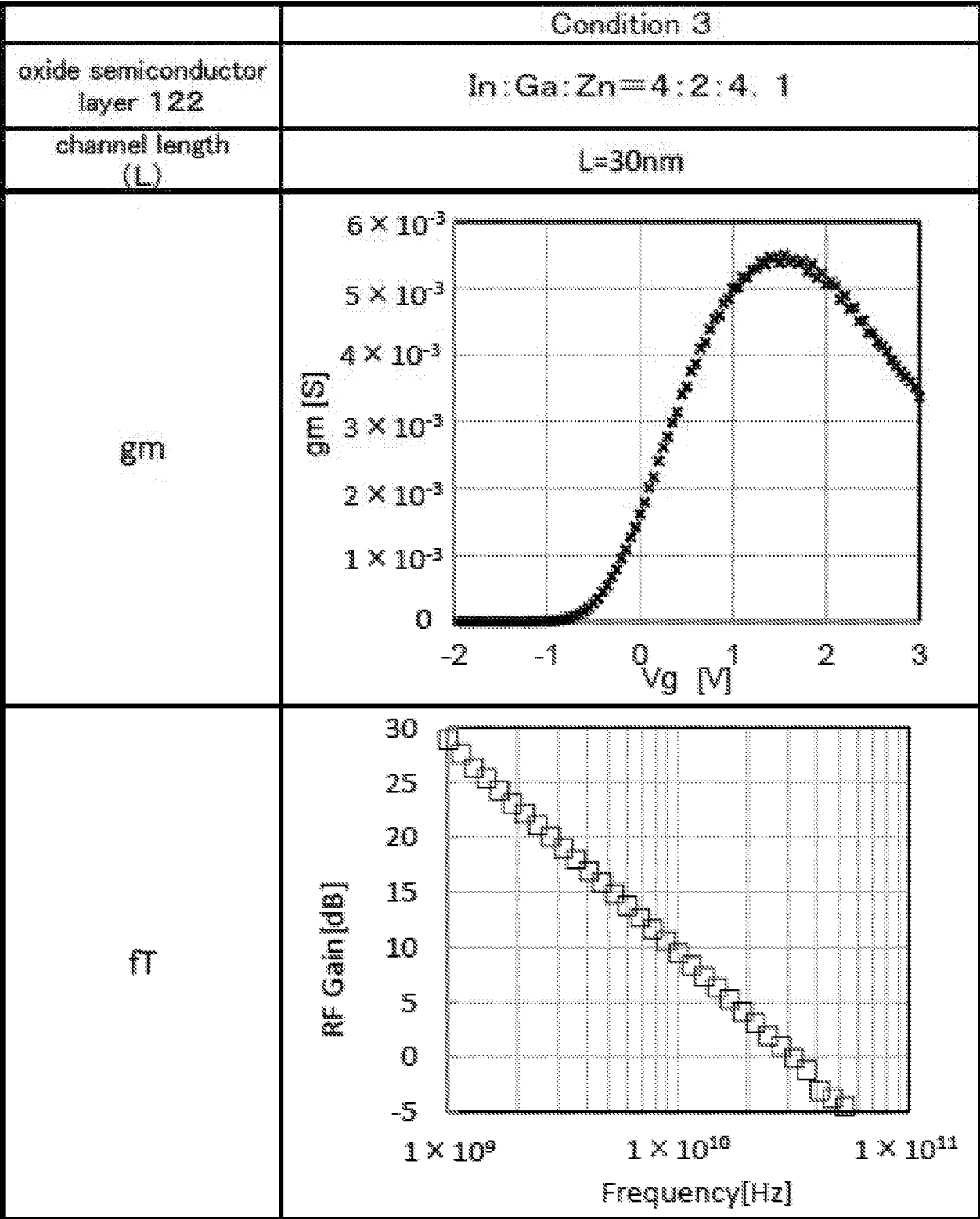


FIG. 56

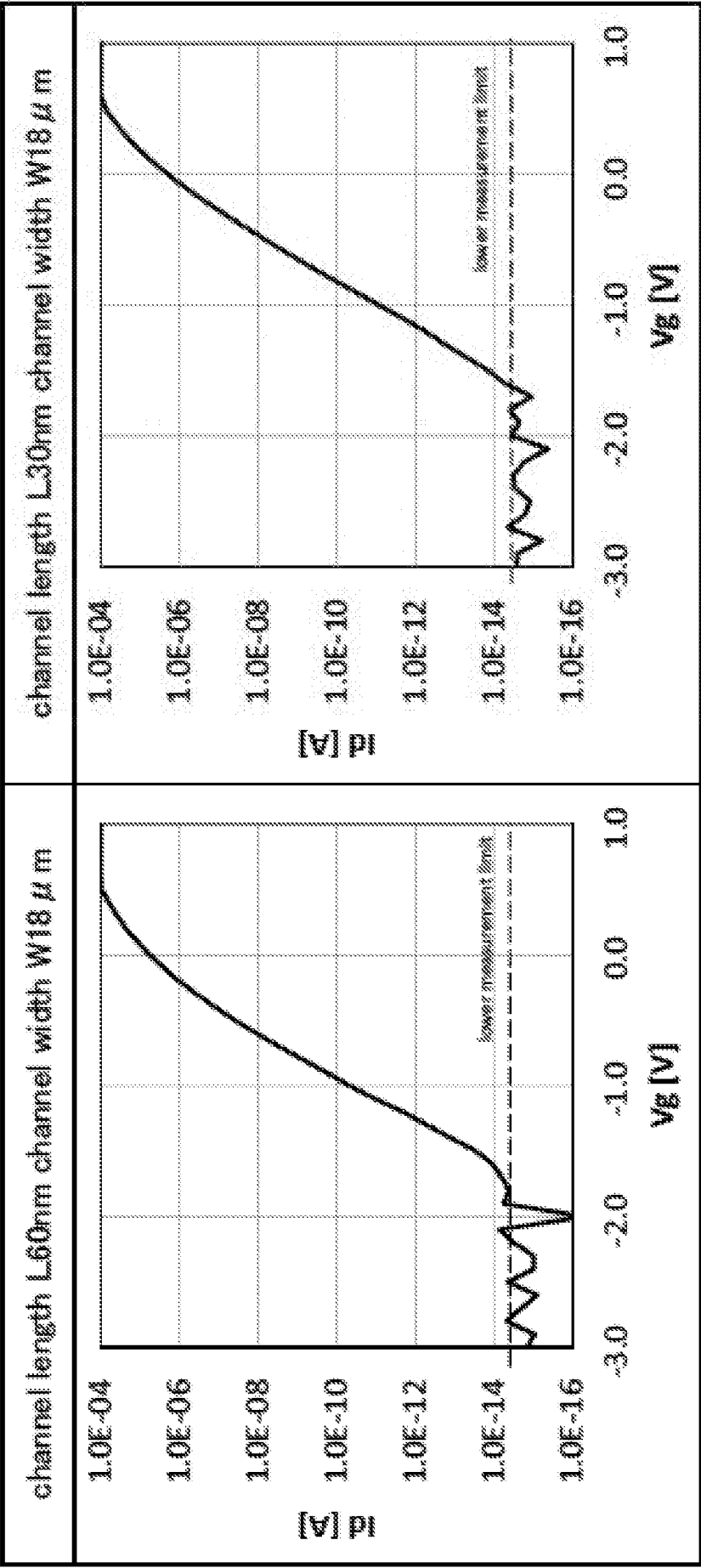
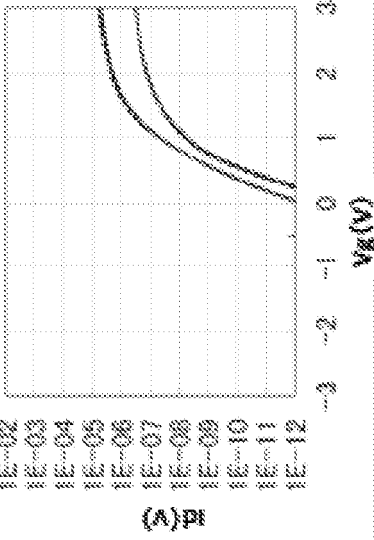
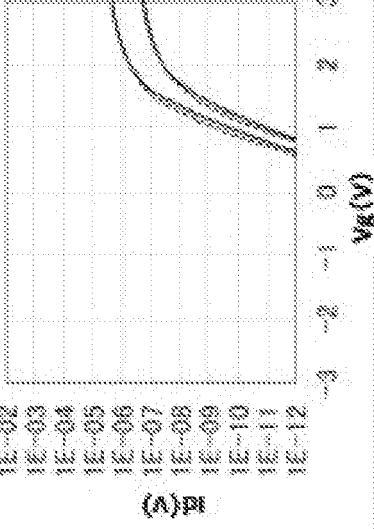
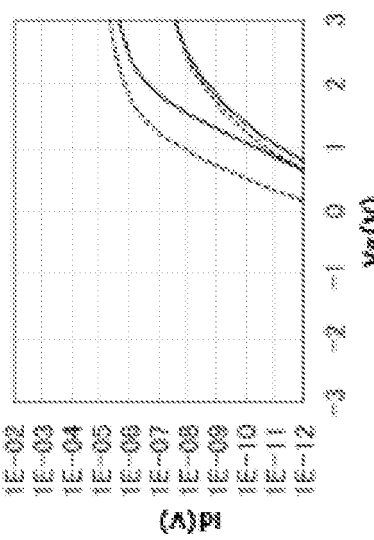
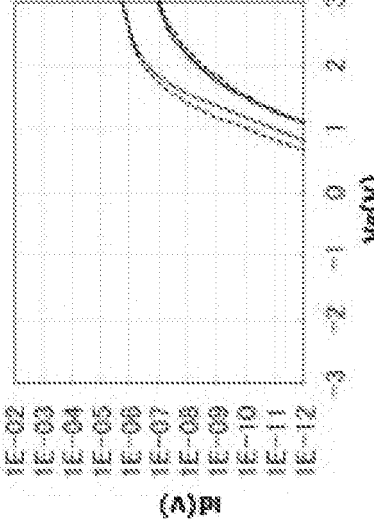


FIG. 57

----- before the source is etched and the data electrode are well closed
— after the source electrode and the data is electrode are well closed

additional heat treatment	not performed	400°C N2 1hr.
before positive drain BT stress test	 (A) PI	 (A) PI
$\Delta V_{th} @ V_d = 1.8V [V]$	0.03	0.05
$\Delta Shift @ V_d = 1.8V [V]$	0.01	0.05
after positive drain BT stress test	 (A) PI	 (A) PI
$\Delta V_{th} @ V_d = 1.8V [V]$	0.63	0.14
$\Delta Shift @ V_d = 1.8V [V]$	0.50	0.09