



(12) **United States Patent**
Matsuda et al.

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(54) **SEMICONDUCTOR DEVICE UTILIZING DUMMY FEATURES TO FORM UNIFORM SIDEWALL STRUCTURES**

5,923,969 A	*	7/1999	Oyamatsu	438/183
6,096,641 A	*	8/2000	Kunikiyo	438/653
6,204,137 B1	*	3/2001	Teo et al.	438/305
6,306,755 B1	*	10/2001	Zheng	438/631
6,384,450 B1	*	5/2002	Hidaka et al.	257/321
2001/0055842 A1	*	12/2001	Uh et al.	438/183
2002/0076867 A1	*	6/2002	Lee et al.	438/183

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(73) **Assignee:** **Matsushita Electric Industrial Co., Ltd., Osaka (JP)**

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

FOREIGN PATENT DOCUMENTS

JP 11330427 A * 11/1999 H01L/27/115

* cited by examiner

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(30) **Foreign Application Priority Data**

Nov. 27, 2001 (JP) 2001-361244

(51) **Int. Cl.⁷** **H01L 23/52**

(52) **U.S. Cl.** **257/365; 257/774**

(58) **Field of Search** 257/202, 365, 257/508, 513, 623, 774, 775; 438/639, 926

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,883,436 A * 3/1999 Sadjadi et al. 257/760

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(57) **ABSTRACT**

An inventive semiconductor device includes: a substrate; a plurality of first projections each including at least a gate electrode and formed on the substrate; and a plurality of second projections formed on the substrate. When a contour surface constituted by the uppermost face of the substrate and by side and upper faces of the first and second projections is measured for every partial area per unit area of the substrate, the maximum partial area of the contour surface is 1.6 or less times larger than the minimum partial area of the contour surface.

12 Claims, 11 Drawing Sheets

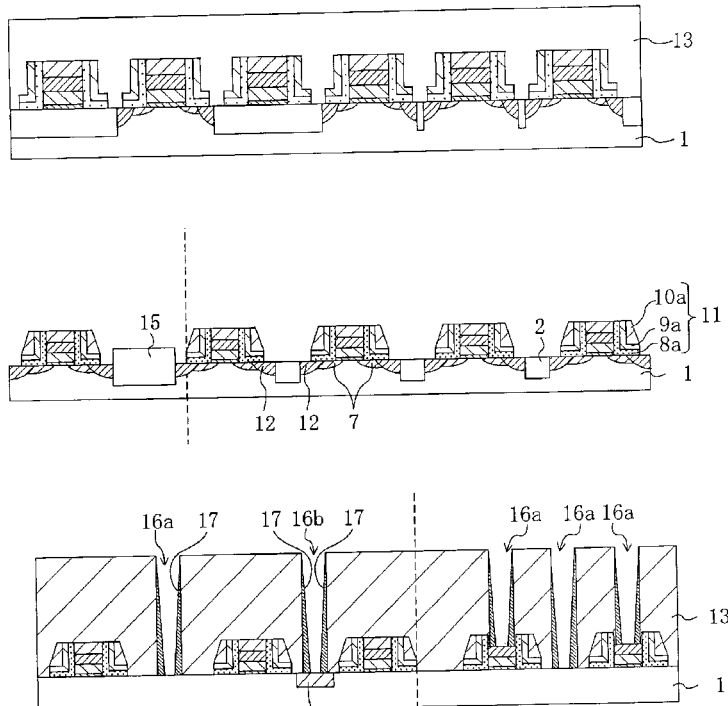
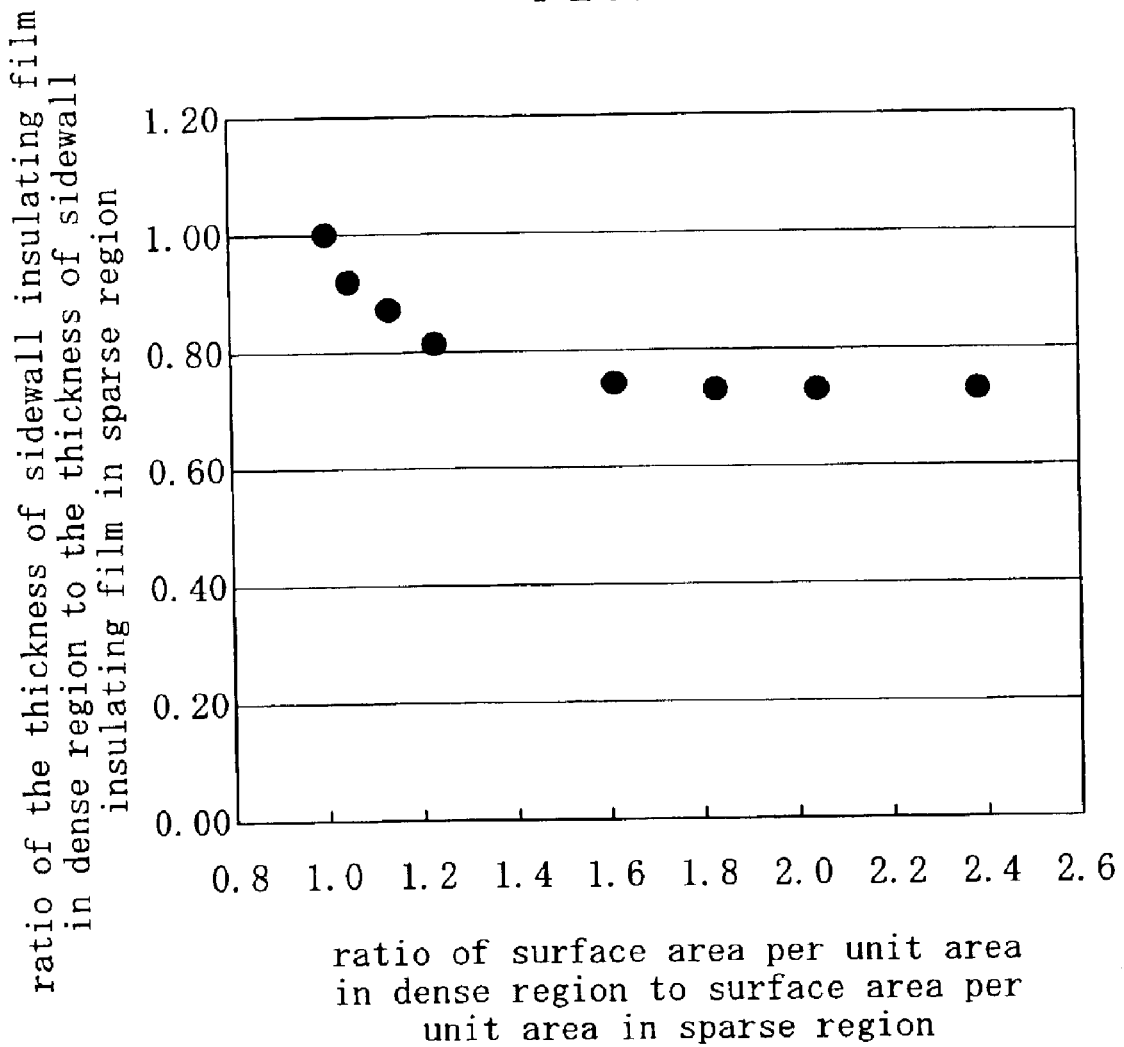


FIG. 1



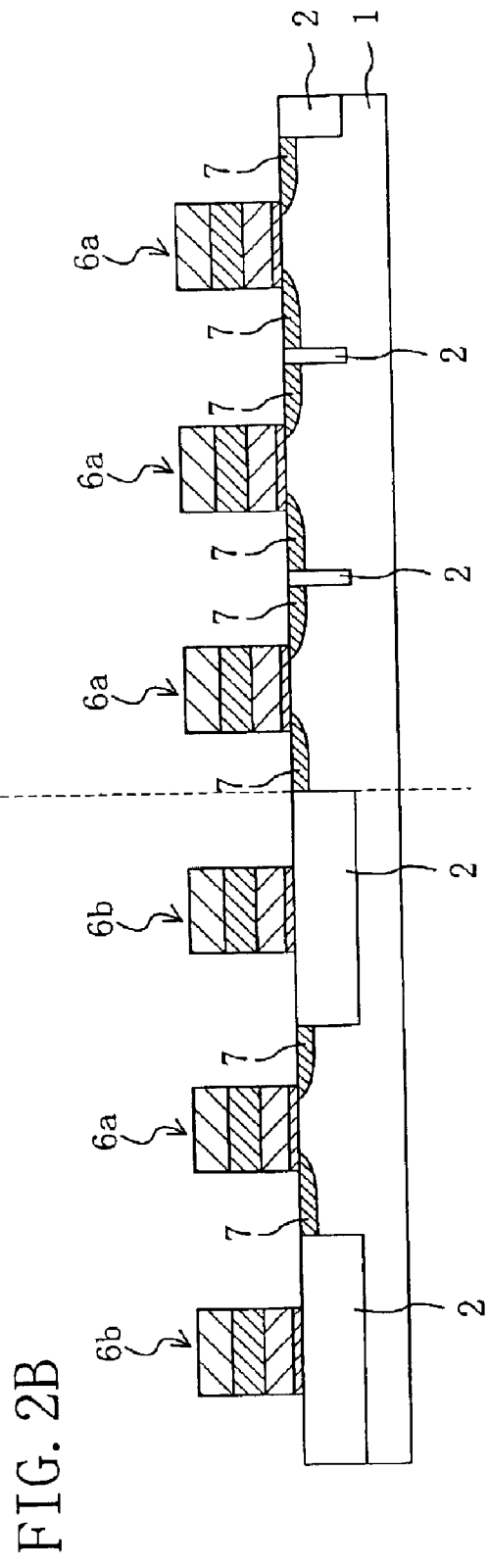
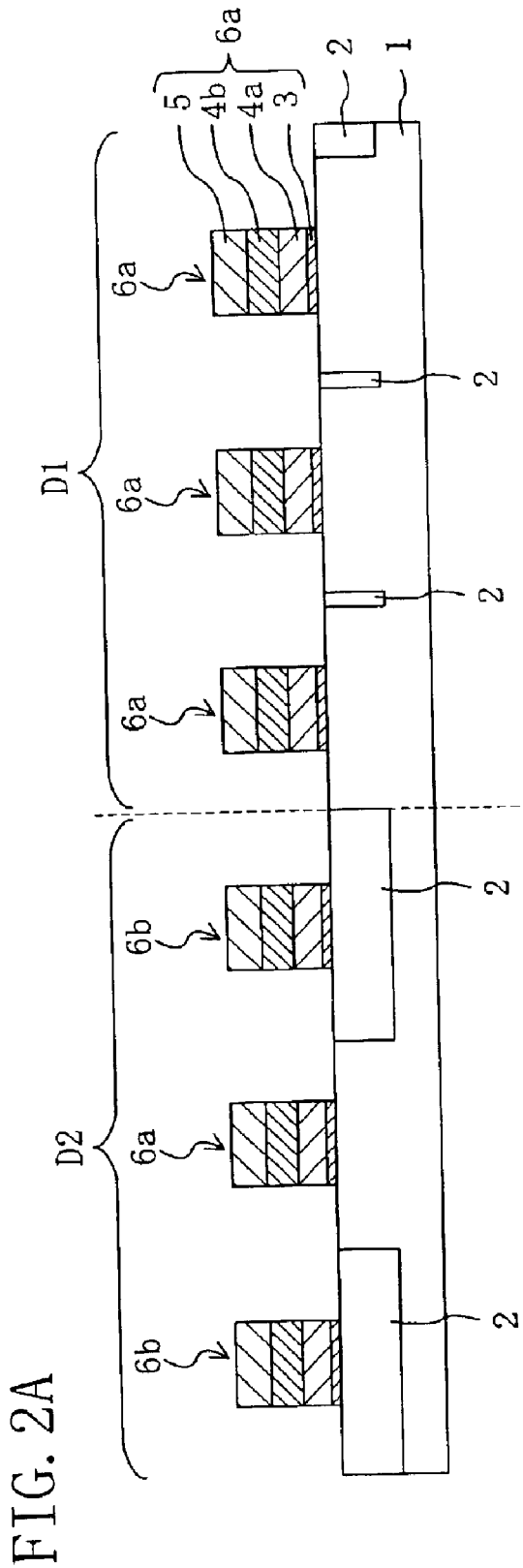


FIG. 3A

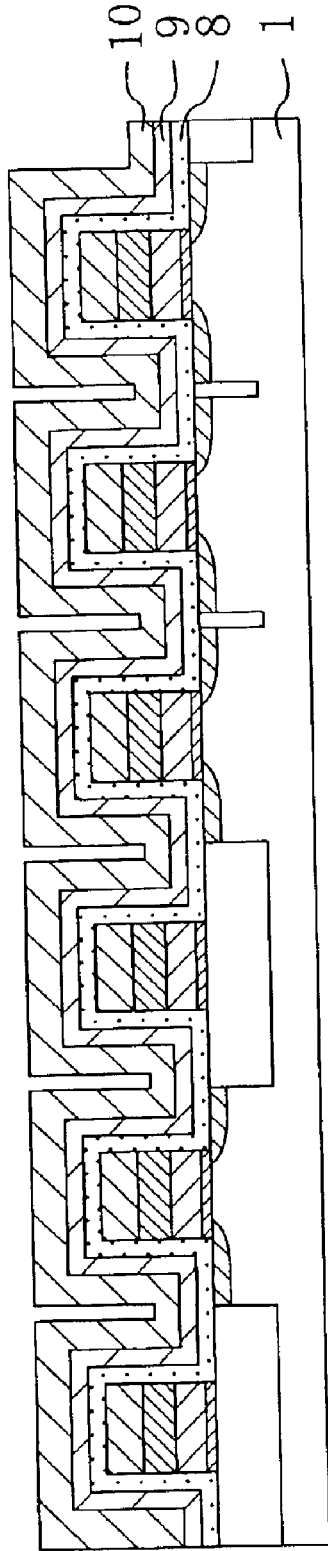


FIG. 3B

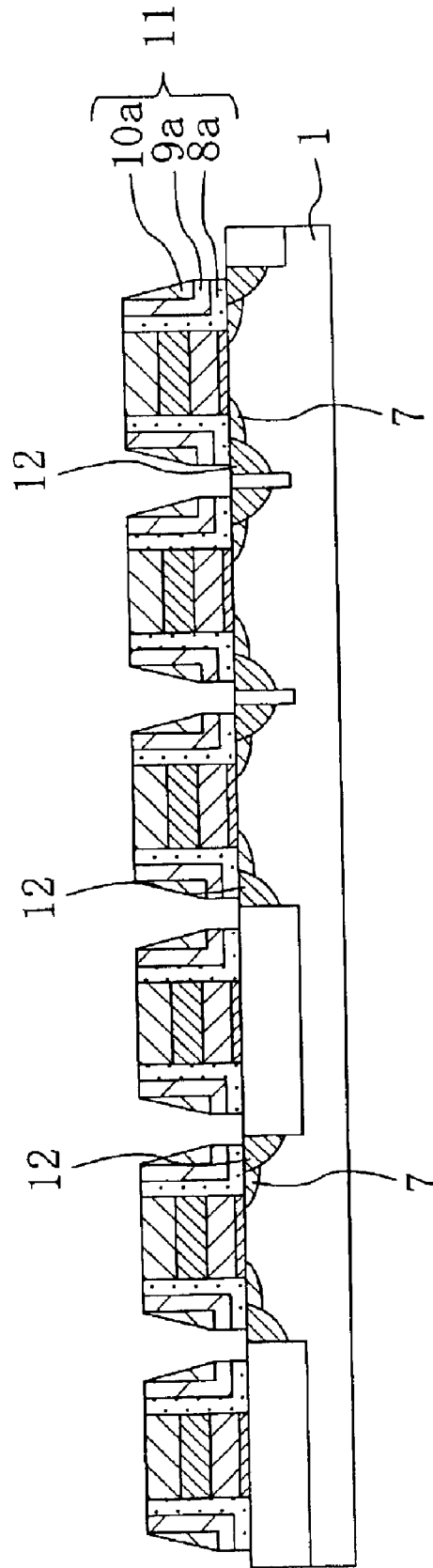


FIG. 4A

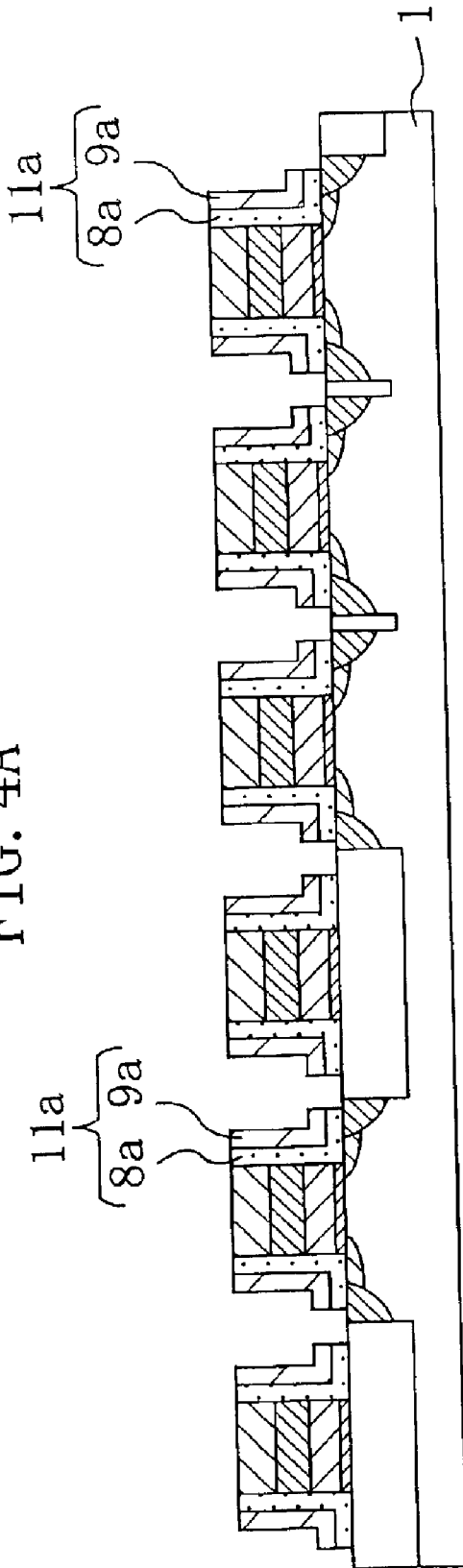
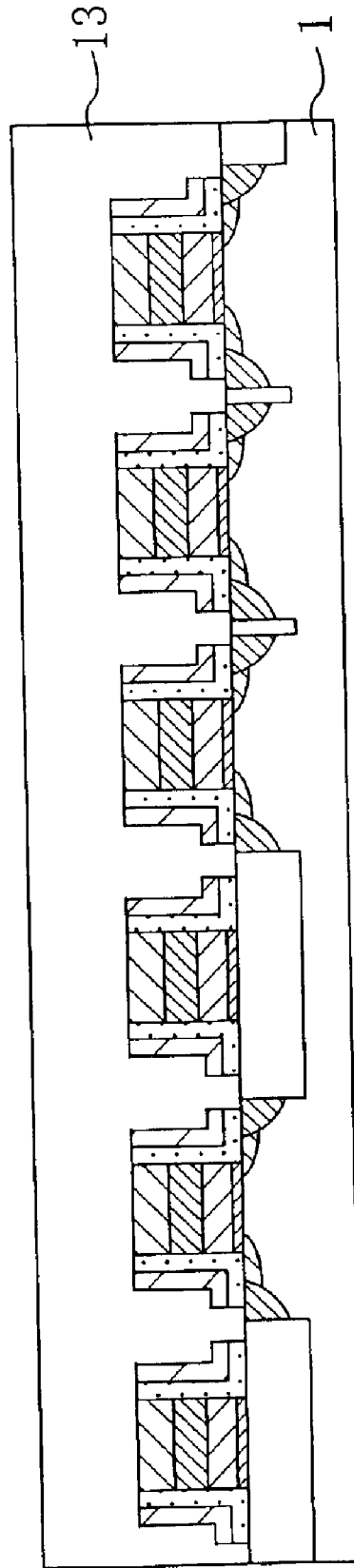


FIG. 4B



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