



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

(10) **Patent No.:** **US 6,870,230 B2**  
(45) **Date of Patent:** **Mar. 22, 2005**

(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

(75) Inventors: **Takayuki Matsuda**, Kyoto (JP);  
**Mizuki Segawa**, Osaka (JP)

(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

(21) Appl. No.: **10/300,798**

(22) Filed: **Nov. 21, 2002**

(65) **Prior Publication Data**

US 2003/0098473 A1 May 29, 2003

(30) **Foreign Application Priority Data**

Nov. 27, 2001 (JP) ..... 2001-361244

(51) **Int. Cl.**<sup>7</sup> ..... **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

*Primary Examiner*—Stephen W. Smoot  
(74) *Attorney, Agent, or Firm*—McDermott Will & Emery LLP

(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**

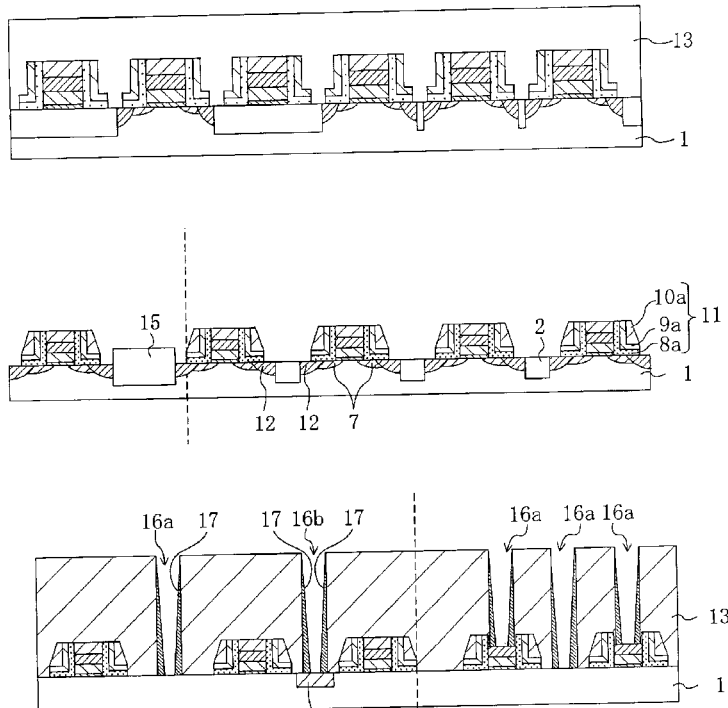
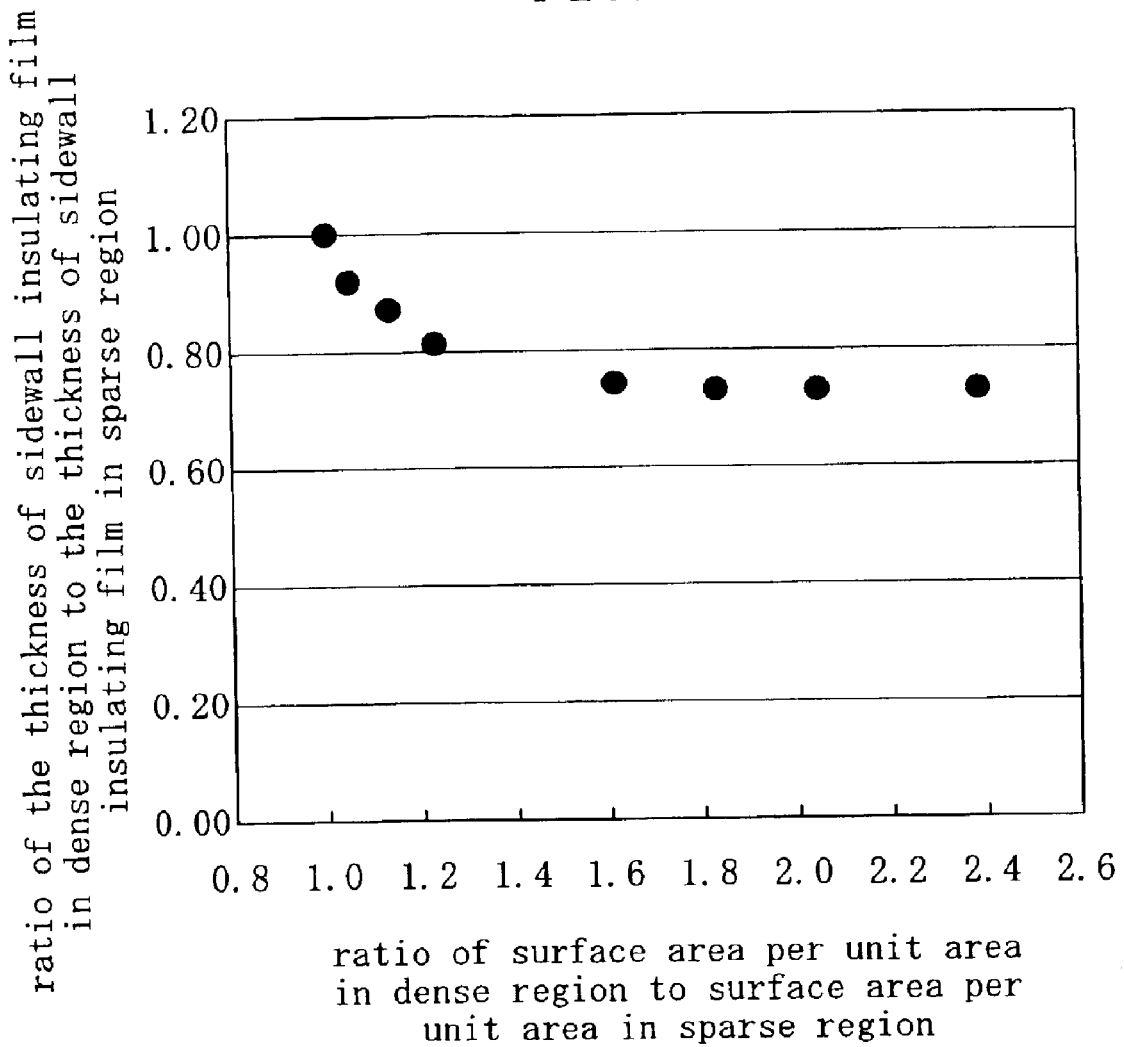


FIG. 1



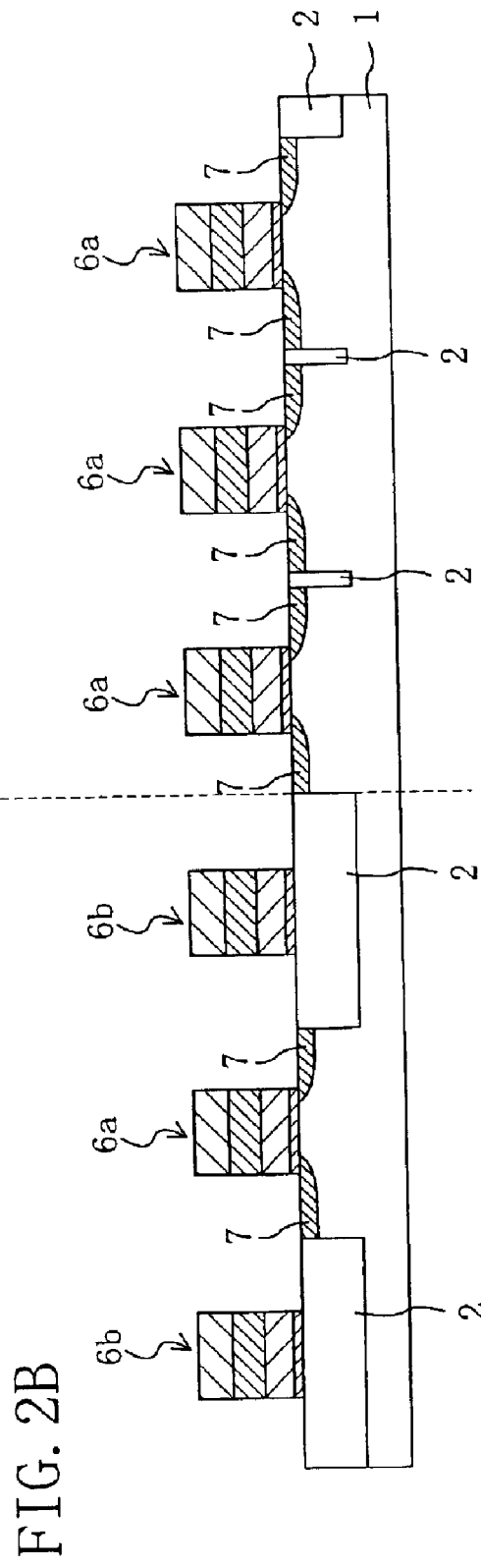
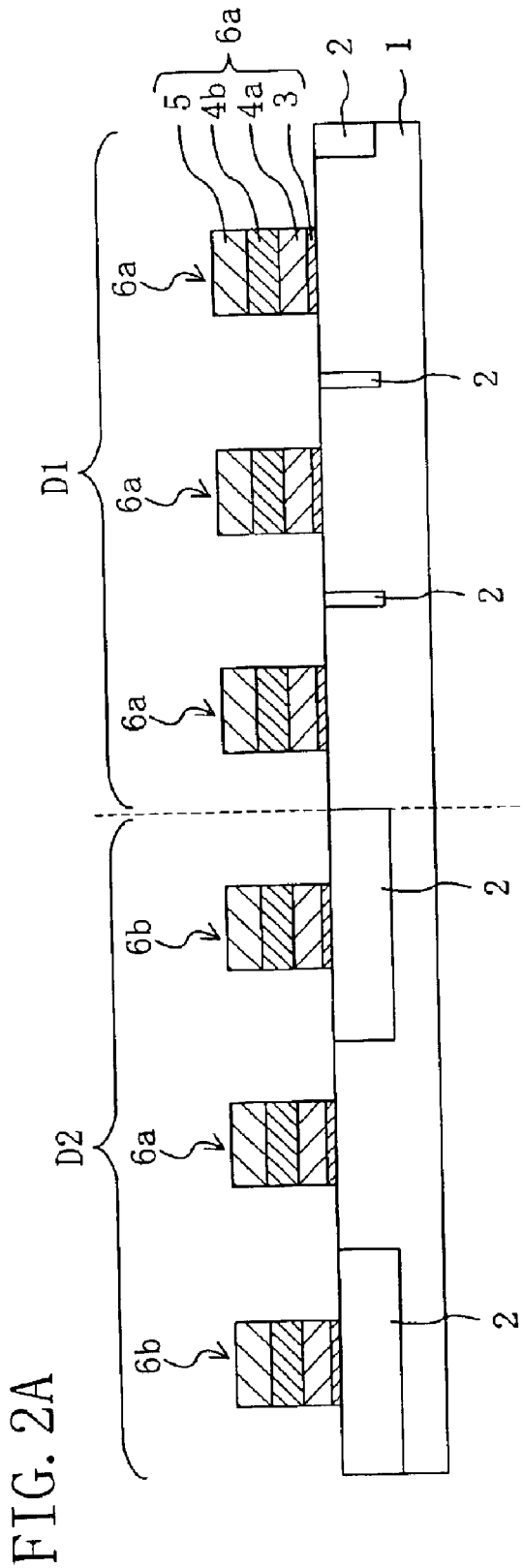


FIG. 3A

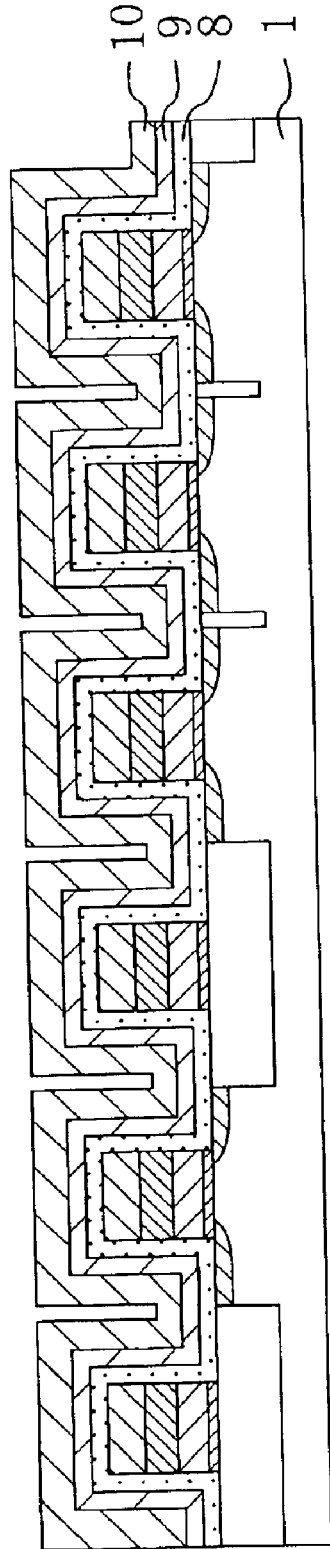


FIG. 3B

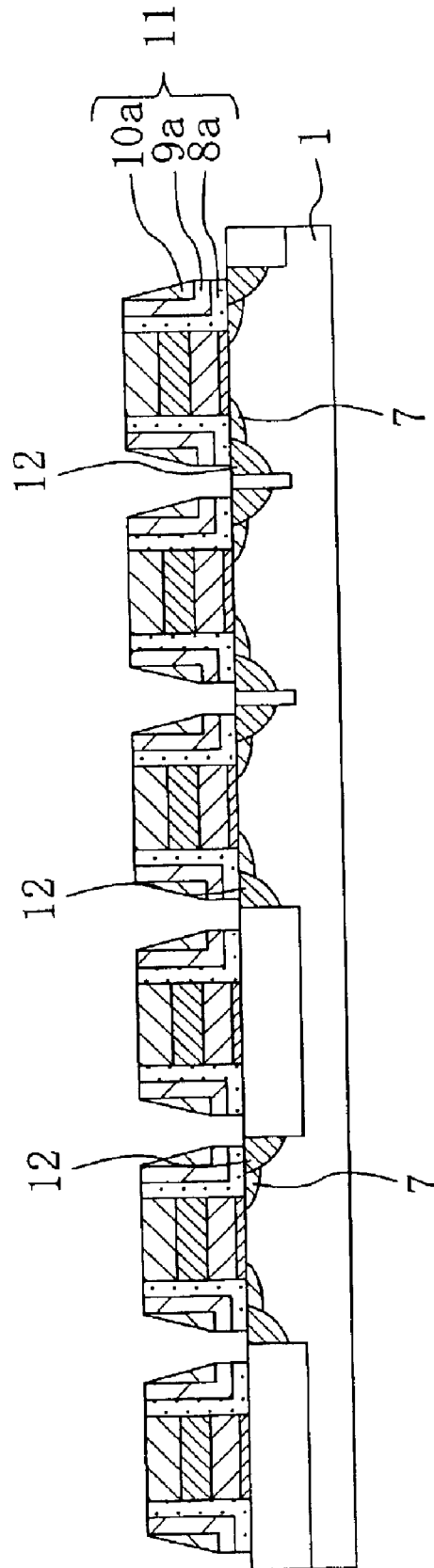


FIG. 4A

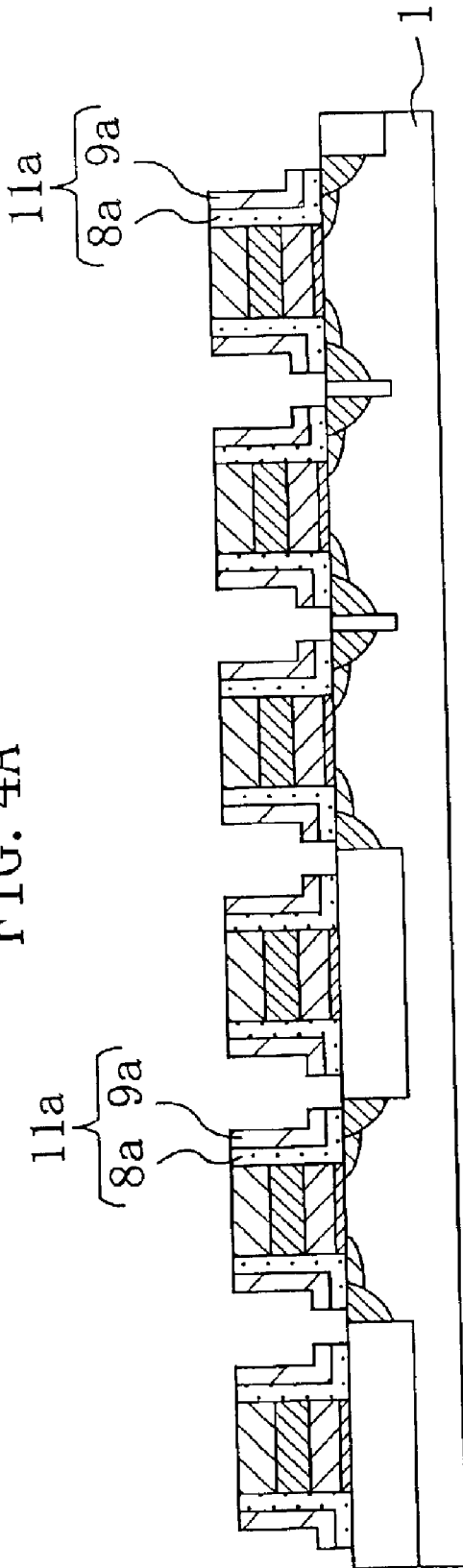
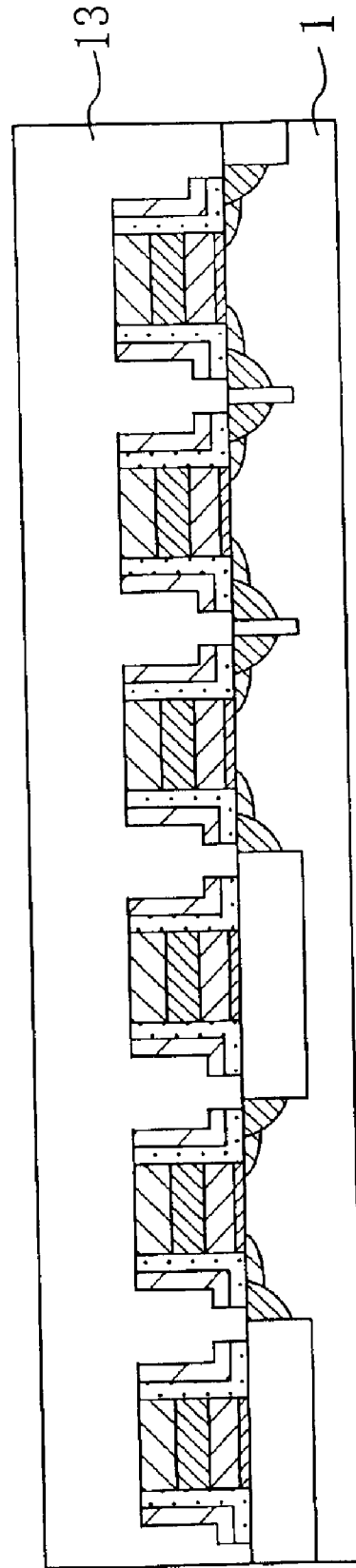


FIG. 4B



# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.