



United States Patent [19]

[11] Patent Number: **5,648,284**

Kusunoki et al.

[45] Date of Patent: **Jul. 15, 1997**

[54] **FIELD EFFECT TRANSISTOR INCLUDING SILICON OXIDE FILM AND NITRIDED OXIDE FILM AS GATE INSULATOR FILM AND MANUFACTURING METHOD THEREOF**

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[73] Assignee: **Mitsubishi Denki Kabushiki Kaisha**, Tokyo, Japan

[21] Appl. No.: **653,090**

[22] Filed: **May 24, 1996**

Related U.S. Application Data

[60] Continuation of Ser. No. 341,952, Nov. 16, 1994, abandoned, which is a division of Ser. No. 930,932, Aug. 18, 1992, Pat. No. 5,369,297.

[30] Foreign Application Priority Data

| | | | | |
|--------------|------|-------|-------|----------|
| Sep. 5, 1991 | [JP] | Japan | | 3-225686 |
| Dec. 6, 1991 | [JP] | Japan | | 3-323239 |
| Jul. 3, 1992 | [JP] | Japan | | 4-176873 |

[51] Int. Cl.⁶ **H01L 21/265**

[52] U.S. Cl. **437/40 GS; 437/41 GS; 437/42; 437/241**

[58] Field of Search **437/40 GS, 41 GS, 437/42, 241**

[56] References Cited

U.S. PATENT DOCUMENTS

4,774,197 9/1988 Haddad et al. 437/24

OTHER PUBLICATIONS

Kusunoki, "Hot-Carrier-resistant Structure By Re-Oxidized Nitrided Oxide Sidewall For Highly Reliable and High Performance LDD MOSFETS", IEDM, IEEE, pp. 649-652. 1991.

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Assistant Examiner—Lynne A. Gurley

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[57] ABSTRACT

An N type field effect transistor having a higher resistivity to hot carriers and exhibiting a higher current handling capability even when used at a low gate voltage, and a method of manufacturing such a transistor are provided. A nitrided oxide film is formed on a drain avalanche hot carrier injection region. The nitrided oxide film is highly resistive to drain avalanche hot carriers as compared to a silicon oxide film. The silicon oxide film is formed on a channel hot electron injection region. The silicon oxide film is highly resistive to channel hot electrons as compared to the nitrided oxide film. A major portion of a gate insulator film is a silicon oxide film. The silicon oxide film exhibits a higher current handling capability at a low gate voltage as compared to the nitrided oxide film.

7 Claims, 39 Drawing Sheets

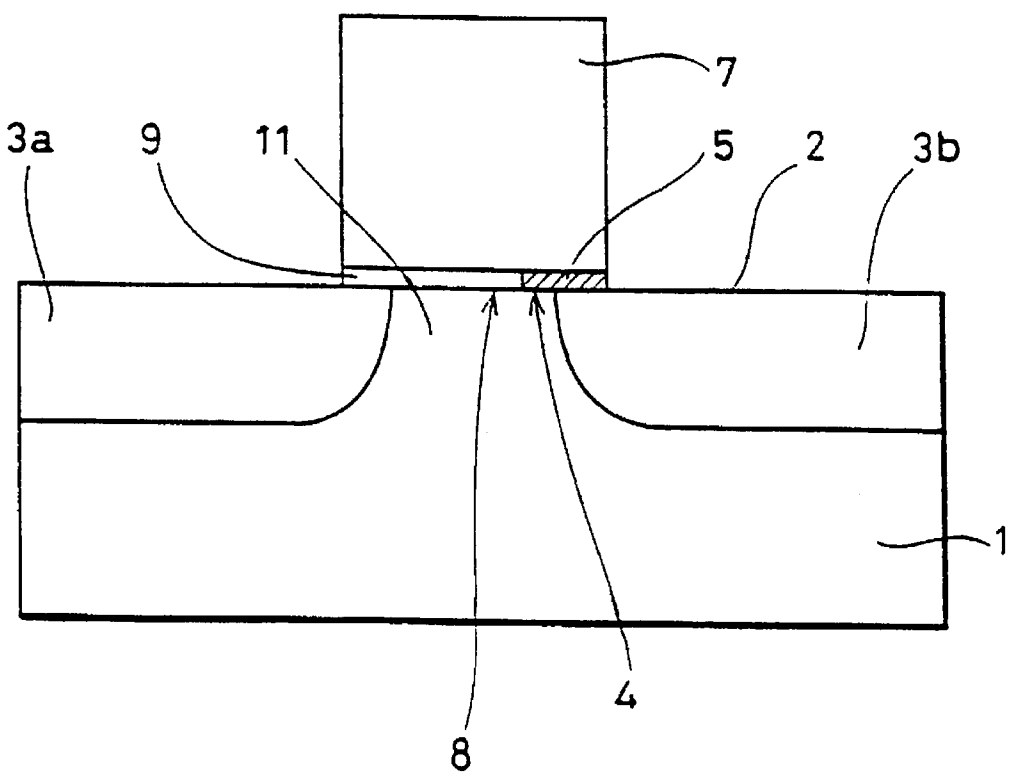


FIG. 1

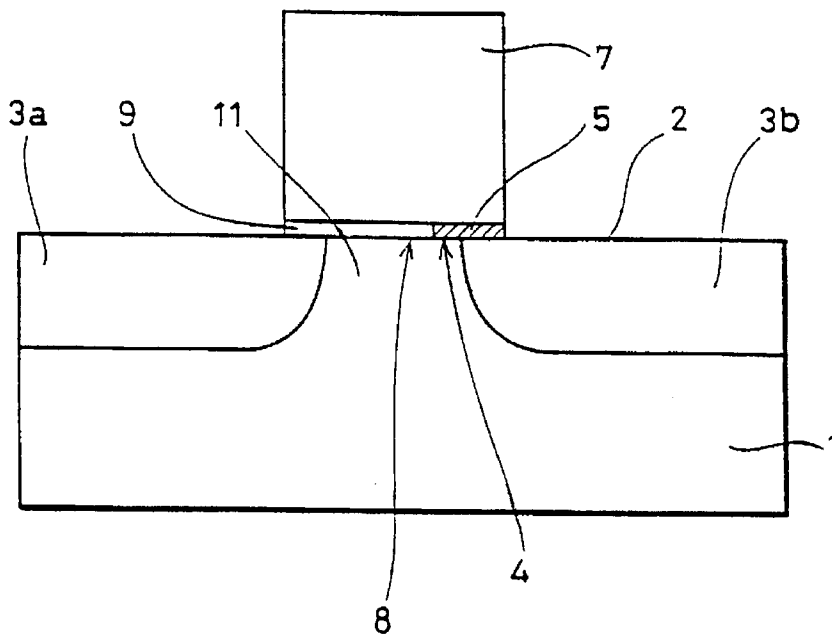


FIG. 2

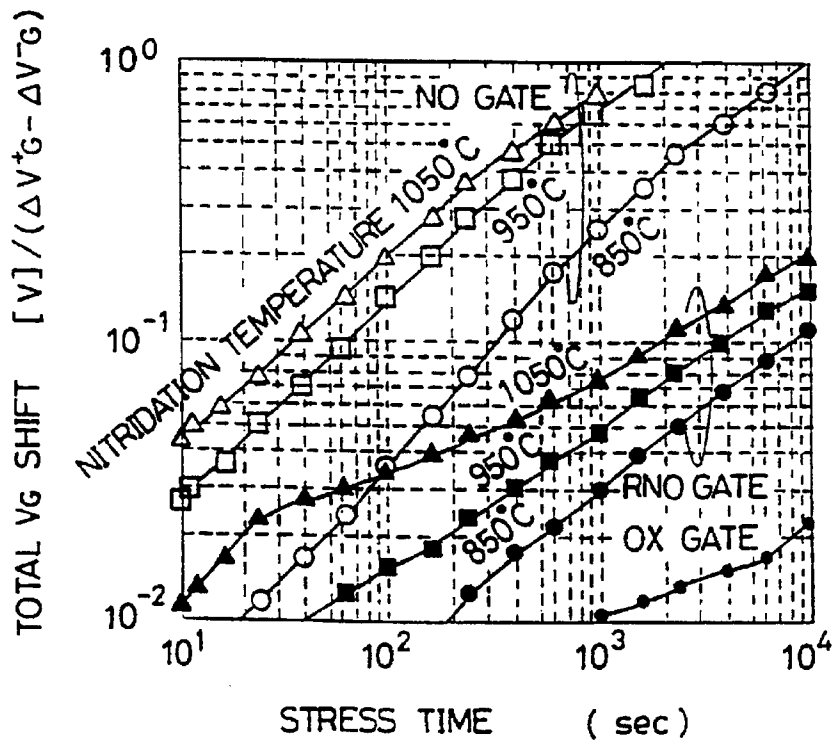


FIG. 3 PRIOR ART

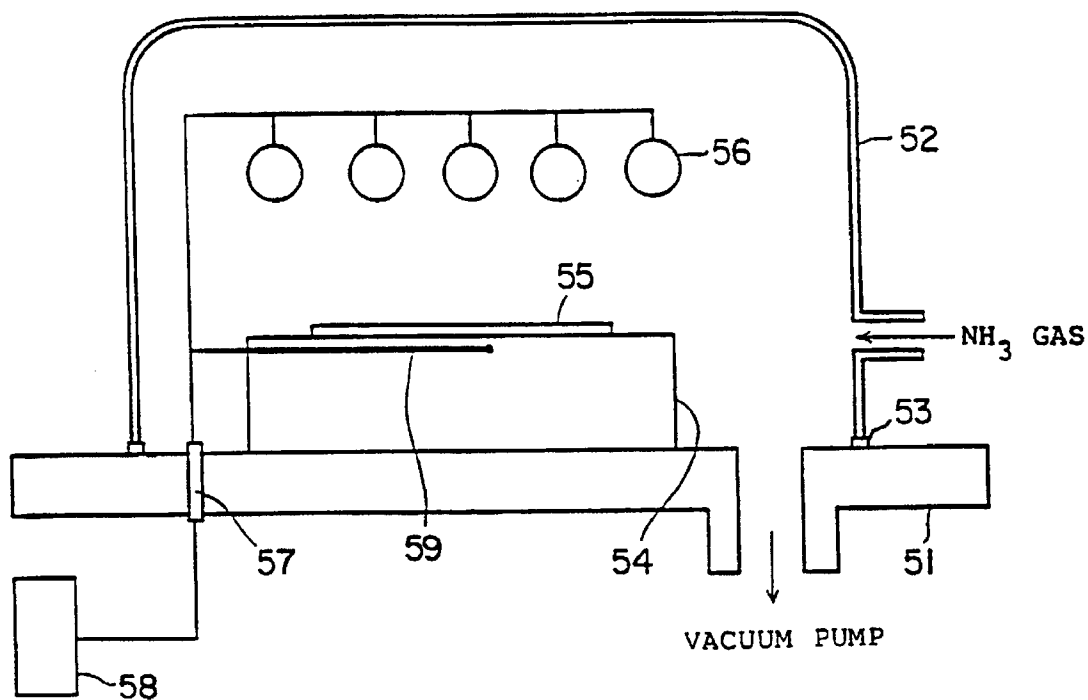


FIG. 4

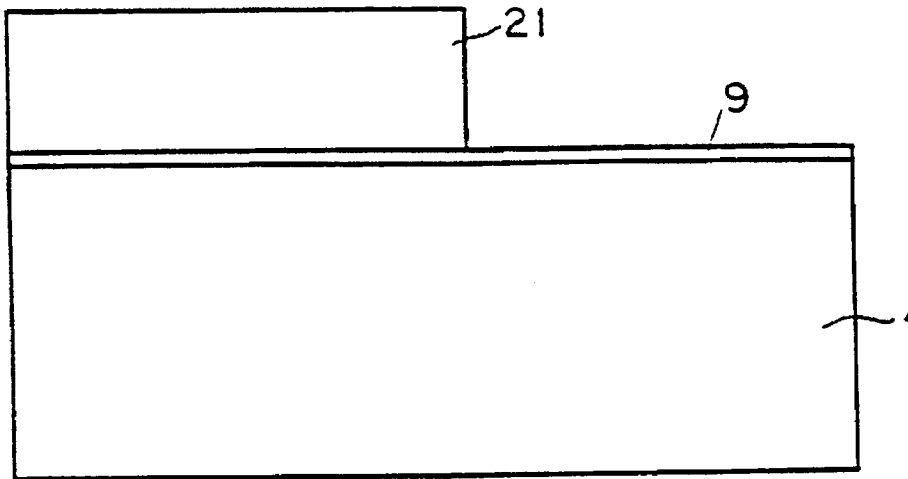


FIG. 5

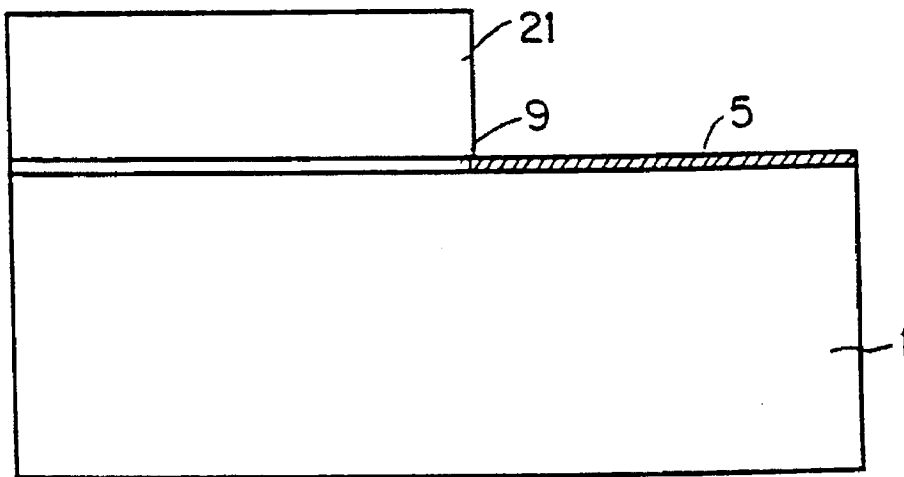


FIG. 6

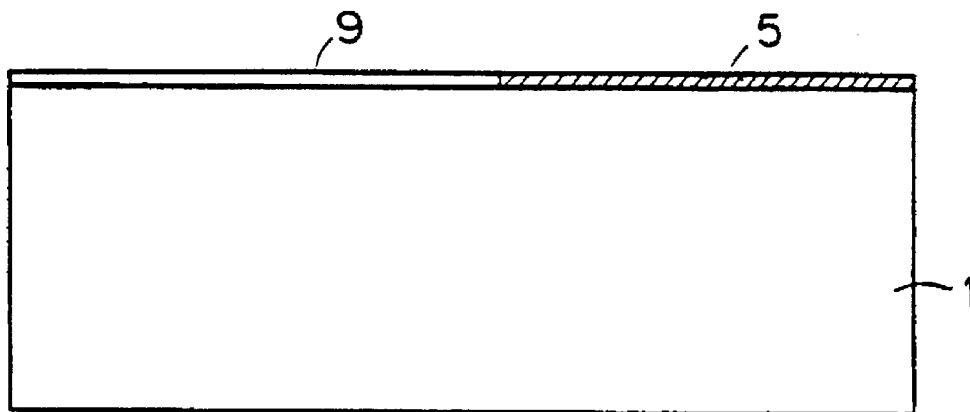
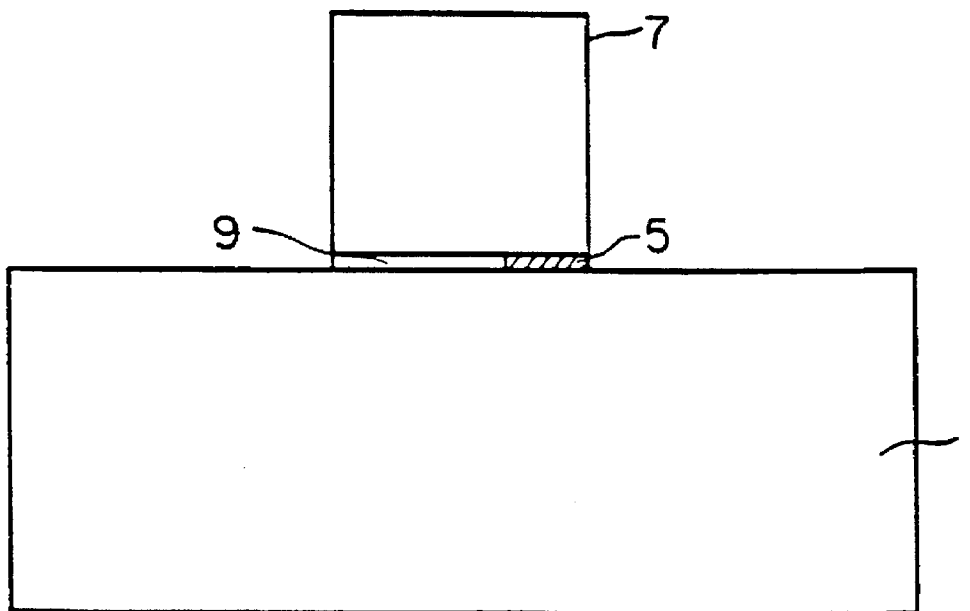


FIG. 7



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