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United States Patent [19]

Jain et al.

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[45] Date of Patent: Apr. 21, 1998

[54] **METHOD FOR FORMING A DIELECTRIC TANTALUM NITRIDE LAYER AS AN ANTI-REFLECTIVE COATING (ARC)**

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[73] Assignee: **Motorola, Inc.**, Schaumburg, Ill.

[21] Appl. No.: **632,209**

[22] Filed: **Apr. 15, 1996**

[51] Int. Cl.⁶ **G03F 7/00; H01L 21/314**

[52] U.S. Cl. **430/314; 430/311; 430/312; 430/316; 430/317; 438/626; 438/633; 438/634; 438/636; 438/692; 438/694; 438/703; 438/785; 216/18**

[58] **Field of Search** **430/311, 312, 430/314, 316, 317; 156/652.1, 661.11; 437/229, 195; 216/18; 438/598, 626, 634, 636, 637, 638, 618, 703, 692, 694, 126, 133, 355, 389, 785, 633**

[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|-----------|--------|-----------------|---------|
| 3,884,698 | 5/1975 | Kakihama et al. | 117/217 |
| 4,374,912 | 2/1983 | Kaneki et al. | 430/5 |
| 4,804,606 | 2/1989 | Ohno et al. | 430/57 |
| 5,091,244 | 2/1992 | Biomard | 428/216 |
| 5,451,543 | 9/1995 | Woo et al. | 438/637 |
| 5,635,423 | 6/1997 | Huang et al. | 438/638 |

FOREIGN PATENT DOCUMENTS

| | | | |
|-----------|--------|--------------------|------------|
| 0661736A1 | 7/1995 | European Pat. Off. | |
| 60-32980 | 2/1985 | Japan | F03G 7/06 |
| 60-55657 | 3/1985 | Japan | H01L 27/04 |
| 63-76325 | 4/1988 | Japan | H01L 21/30 |
| 4-124869 | 4/1992 | Japan | H01L 27/04 |

OTHER PUBLICATIONS

Dan C. Anderson et al., "The Great Static Protection Debate", Australian Electronics Engineering 17(10):52-5 Oct. 1984, 5 pgs.

Yasushiro Fukuda et al., "Electrical Overstress/Electrostatic Discharge", VLSI ESD Phenomenon and Protection—1988 EOS/ESD Symposium Proceedings, pp. 228-234.

"Dual Damascene: A ULSI Wiring Technology," Kaanta, et al.; VMIC Conference, Jun. 11, 1991.

"Chemical Vapor Deposition of Vanadium, Niobium, and Tantalum Nitride Thin Films," Fix, et al.; Chem. Mater, vol. 5, No. 5, 1993.

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Attorney, Agent, or Firm—Keith E. Witek

[57] **ABSTRACT**

The present invention provides an anti-reflective Ta₃N₅ coating which can be used in a dual damascene structure and for I line or G line lithographies. In addition, the Ta₃N₅ coating may also be used as an etch stop and a barrier layer. A dual damascene structure is formed by depositing a first dielectric layer (16). A dielectric tantalum nitride layer (18) is deposited on top of the first dielectric layer. A second dielectric layer (20) is deposited on the tantalum nitride layer. A dual damascene opening (34) is etched into the dielectric layers by patterning a first opening portion (26) and a second opening portion (32) using photolithography operations. Dielectric tantalum nitride layer (18) serves as an ARC layer during these operations to reduce the amount of reflectance from conductive region (14) to reduce distortion of the photoresist pattern. The use of a dielectric tantalum nitride layer as an ARC is particularly suitable for I line and G line lithography.

27 Claims, 6 Drawing Sheets

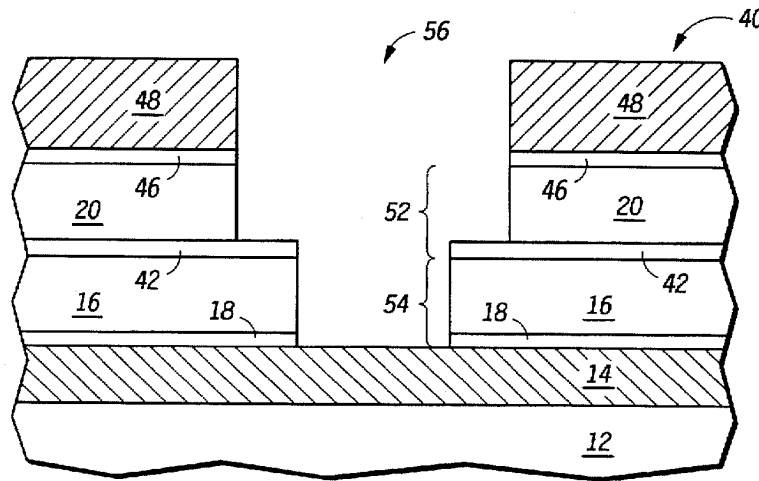


FIG. 1

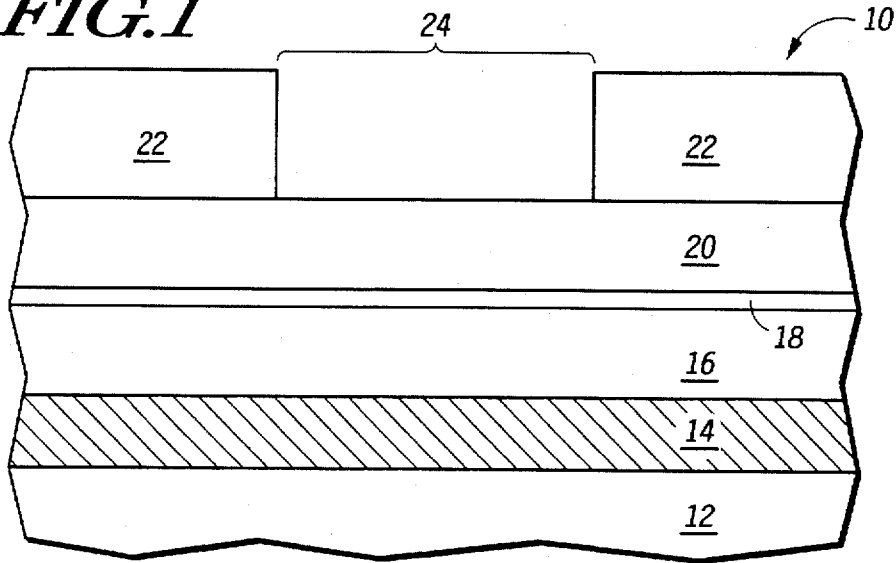


FIG. 2

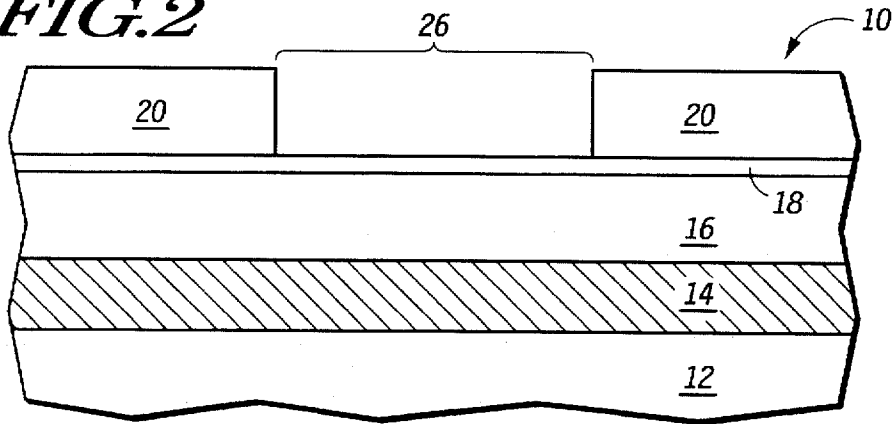
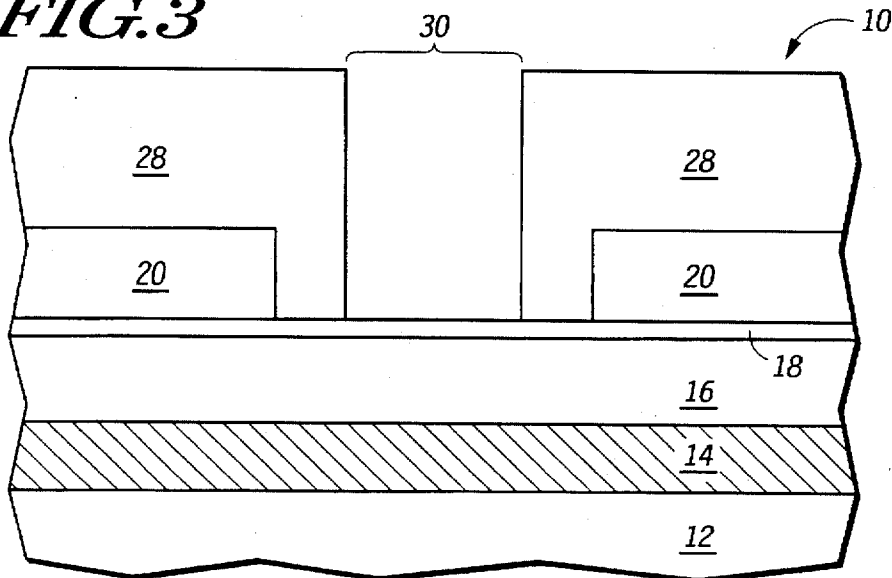
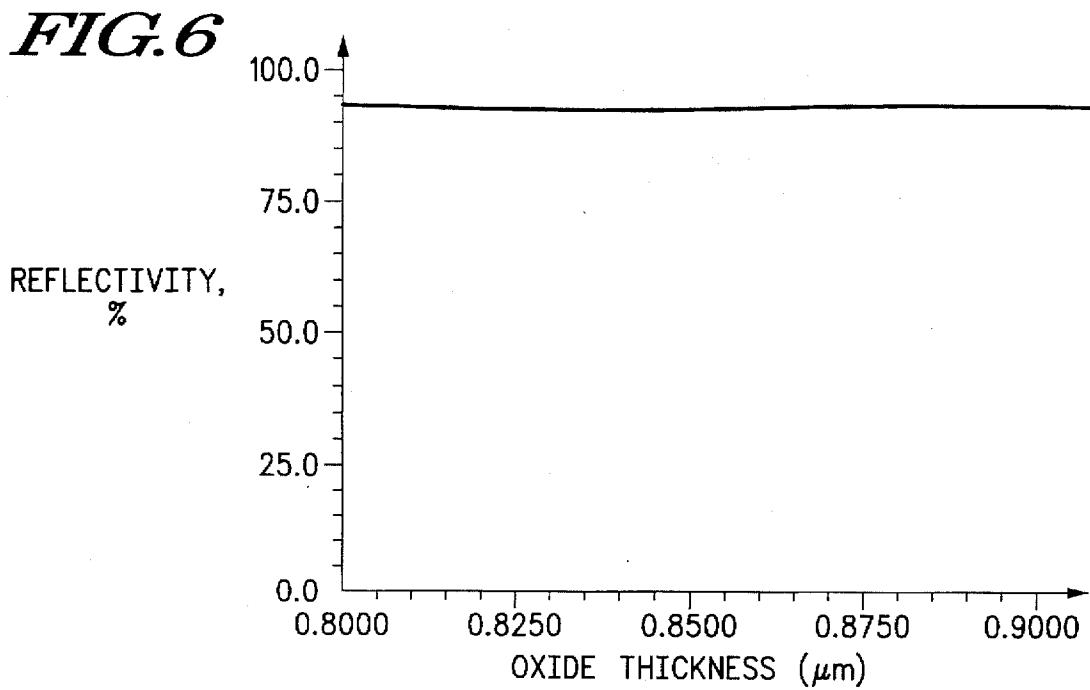
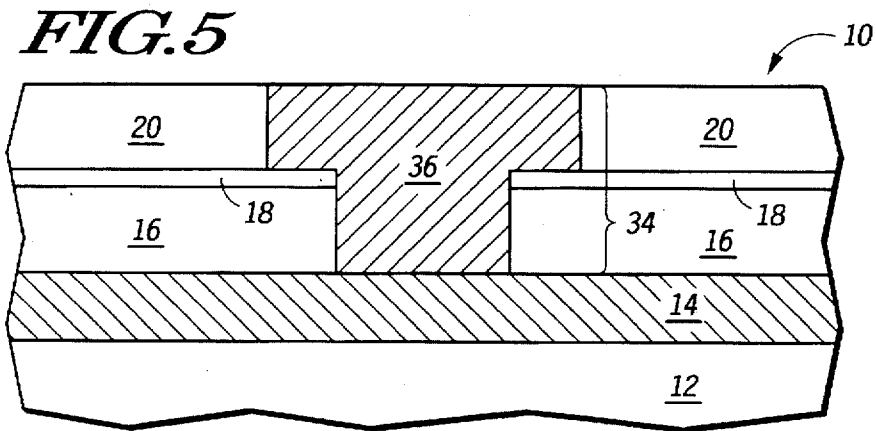
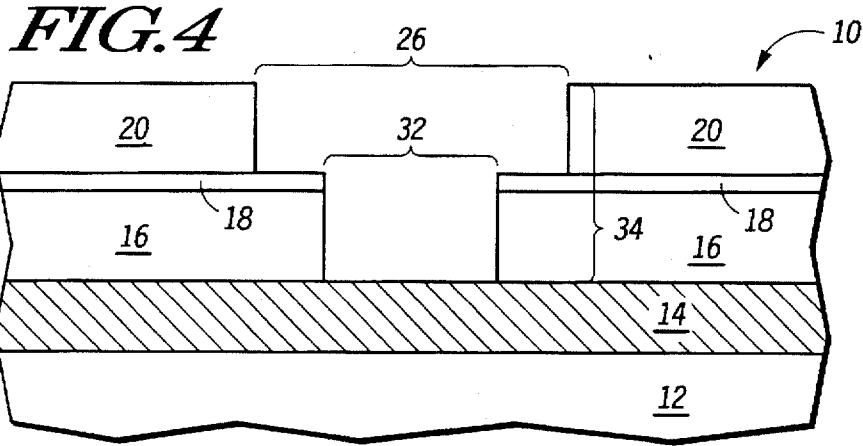


FIG. 3





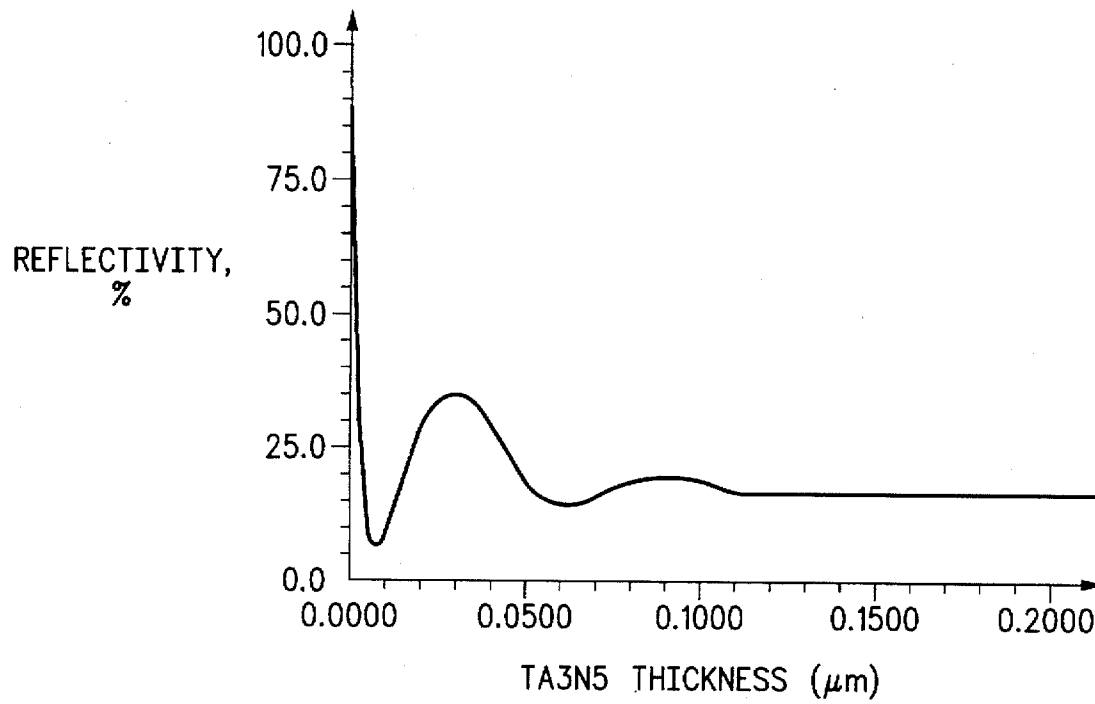


FIG. 7

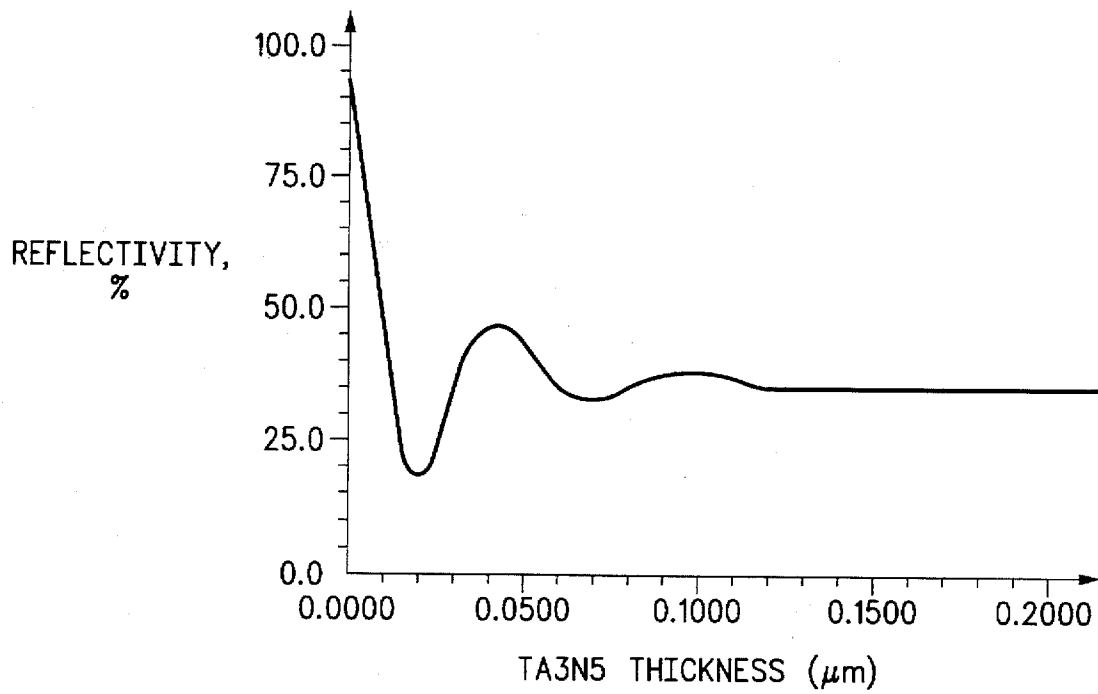


FIG. 8

FIG. 9

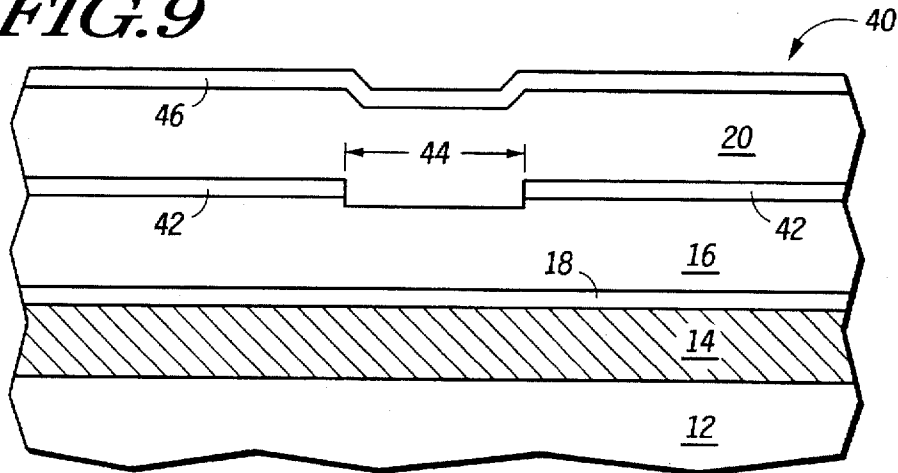


FIG. 10

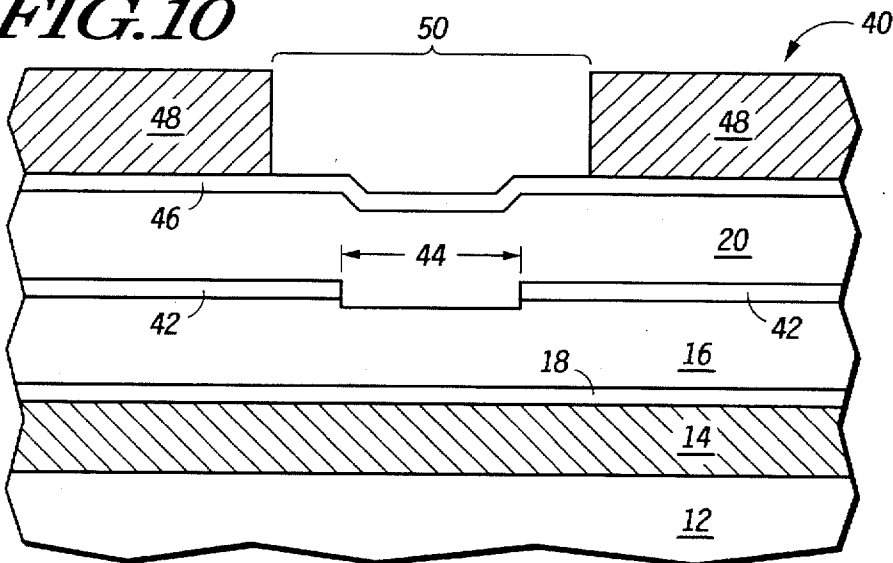
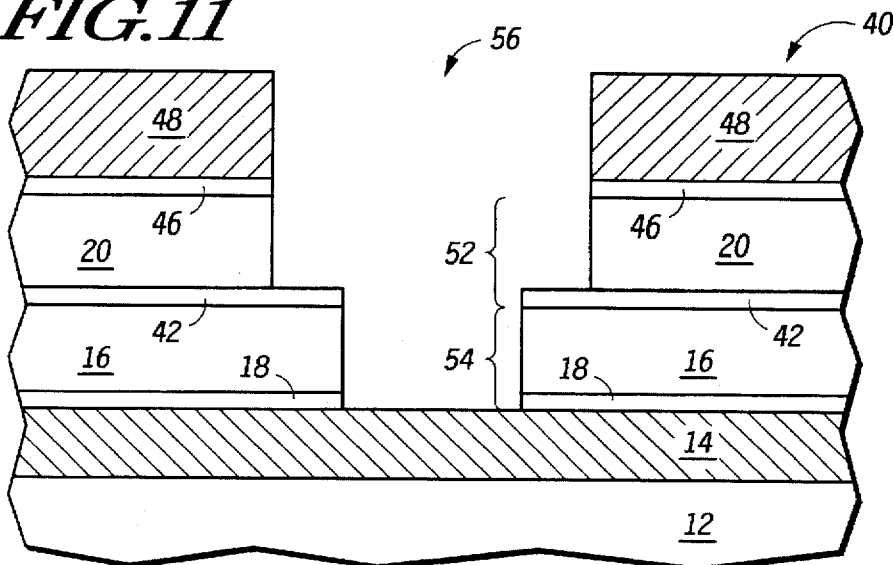


FIG. 11



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