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United States Patent [19]

Aoyama et al.

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[45] Date of Patent: **Jan. 7, 1997**

[54] SEMICONDUCTOR DEVICE HAVING A WIRING LAYER WITH A BARRIER LAYER

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[73] Assignee: **Kabushiki Kaisha Toshiba**, Kawasaki, Japan

[21] Appl. No.: **330,998**

[22] Filed: **Oct. 28, 1994**

[30] Foreign Application Priority Data

Oct. 29, 1993	[JP]	Japan	.....	5-272784
Mar. 15, 1994	[JP]	Japan	.....	6-070156
Sep. 19, 1994	[JP]	Japan	.....	6-249984

[51] Int. Cl.⁶ **H01L 23/535**; H01L 29/41; H01L 29/43

[52] U.S. Cl. **257/751**; 257/752; 257/760; 257/763; 257/764; 257/762; 257/915

[58] Field of Search 257/750-753, 257/759, 760, 762, 773, 763, 764, 915

[56] References Cited

U.S. PATENT DOCUMENTS

4,091,406	5/1978	Lewis	.....	257/760
4,789,648	12/1988	Chow et al.	.....	437/225
5,300,813	4/1994	Joshi et al.	.....	257/752

FOREIGN PATENT DOCUMENTS

0040745	12/1970	Japan	.	
0040515	10/1972	Japan	.	
0242331	10/1987	Japan	.....	257/760
0082653	3/1989	Japan	.....	257/760
2-78769	11/1990	Japan	.....	257/760
0270256	12/1991	Japan	.....	257/760
0343541	12/1993	Japan	.....	257/760

OTHER PUBLICATIONS

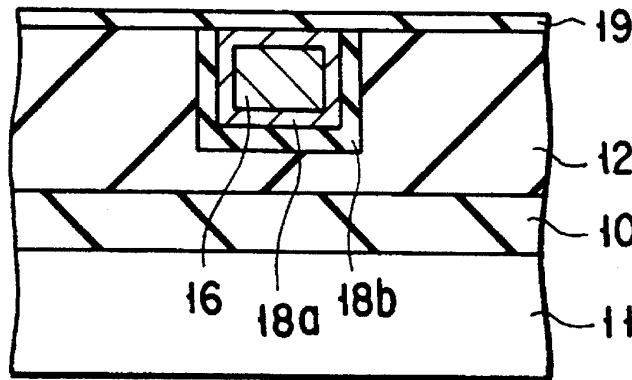
IBMTDB, Lithographic Patterns With a Barrier Liner, vol. 32, No. 103, Mar. 1990, pp. 114-115.
IBMTDB, Copper Multilevel Interconnections, vol. 33, No. 11, Apr. 1991, pp. 299-300.
IBMTDB, AG Metallurgy System for Integrated Circuit Devices vol. 13, No. 2, Jul. 1970, pp. 511-512.

Primary Examiner—Peter Toby Brown
Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

[57] ABSTRACT

A semiconductor device comprises a semiconductor substrate in which a semiconductor element is formed, an interlayer insulating film formed on the semiconductor substrate, an insulating barrier layer, formed on the interlayer insulating film by plasma nitriding, for preventing diffusion of a metal constituting a wiring layer, a conductive barrier layer, formed on the insulating barrier layer, for preventing diffusion of the metal, and a wiring layer formed of the metal on the conductive barrier layer. A bottom portion of the wiring layer is protected by the conductive barrier layer and the insulating barrier layer. Therefore, the diffusion of the metal constituting the wiring layer can be surely prevented.

5 Claims, 35 Drawing Sheets



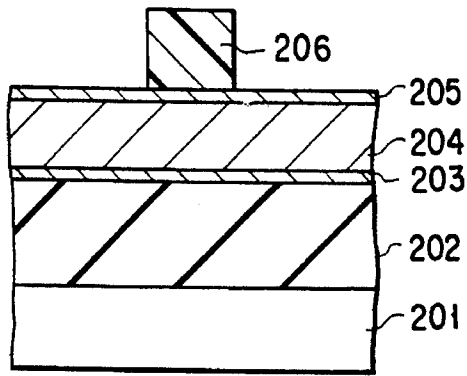


FIG. 1A PRIOR ART

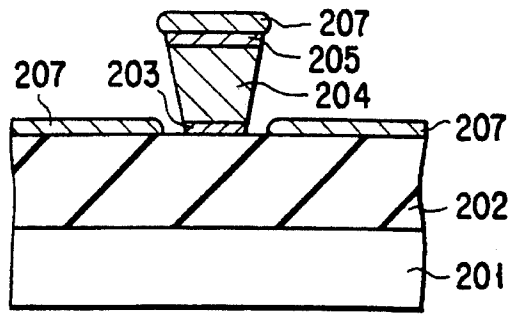


FIG. 2A PRIOR ART

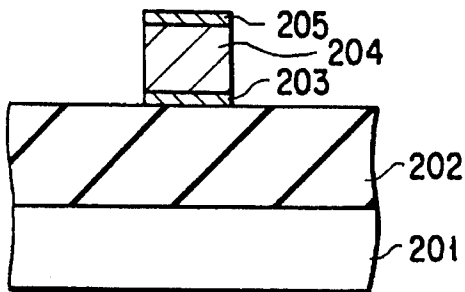


FIG. 1B PRIOR ART

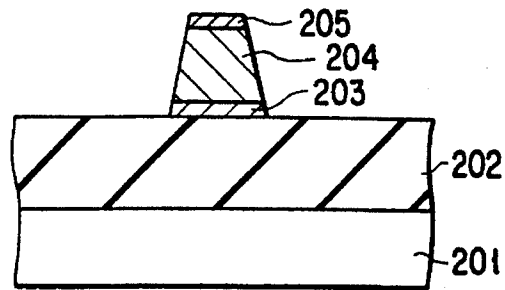


FIG. 2B PRIOR ART

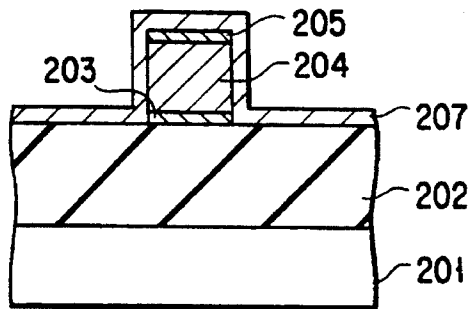


FIG. 1C PRIOR ART

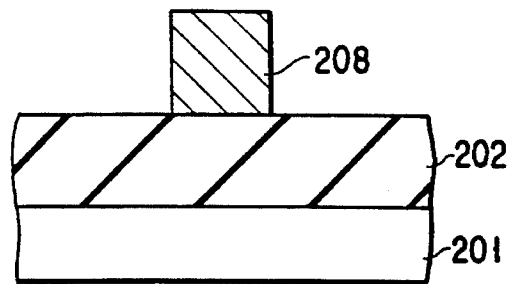


FIG. 3A PRIOR ART

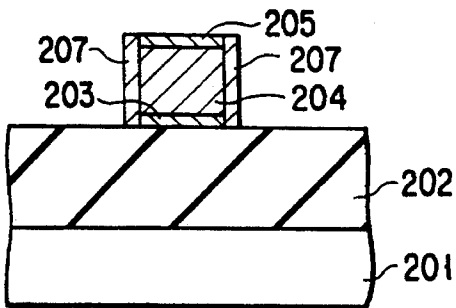


FIG. 1D PRIOR ART

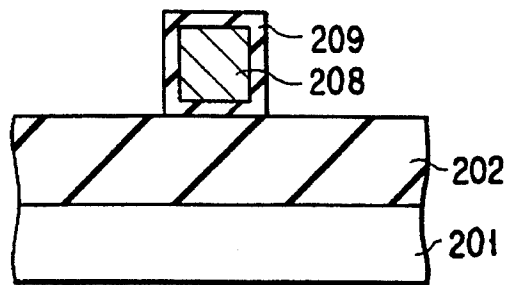


FIG. 3B PRIOR ART

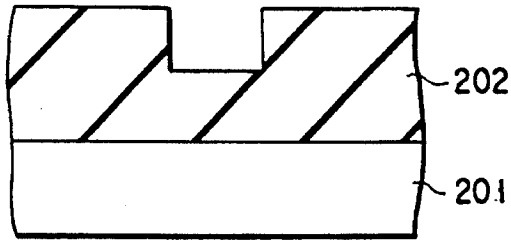


FIG. 4A PRIOR ART

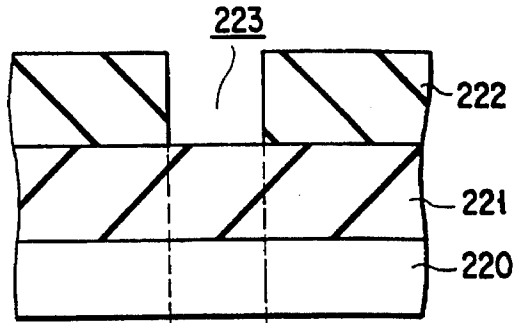


FIG. 5A PRIOR ART

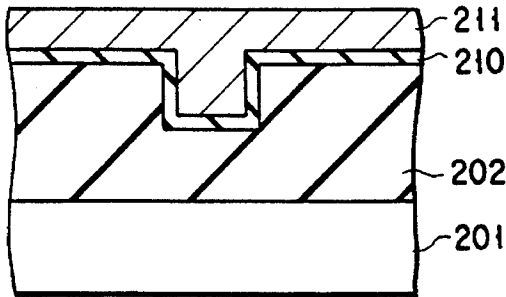


FIG. 4B PRIOR ART

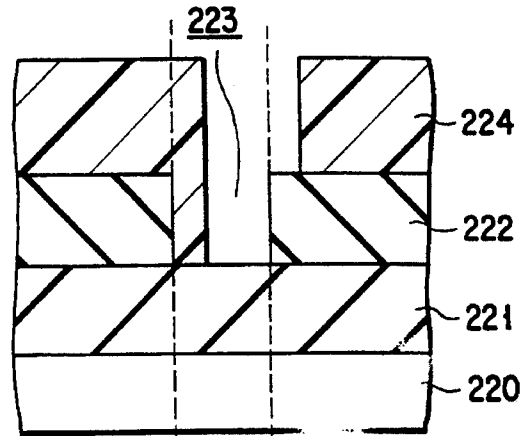


FIG. 5B PRIOR ART

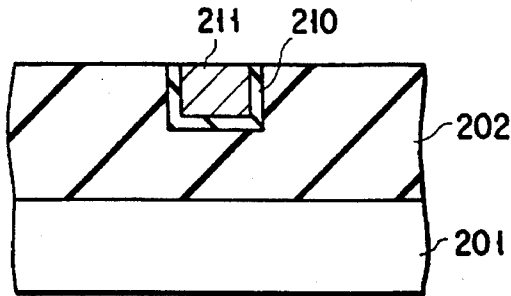


FIG. 4C PRIOR ART

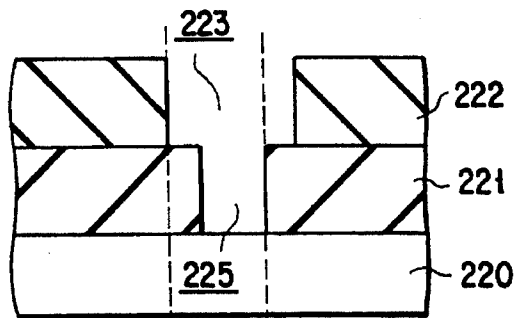


FIG. 5C PRIOR ART

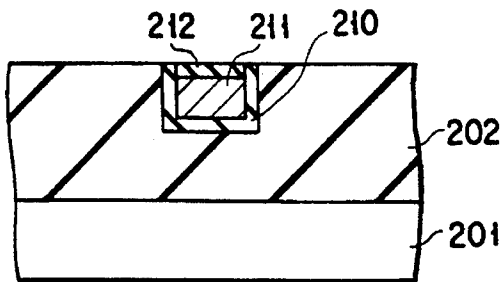


FIG. 4D PRIOR ART

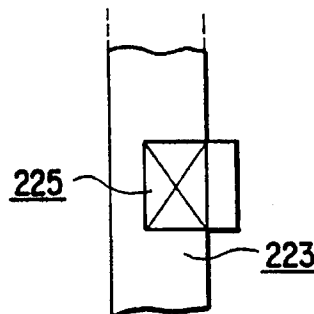
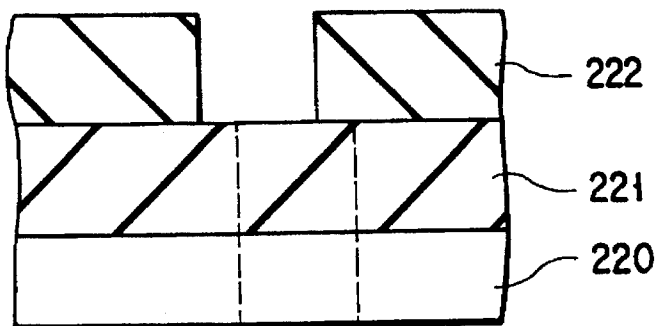
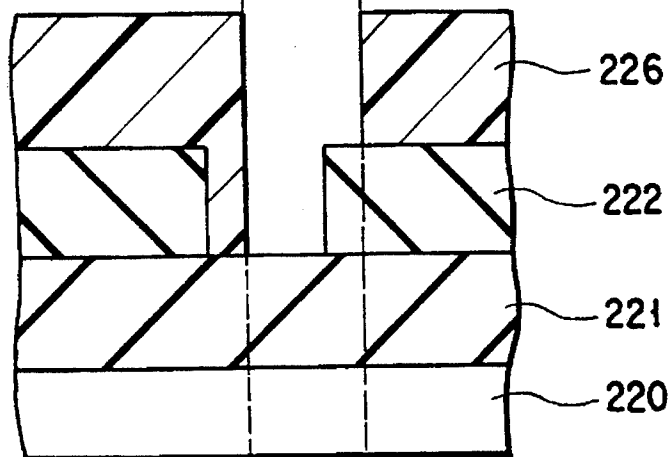


FIG. 5D PRIOR ART

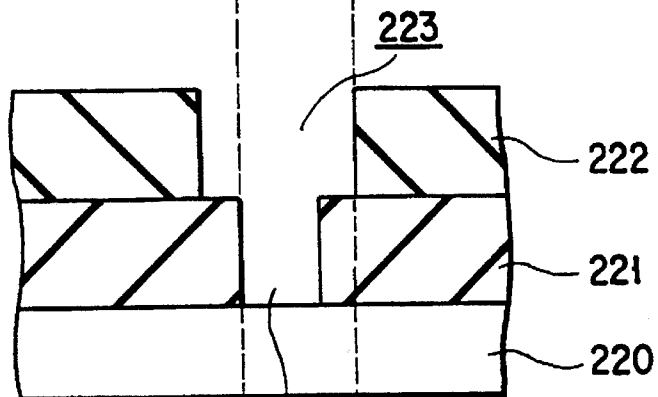
PRIOR ART
FIG. 6A



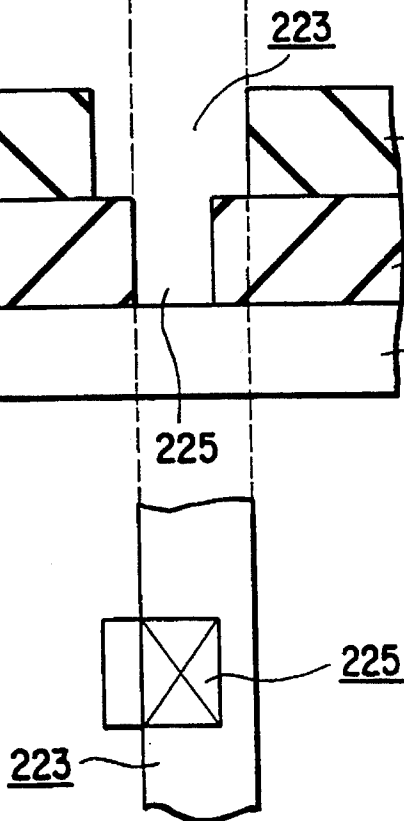
PRIOR ART
FIG. 6B



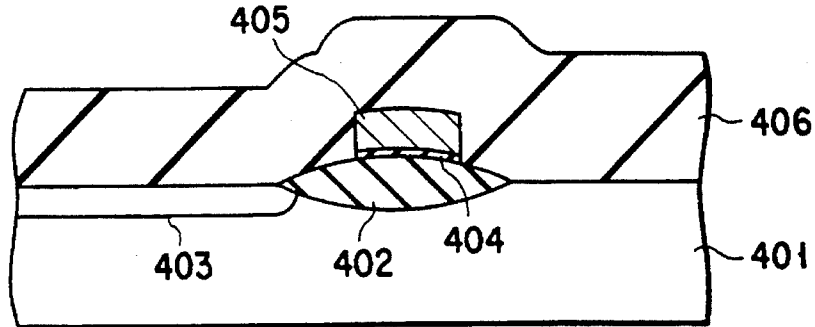
PRIOR ART
FIG. 6C



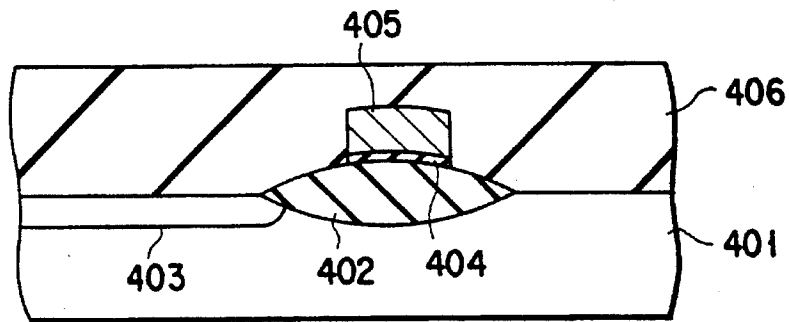
PRIOR ART
FIG. 6D



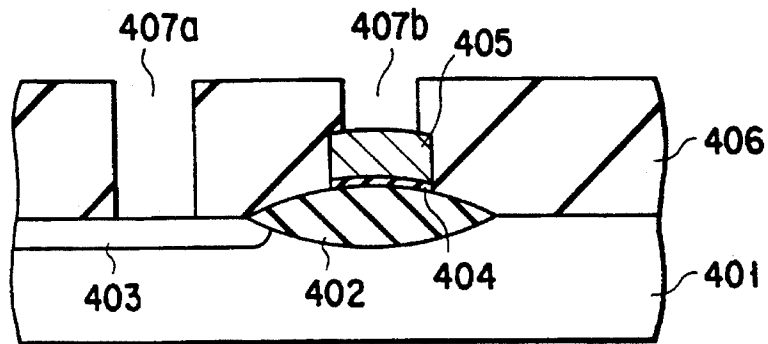
PRIOR ART
FIG. 7A



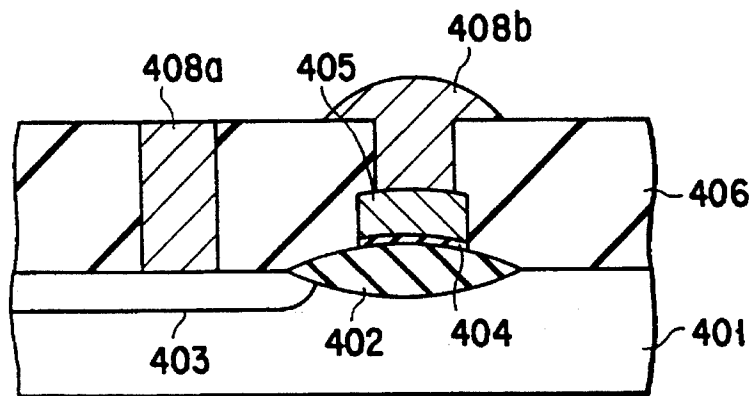
PRIOR ART
FIG. 7B



PRIOR ART
FIG. 7C



PRIOR ART
FIG. 7D



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