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Tagami et al.

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(54) MULTI-LAYERED WIRING LAYER AND METHOD OF FABRICATING THE SAME

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U.S.C. 154(b) by 0 days.

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- (22) Filed: Jun. 19, 2000

(30) Foreign Application Priority Data

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(51)	Int. Cl. ⁷	H01L 23/48 ; H01L 23/52
(52)	U.S. Cl	
(58)	Field of Search	257/751, 752,

257/753, 758, 762, 773; 438/626, 627, 628, 643, 644, 645

(56) References Cited

U.S. PATENT DOCUMENTS

5,668,411	Α	*	9/1997	Hong et al	257/751
5,858,873	Α	*	1/1999	Vitkavage et al	438/626

FOREIGN PATENT DOCUMENTS

JP	8-139092	5/1996
JP	8-274098	10/1996
JP	9-64044	3/1997
JP	9-293690	* 11/1997
JP	10-256256	9/1998

OTHER PUBLICATIONS

Semiconductor World Nobuyoshi Awaya, Feb. 1998, pp. 91-96

Kee-Won Kwon et al., "Characteristics of Ta As An Underlayer for Cu Interconnects", Advanced Metallization and Interconnect Systems for ULSIApplications in 1997, 1998, pp. 711–716.

M. T. Wang, et al., "Barrier Properties of Very Thin Ta and TaN Layers Against Copper Diffusion", Journal Electrochemical Society, Jul. 1998, pp. 2538–2545.

D. Denning, et al., An Inlaid CVD Cu Based Integration for Sub 0.25μm Technology, 1998 Symposium on VLSI Technology Digest of Technical Papers, 1998, pp. 22–23.

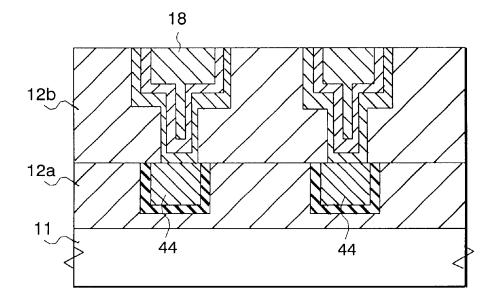
* cited by examiner

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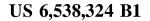
(57) ABSTRACT

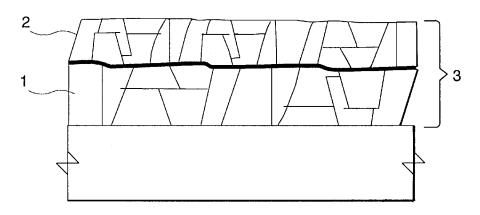
There is provided a barrier film preventing diffusion of copper from a copper wiring layer formed on a semiconductor substrate. The barrier film has a multi-layered structure of first and second films wherein the first film is composed of crystalline metal containing nitrogen therein, and the second film is composed of amorphous metal nitride. The barrier film is constituted of common metal atomic species. The barrier film prevents copper diffusion from a copper wiring layer into a semiconductor device, and has sufficient adhesion characteristic to both a copper film and an interlayer insulating film.

10 Claims, 20 Drawing Sheets









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FIG. 1 (Prior Art)

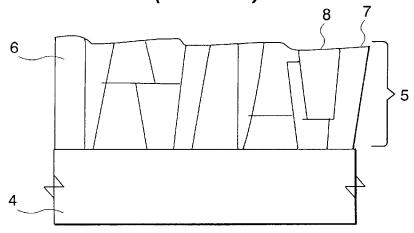


FIG. 2 (Prior Art)

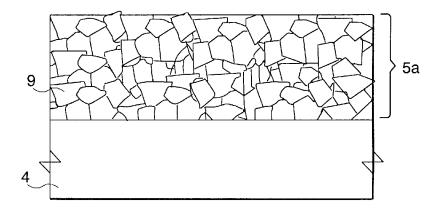


FIG. 3 (Prior Art)

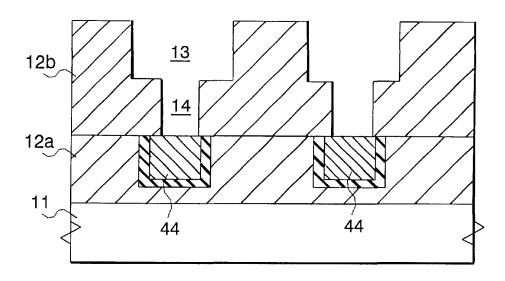


FIG. 4A

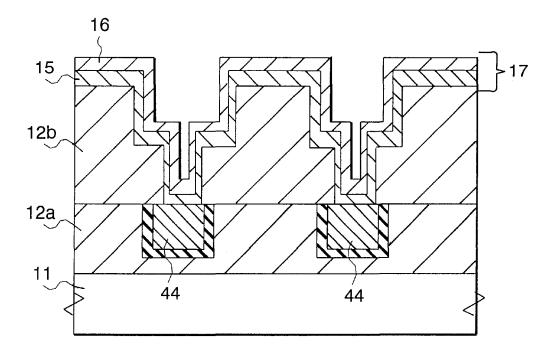


FIG. 4B



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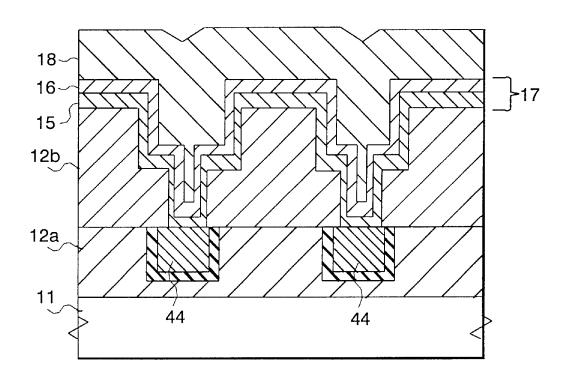


FIG. 4C

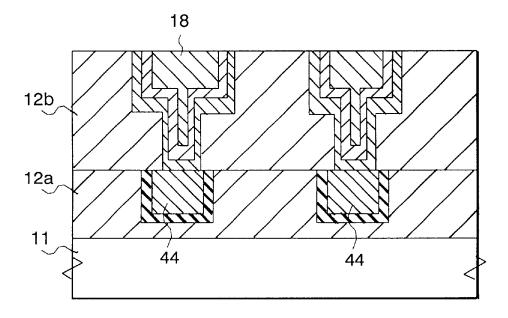
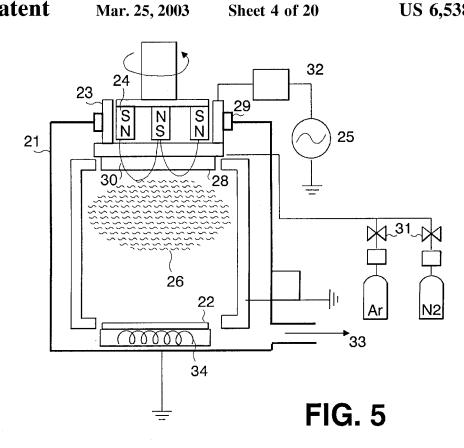


FIG. 4D





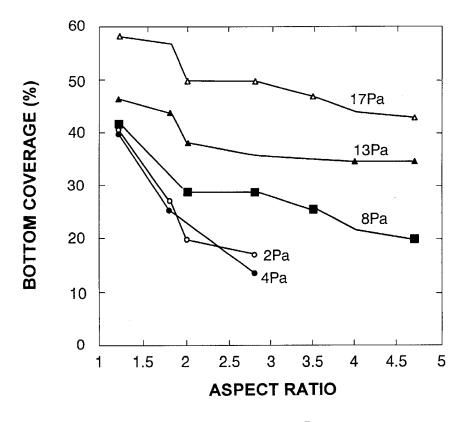


FIG. 6

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