



US006136682A

# United States Patent [19]

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Hegde et al.

[45] Date of Patent: **\*Oct. 24, 2000**

[54] **METHOD FOR FORMING A CONDUCTIVE STRUCTURE HAVING A COMPOSITE OR AMORPHOUS BARRIER LAYER**

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

[\*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/954,149**

[22] Filed: **Oct. 20, 1997**

[51] Int. Cl.<sup>7</sup> ..... **H01L 21/4763**

[52] U.S. Cl. .... **438/622; 438/643; 438/644; 438/648; 438/687; 204/192.15**

[58] Field of Search ..... **438/644, 656, 438/648, 622, 643, 653, 654, 685, 687; 204/192.15**

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*Primary Examiner*—Wael Fahmy

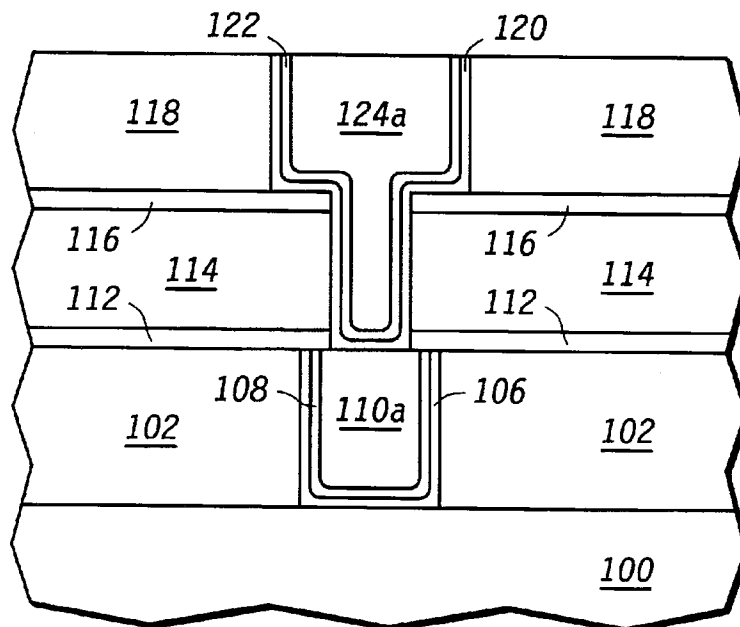
*Assistant Examiner*—Kurt Eaton

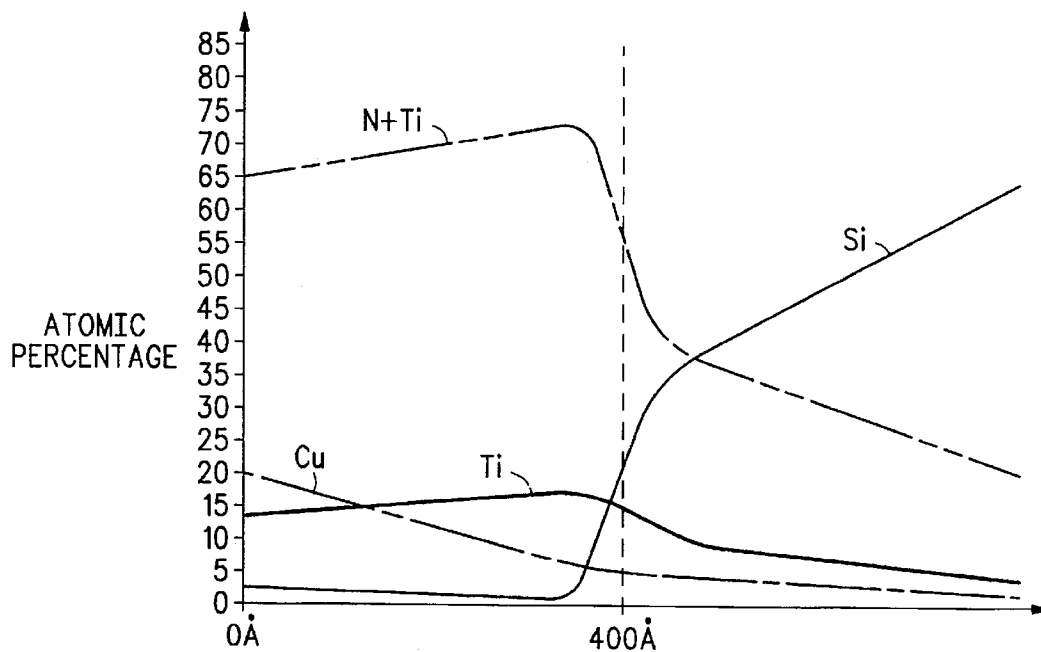
*Attorney, Agent, or Firm*—Keith E. Witek; Sandra L. Godsey; George R. Meyer

[57] **ABSTRACT**

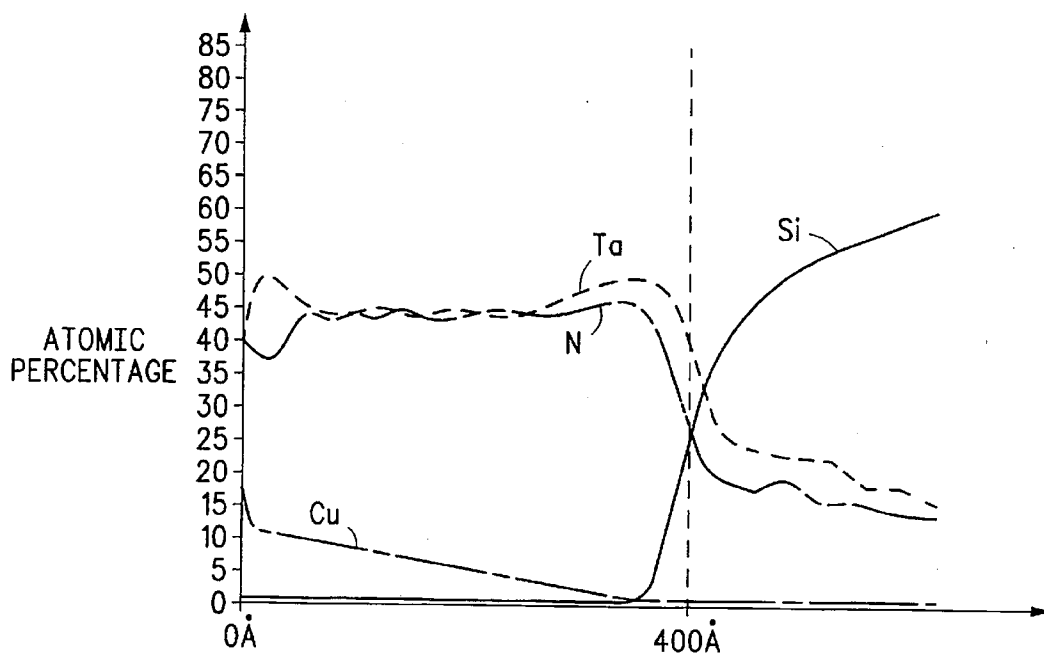
A method for forming an improved copper barrier layer begins by providing a silicon-containing layer (10). A physical vapor deposition process is then used to form a thin tantalum nitride amorphous layer (12). A thin amorphous titanium nitride layer (14) is then deposited over the amorphous tantalum nitride layer. A collective thickness of the tantalum nitride and titanium nitride layers 12 and 14 is roughly 400 angstroms or less. A copper material 16 is then deposited on top of the amorphous titanium nitride wherein the composite tantalum nitride layer 12 and titanium nitride layer 14 effectively prevents copper from diffusion from the layer 16 to the layer 10.

**19 Claims, 4 Drawing Sheets**





**FIG. 1**  
-PRIOR ART-



**FIG. 2**  
-PRIOR ART-

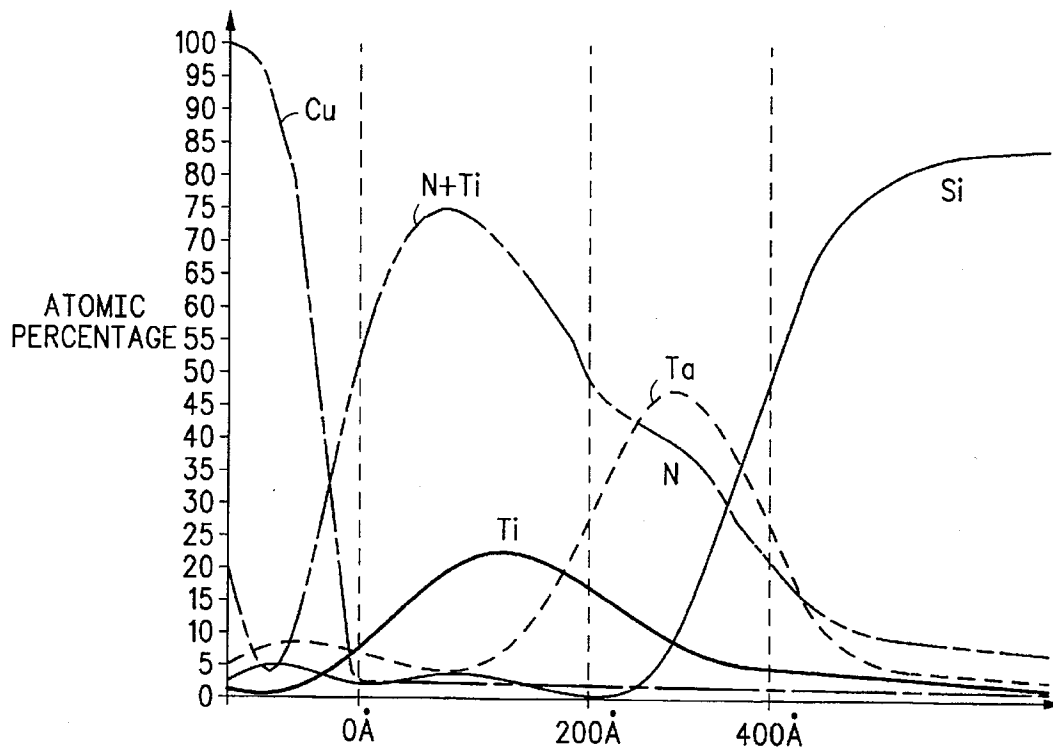


FIG. 3

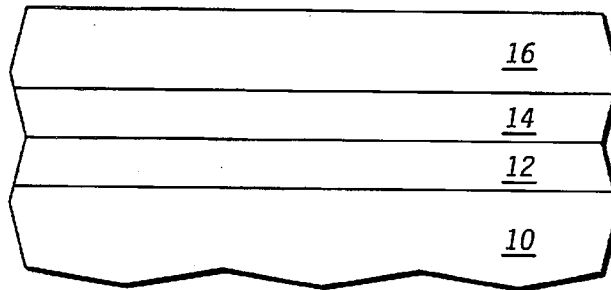


FIG. 4

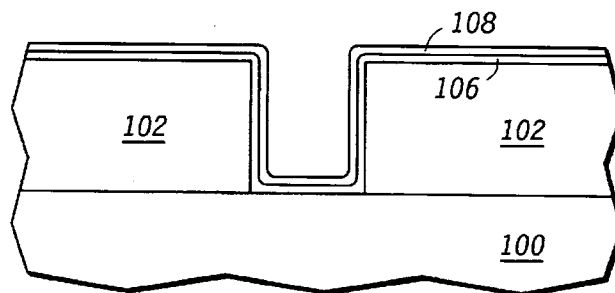
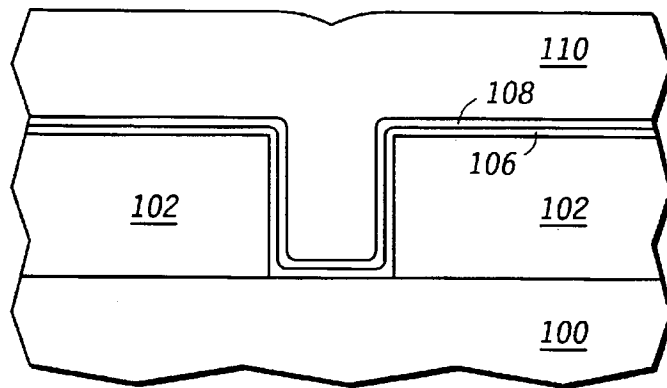
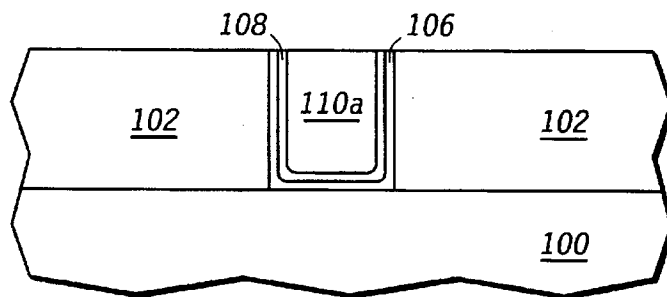


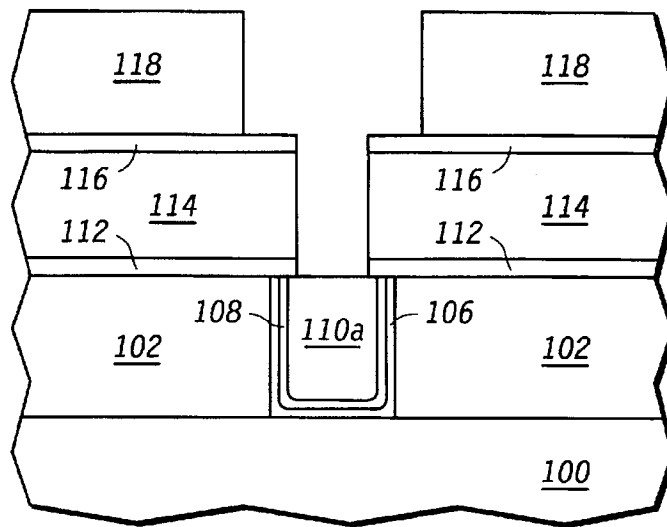
FIG. 5



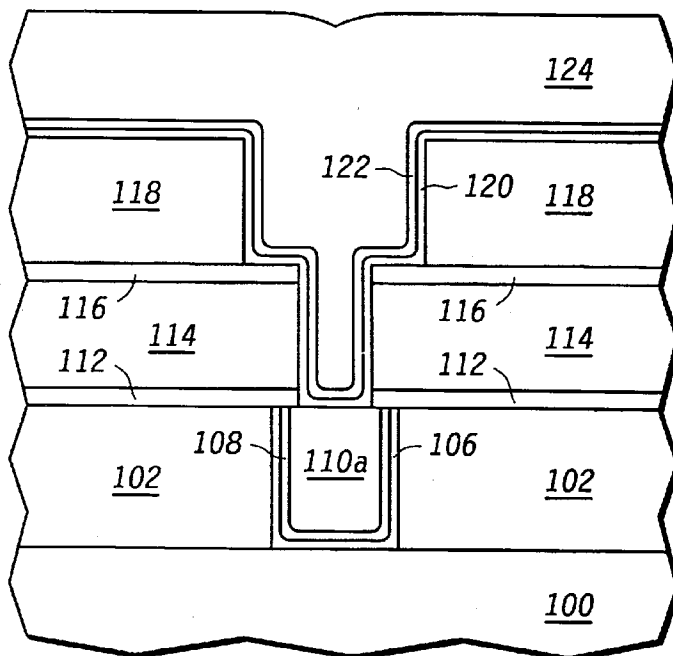
**FIG. 6**



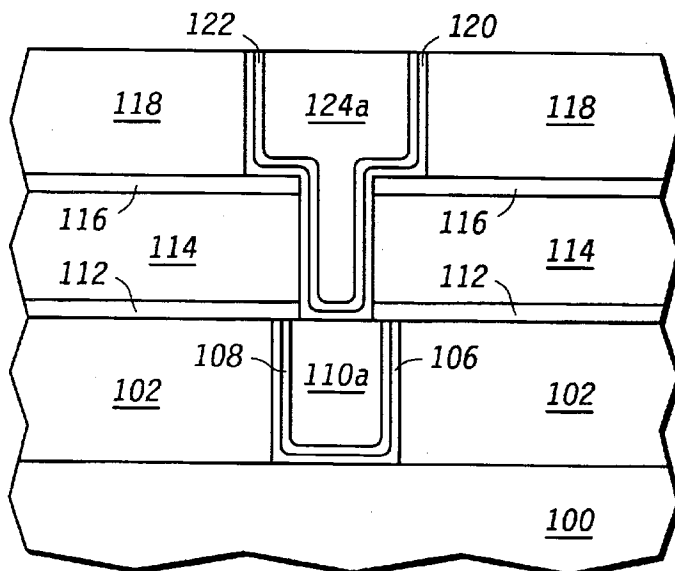
**FIG. 7**



**FIG. 8**



**FIG. 9**



**FIG. 10**

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