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**United States Patent** [19]  
**Zhang et al.**

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[45] **Date of Patent:** **Apr. 13, 1999**

- [54] **PROCESS FOR FORMING A SEMICONDUCTOR DEVICE**
- [75] Inventors: **Jiming Zhang, Austin; Dean J. Denning, Del Valle**, both of Tex.
- [73] Assignee: **Motorola, Inc., Schaumburg, Ill.**
- [21] Appl. No.: **08/996,000**
- [22] Filed: **Dec. 22, 1997**
- [51] **Int. Cl.<sup>6</sup>** ..... **H01L 21/00**
- [52] **U.S. Cl.** ..... **438/687; 438/687; 438/627; 438/628; 438/643**
- [58] **Field of Search** ..... **438/653, 627-28, 438/654, 656, 643, 644, 645, 648, 680, 681, 658, 687**

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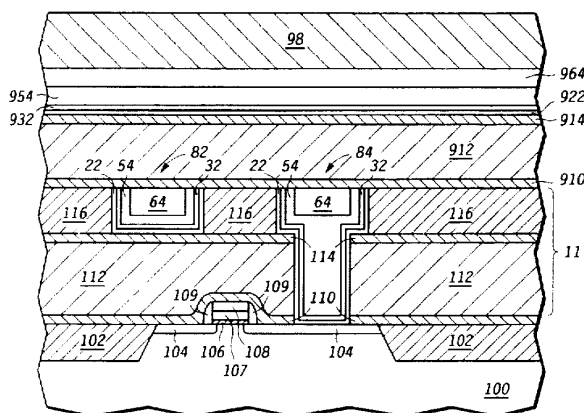
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[57] **ABSTRACT**

A semiconductor device comprises a substrate (100), first conductive film (22 and 32) over the substrate (100), and a second conductive film (54 and 64) over the first conductive film (22 and 32). The first conductive film includes a refractory metal and nitrogen. The first conductive film has a first portion (22) that lies closer to the substrate and a second portion (32) that lies further from the substrate. The nitrogen percentage for the second portion (32) is lower than the nitrogen atomic percentage for the first portion (22). The second conductive film (54 and 64) includes mostly copper. The combination of portions (22 and 32) within the first conductive film provides a good diffusion barrier (first portion) and has good adhesion (second portion) with the second conductive film (54 and 64).

**22 Claims, 5 Drawing Sheets**



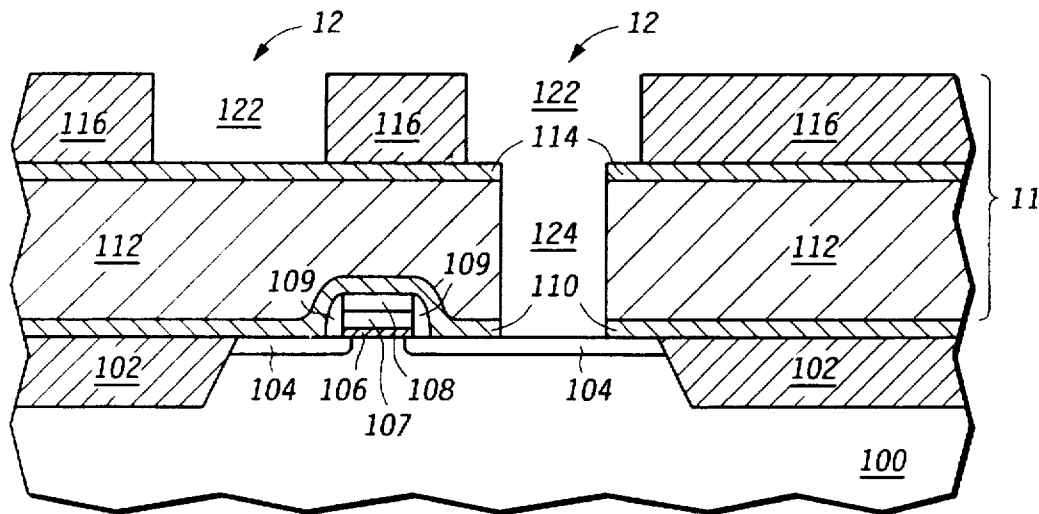


FIG. 1

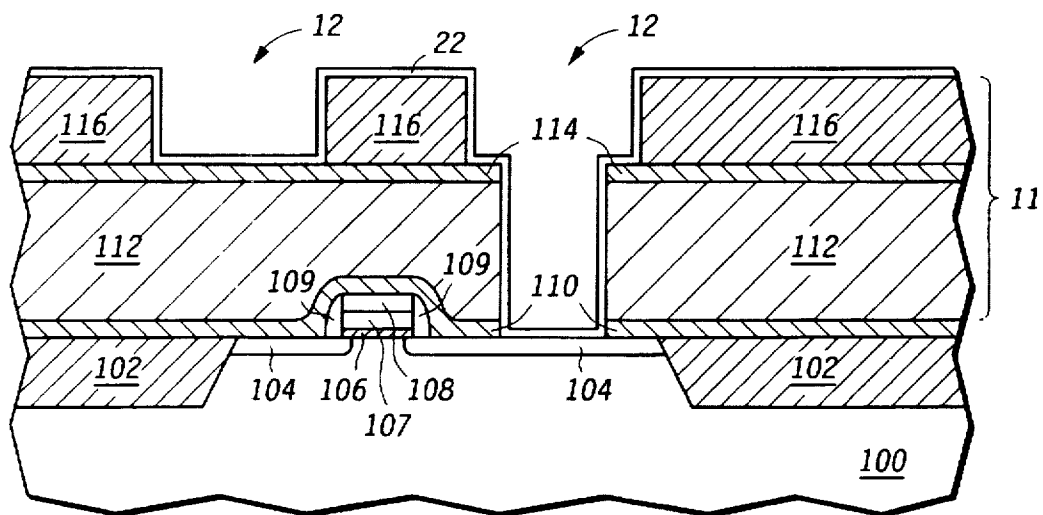


FIG. 2

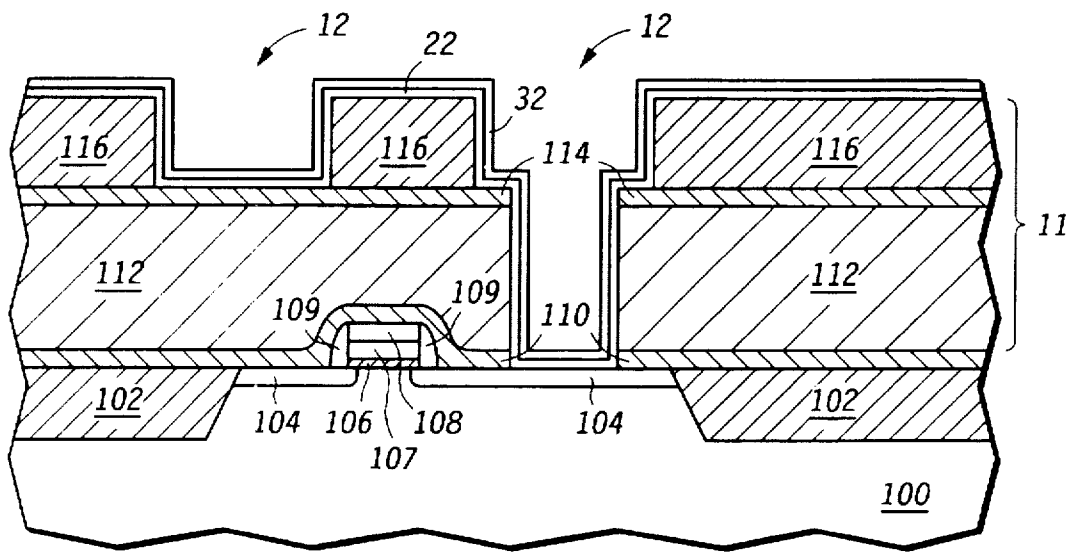


FIG. 3

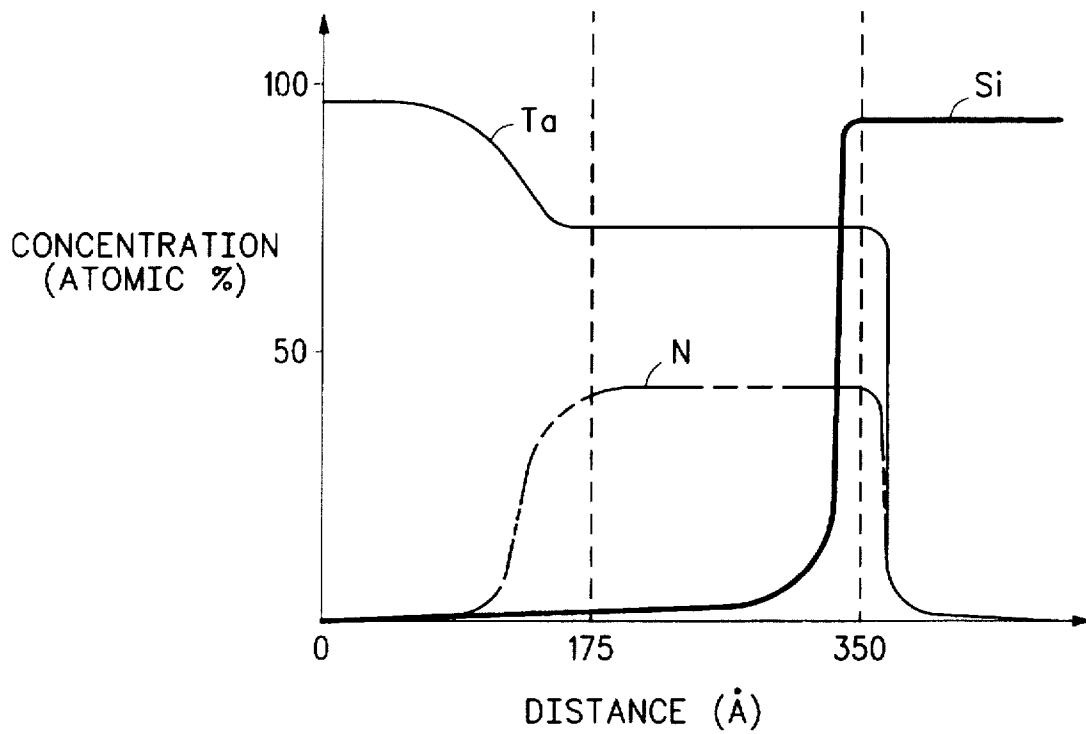


FIG. 4

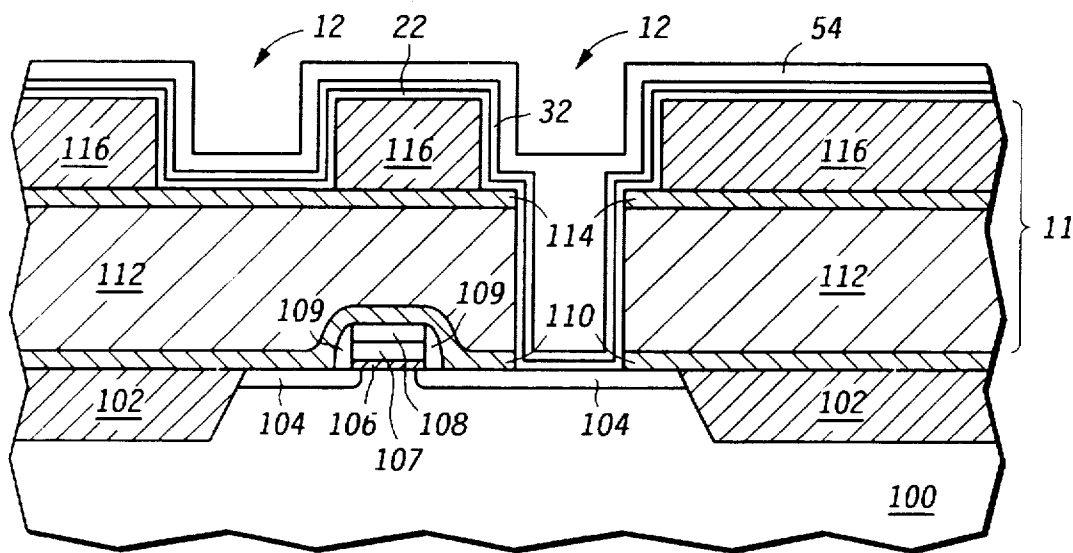


FIG. 5

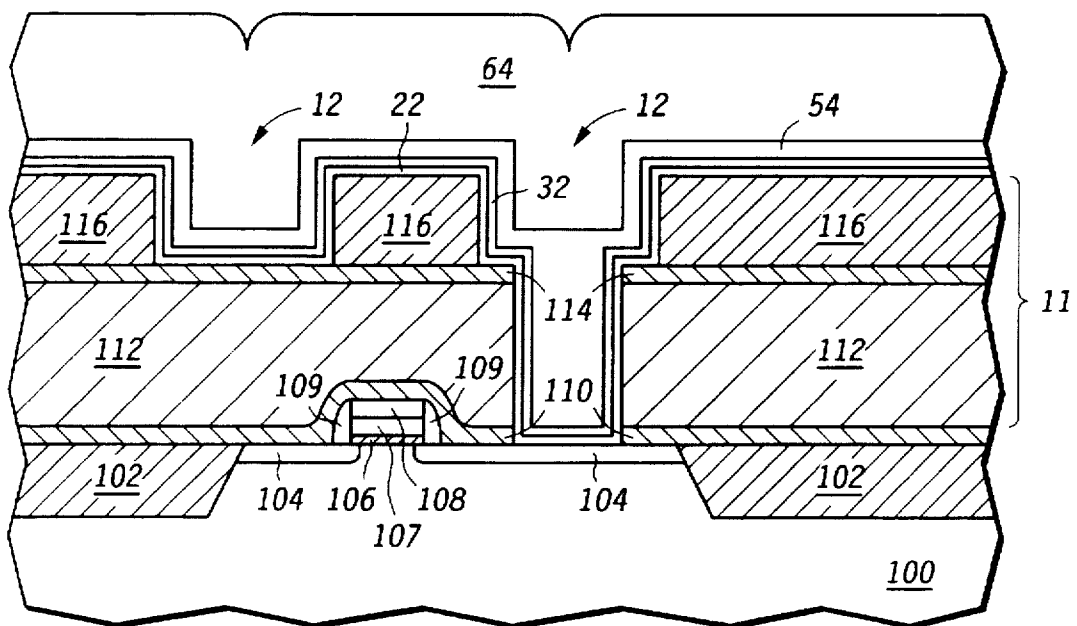


FIG. 6

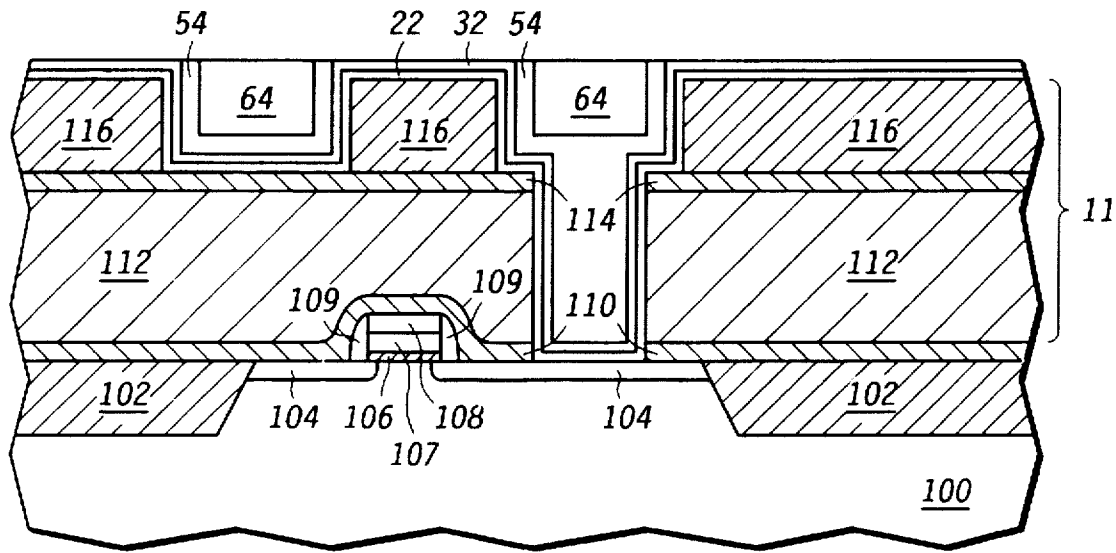


FIG. 7

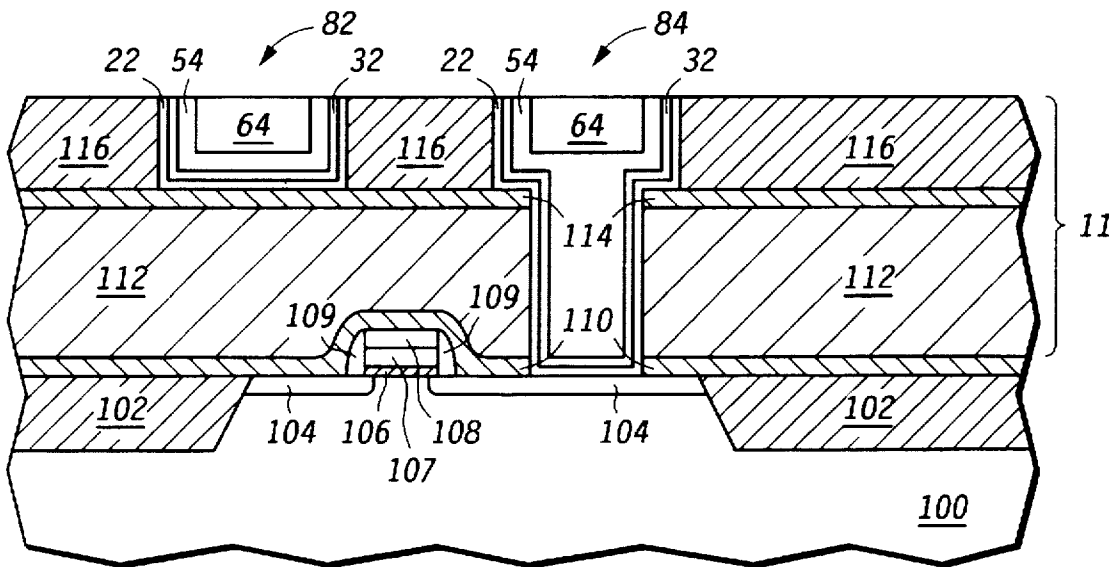


FIG. 8

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