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United States Patent [19]

Jain

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[45] **Date of Patent: Oct. 13, 1998**

[54] **PROCESS FOR FORMING A SEMICONDUCTOR DEVICE**

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

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[51] **Int. Cl.**[6] **H01L 21/00**

[52] **U.S. Cl.** **438/692**; 216/18; 216/38; 216/88; 438/627; 438/628; 438/633

[58] **Field of Search** 438/626, 627, 438/628, 633, 692, 693, 697, 748; 216/18, 38, 39, 56, 88

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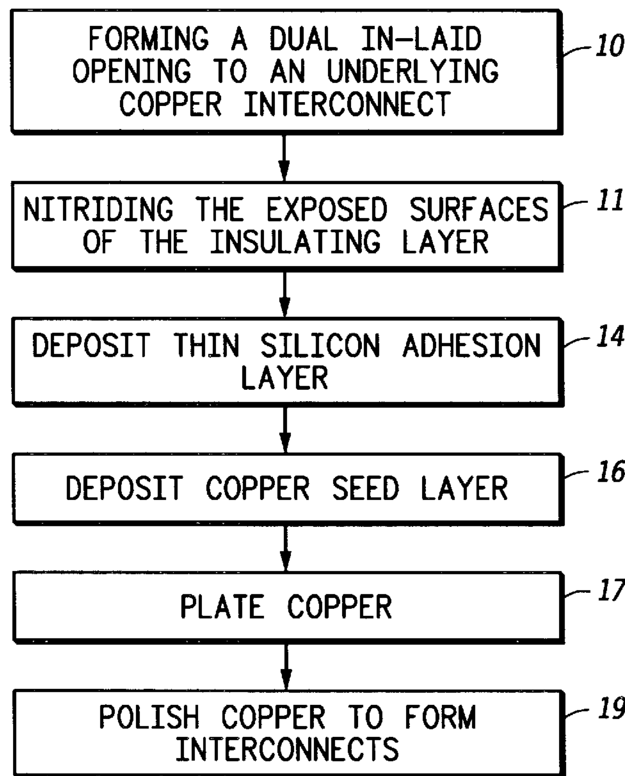
[57] **ABSTRACT**

A process for forming a semiconductor device **(68)** in which an insulating layer **(52)** is nitrided and then covered by a thin adhesion layer **(58)** before depositing a composite copper layer **(62)**. This process does not require a separate diffusion barrier as a portion of the insulating layer **(52)** has been converted to form a diffusion barrier film **(56)**. Additionally, the adhesion layer **(58)** is formed such that it can react with the interconnect material resulting in strong adhesion between the composite copper layer **(62)** and the diffusion barrier film **(56)** as well as allow a more continuous interconnect and via structure that is more resistant to electromigration.

21 Claims, 5 Drawing Sheets



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FORMING A DUAL IN-LAID OPENING TO AN UNDERLYING COPPER INTERCONNECT — 10

NITRIDING THE EXPOSED SURFACES OF THE INSULATING LAYER — 11

DEPOSIT THIN SILICON ADHESION LAYER — 14

DEPOSIT COPPER SEED LAYER — 16

PLATE COPPER — 17

POLISH COPPER TO FORM INTERCONNECTS — 19

FIG.1

30 28 30 28
36 38 40 36 38 36
46 44 42 44 46
12

FIG.2

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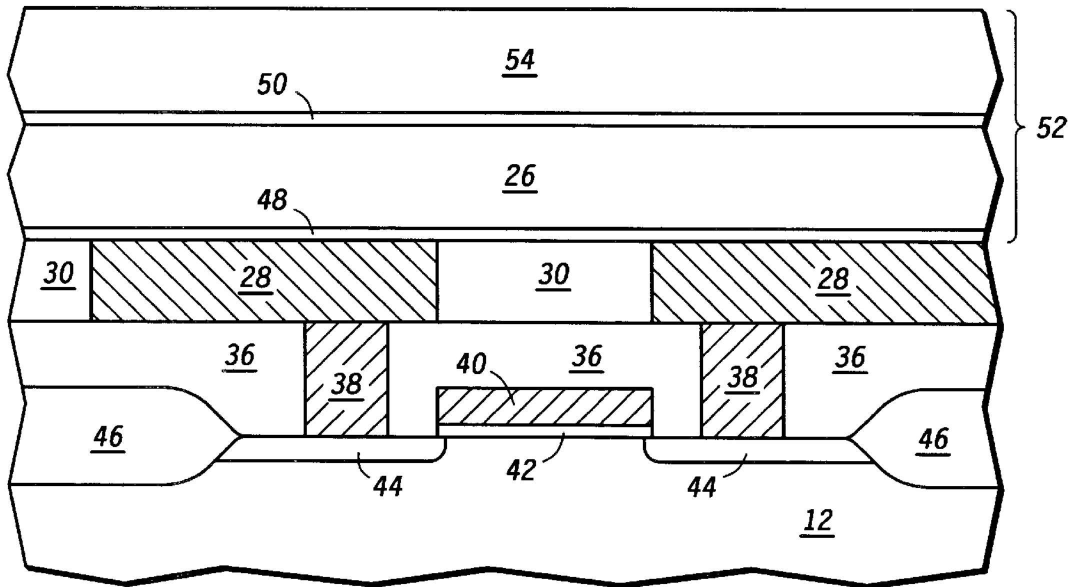

FIG. 3

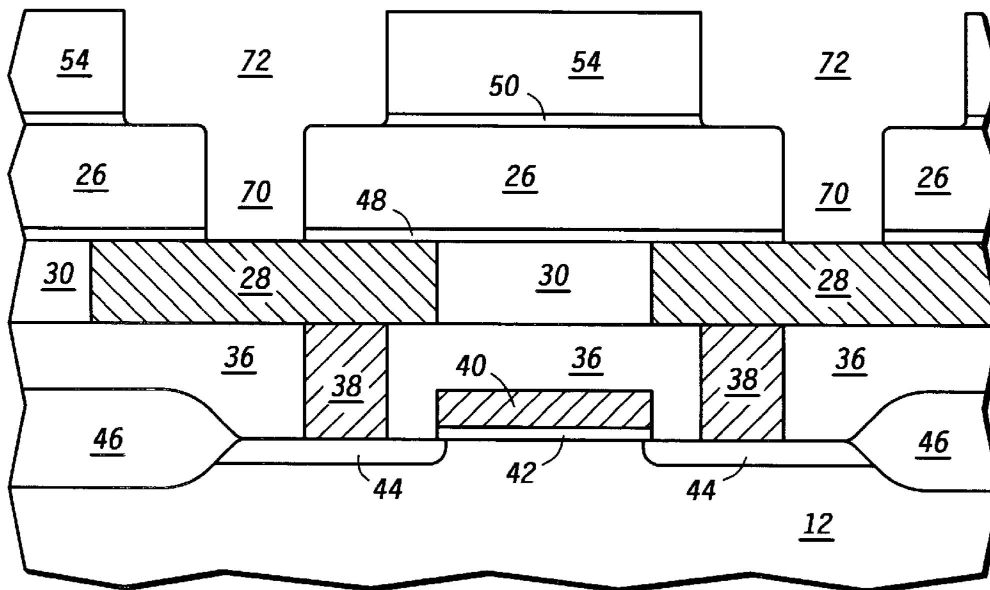

FIG. 4

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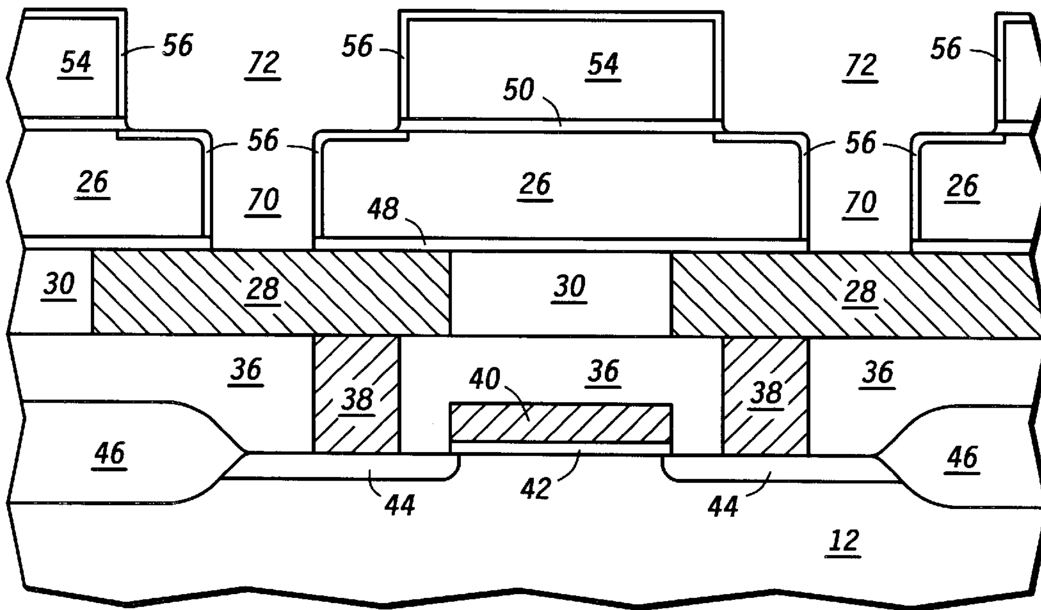

FIG. 5

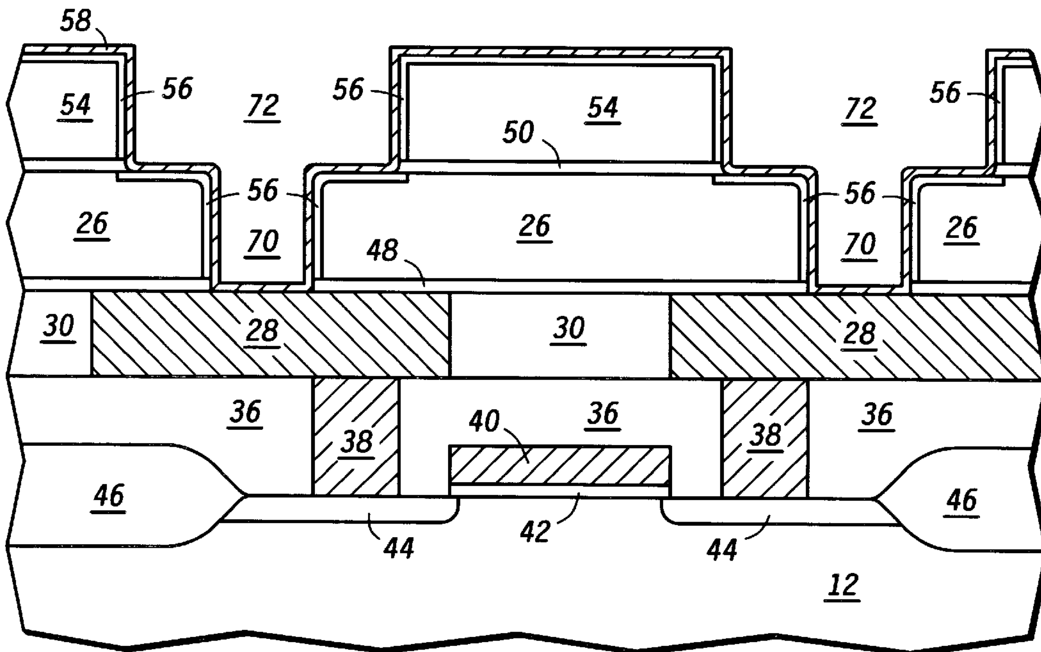

FIG. 6

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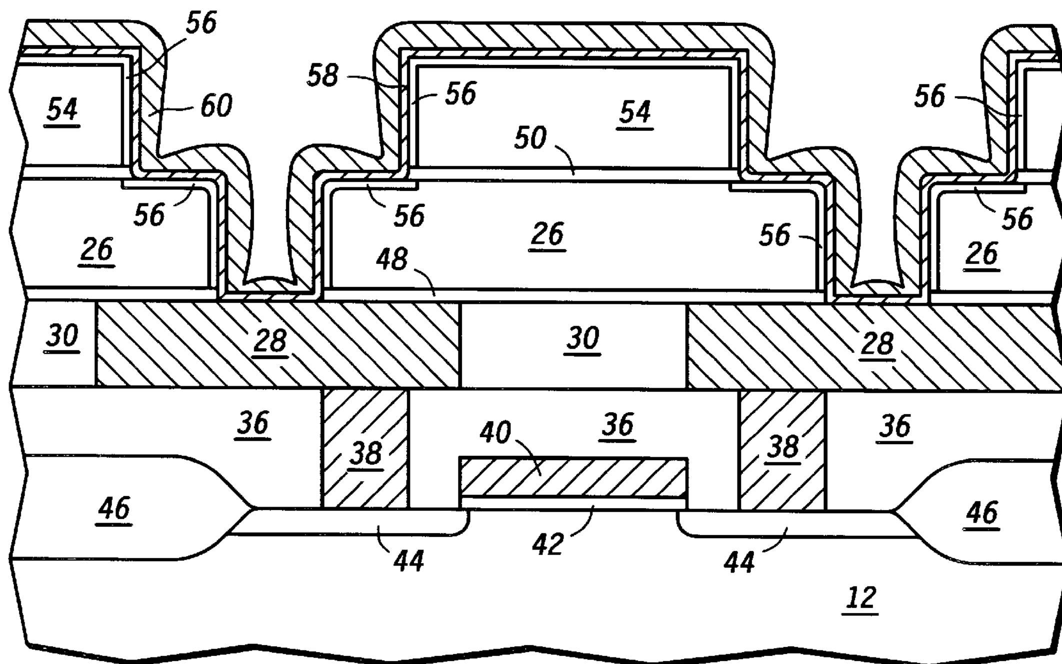

FIG. 7

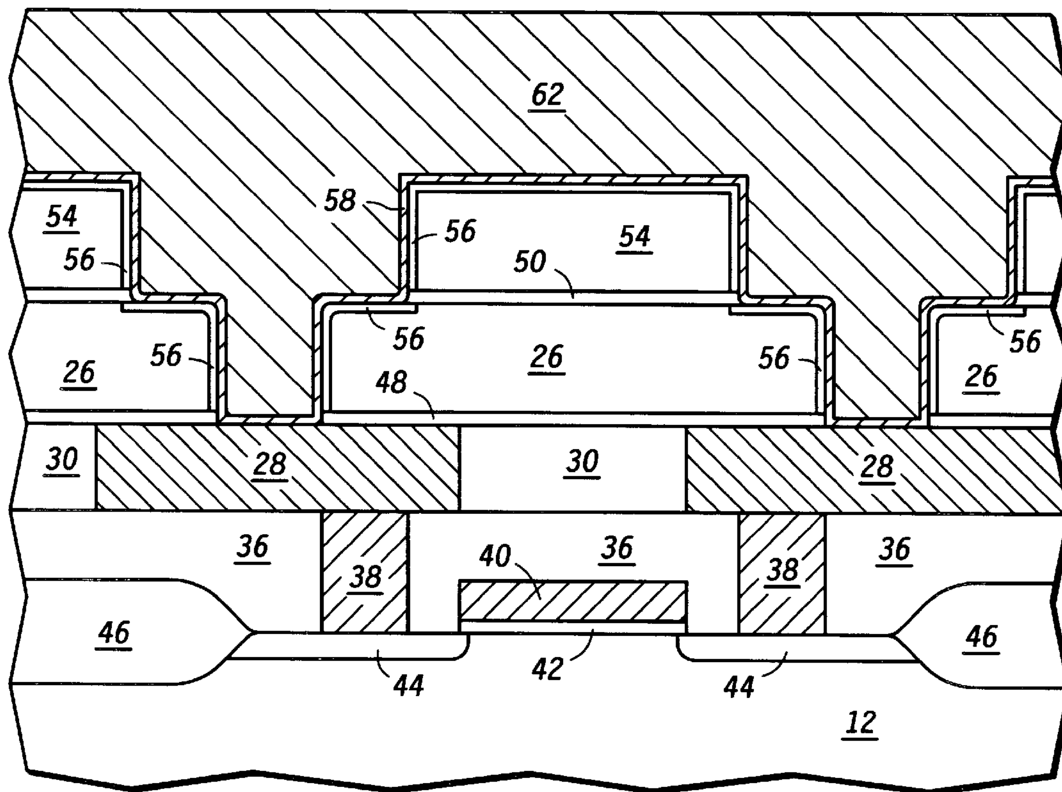

FIG. 8

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