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# United States Patent [19]

Grill et al.

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[45] **Date of Patent:** Oct. 31, 2000

[54] **DUAL DAMASCENE PROCESSING FOR SEMICONDUCTOR CHIP INTERCONNECTS**

5,882,996 3/1999 Dai ..... 438/597

### FOREIGN PATENT DOCUMENTS

[75] Inventors: **Alfred Grill**, White Plains; **John Patrick Hummel**, Millbrook; **Christopher Vincent Jahnes**, Monsey; **Vishnubhai Vitthalbhai Patel**, Yorktown Heights; **Katherine Lynn Saenger**, Ossining, all of N.Y.

905768 3/1999 European Pat. Off. .

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*Attorney, Agent, or Firm*—Robert M. Trepp

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

### [57] ABSTRACT

[21] Appl. No.: 09/126,212

The present invention relates to lithographic methods for forming a dual relief pattern in a substrate, and the application of such methods to fabricating multilevel interconnect structures in semiconductor chips by a Dual Damascene process in which dual relief cavities formed in a dielectric are filled with conductive material to form the wiring and via levels. The invention comprises a twice patterned single mask layer Dual Damascene process modified by the addition of an easy-to-integrate sidewall liner to protect organic interlevel and intralevel dielectrics from potential damage induced by photoresist stripping steps during lithographic rework. The invention further comprises a method for forming a dual pattern hard mask which may be used to form dual relief cavities for use in Dual Damascene processing, said dual pattern hard mask comprising a first set of one or more layers with a first pattern, and a second set of one or more layers with a second pattern.

[22] Filed: Jul. 30, 1998

### Related U.S. Application Data

[60] Provisional application No. 60/071,628, Jan. 16, 1998.

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

[52] U.S. Cl. .... 438/637; 438/701; 438/638

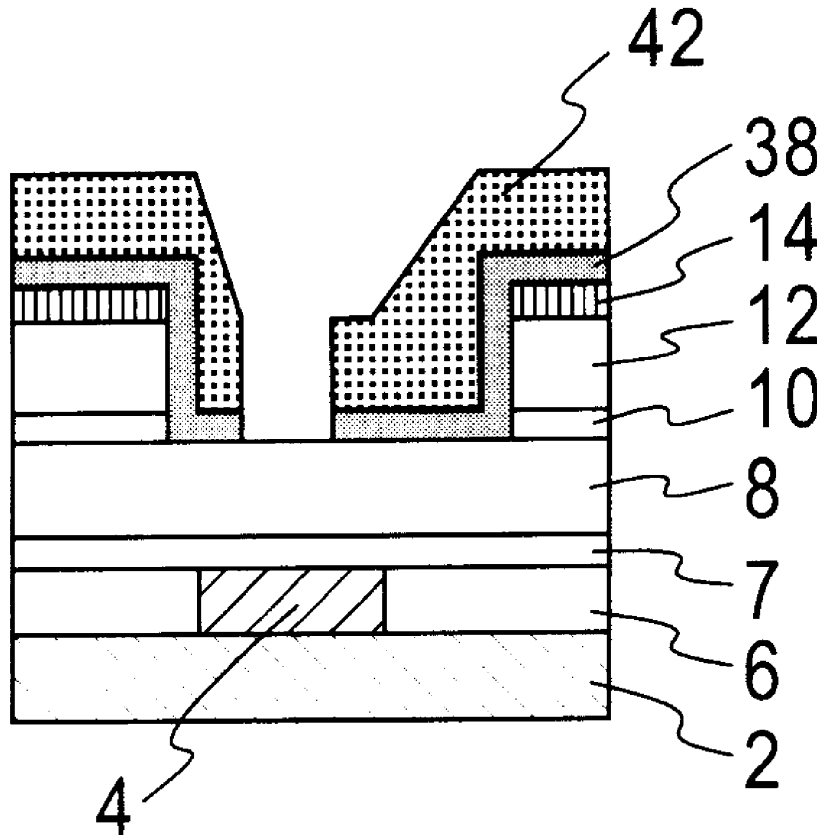
[58] Field of Search ..... 438/637, 636, 438/700, 701, 702, 638, 640

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48 Claims, 8 Drawing Sheets



PRIOR ART

Fig. 1A

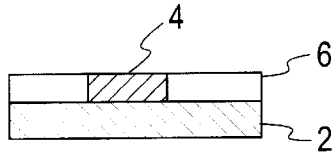


Fig. 1B

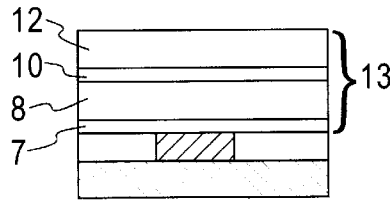


Fig. 1C

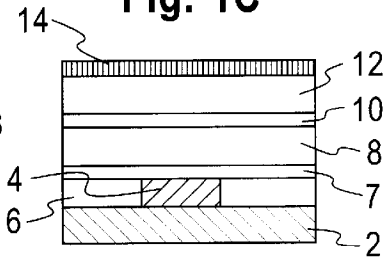


Fig. 1D

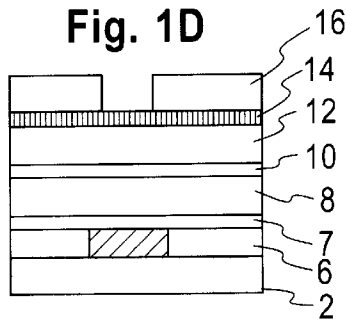


Fig. 1E

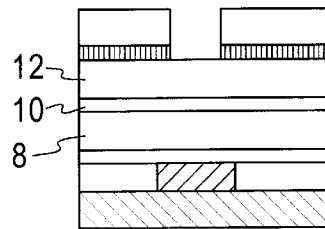


Fig. 1F

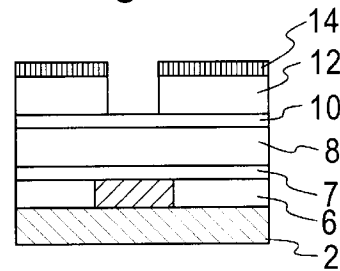


Fig. 1G

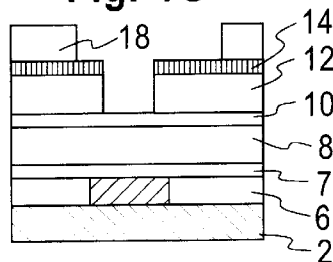


Fig. 1H

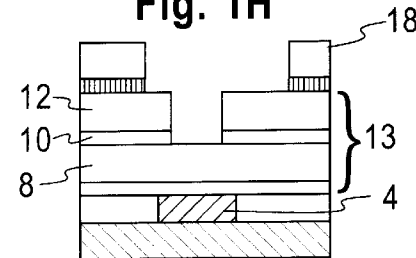


Fig. 1I

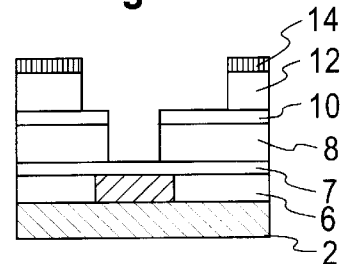


Fig. 1J

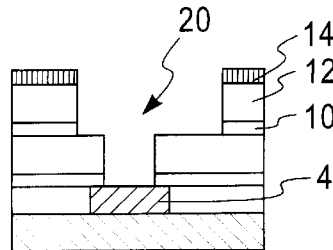


Fig. 1K

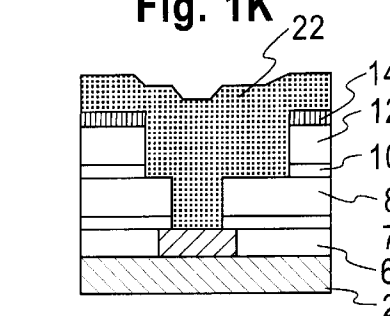


Fig. 1L

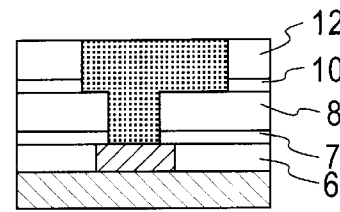


Fig. 2A

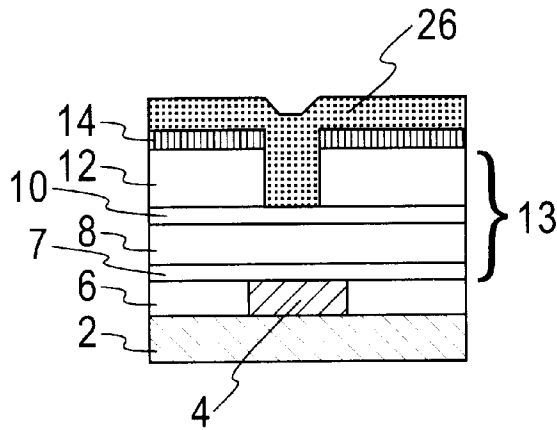


Fig. 2B

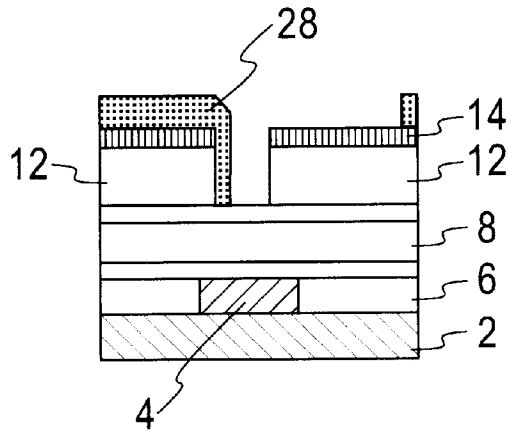


Fig. 2C

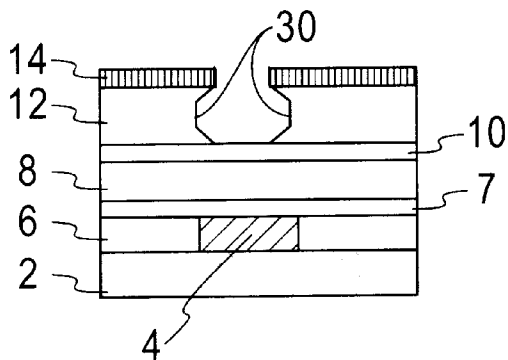
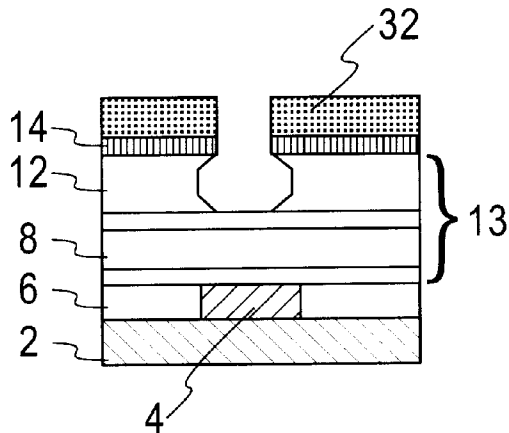


Fig. 2D



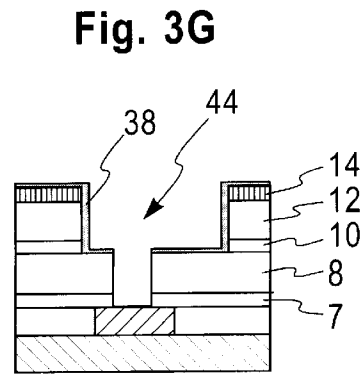
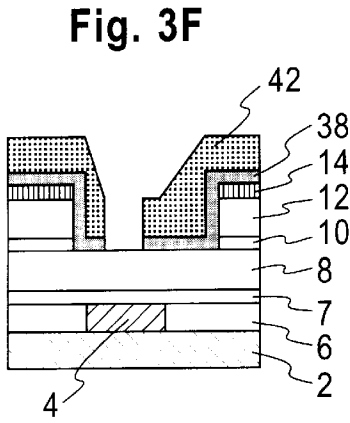
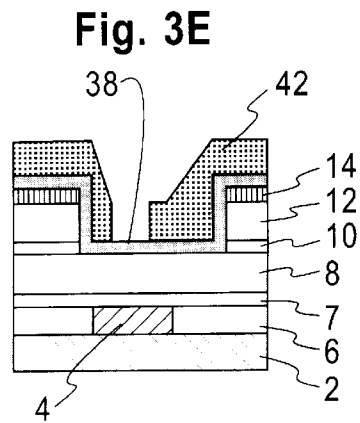
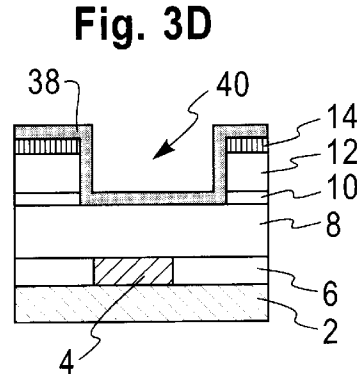
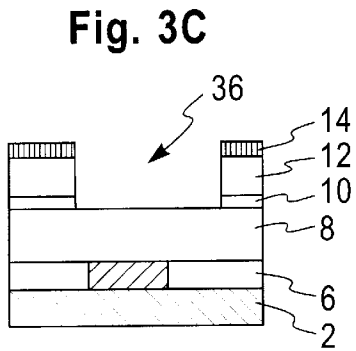
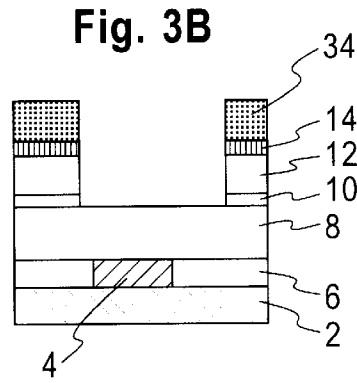
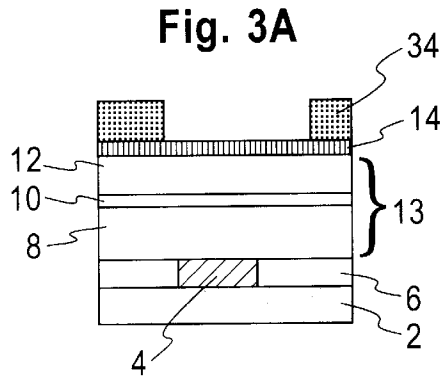


Fig. 4A

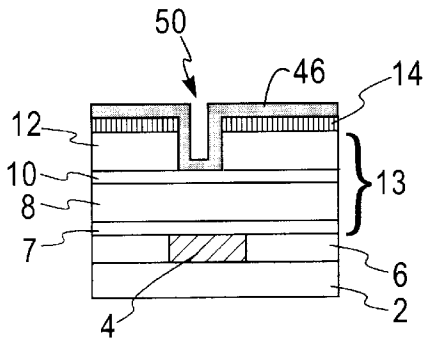


Fig. 4B

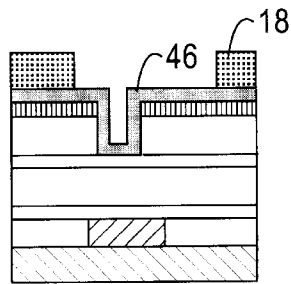


Fig. 4C

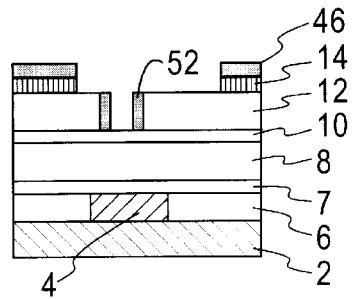


Fig. 4D

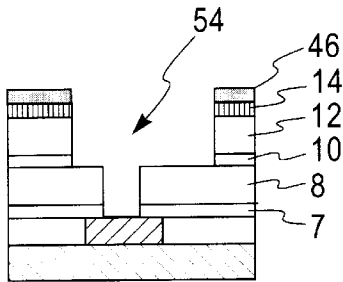


Fig. 4E

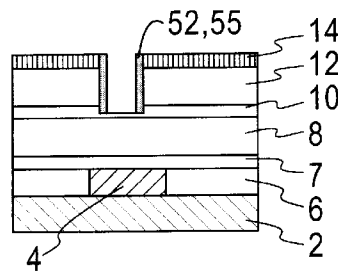
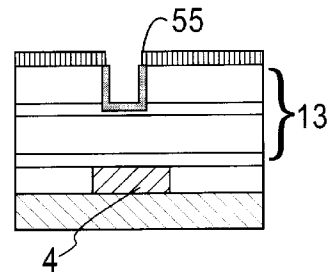


Fig. 4F



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