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Method of Improving Contact Bonds in Silicon Integrated Circuits

The problem:

Producing stable and reliable metallic systems for interconnections, contact pads, and bonded leads in silicon planar integrated circuits. In a conventional fabrication, employing interconnection metal of vapor-deposited aluminum, contact pads of vapor-deposited gold on chromium, and bonded lead wires of gold, metal-to-metal contact bonds are formed. The intermetallic compounds present in the interfaces result in a degradation of bond strength, an increase in ohmic contact resistance, and eventually in open circuits caused by voids which arise from volumetric phase mismatch.

The solution:

A method of fabrication based on substrate isolation of the interconnection metal from the contact pad and bonded wire.

How it's done:

The interconnections are separated from the contact pads by a barrier domain of bulk silicon substrate material which has been degenerately doped. The entire region, which is comprised of the interconnection metal (vapor-deposited aluminum), the degenerate substrate section, and the contact pad (vapor-deposited gold on chromium), is bounded by a diffused isolation ring. Degradation is avoided as the metal compatibility need only be between the respective land metals and the substrate material, and not between all the metals collectively. The relatively thick substrate barrier prevents any phase reactions between the interconnection and pad-wire components of the metal assemblage. The preparation of this specific interconnection-contact-bonding aggregation involves techniques that are essentially standard to integrated circuit processing: planar diffusion, vapor deposition, and photoengraving.

Notes:

1. This approach may be applied not only to silicon integrated circuits but also to circuits fabricated from the more exotic semiconductor materials and to hybrid and thin-film circuits.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10335

Patent status:

No patent action is contemplated by NASA.

Source: M. A. Schuster and W. J. Lytle
of Westinghouse Electric Corporation
under contract to
Marshall Space Flight Center
(MFS-1753)

Category 01

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