

[54] METHOD OF MANUFACTURING BIPOLAR TRANSISTOR

Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt

[75] Inventors: Hiroyuki Nihira, Ayase; Nobuyuki Itoh, Tokyo, both of Japan

[57] ABSTRACT

[73] Assignee: Kabushiki Kaisha Toshiba, Kawasaki, Japan

A method of manufacturing a bipolar transistor is disclosed. A first mask material film pattern is formed on an internal base region prospective portion on a collector region of a first conductive type, and then a first conductive film is deposited. A recess around the projection of the mask film pattern are transferred on the surface of the first conductive film. After a second mask material film pattern is buried in the recess, the first conductive film is selectively etched using the second mask material pattern as a mask, thereby exposing the first mask material film pattern. The first conductive film is continuously, selectively etched by anisotropic etching using the exposed first mask material film pattern and the second mask material film pattern as etching masks to form a first opening between the two mask material film patterns. An impurity of a second conductivity type is doped through the first opening to form an external base region. The first opening is buried with a second conductive film before or after formation of the external base region. The first mask material film pattern is removed to form a second opening. After a thermal oxide film is formed on the surface of the second conductive film, an impurity of the second conductivity type is doped through the second opening, thereby forming the internal base region. An impurity of the first conductivity type is doped in the wafer through the second opening to form an emitter region.

[21] Appl. No.: 225,804

[22] Filed: Jul. 29, 1988

[30] Foreign Application Priority Data

Jul. 29, 1987 [JP] Japan 62-189419
Oct. 27, 1987 [JP] Japan 62-269259

[51] Int. Cl.⁴ H01L 21/314; H01L 21/225

[52] U.S. Cl. 437/31; 437/33; 437/162; 437/228; 357/34; 156/653

[58] Field of Search 437/31, 32, 33, 162, 437/228, 239; 357/34, 35; 156/643, 653; 148/DIG. 51, DIG. 103, DIG. 131

[56] References Cited

U.S. PATENT DOCUMENTS

4,693,782 9/1987 Kikuchi et al. 437/31

OTHER PUBLICATIONS

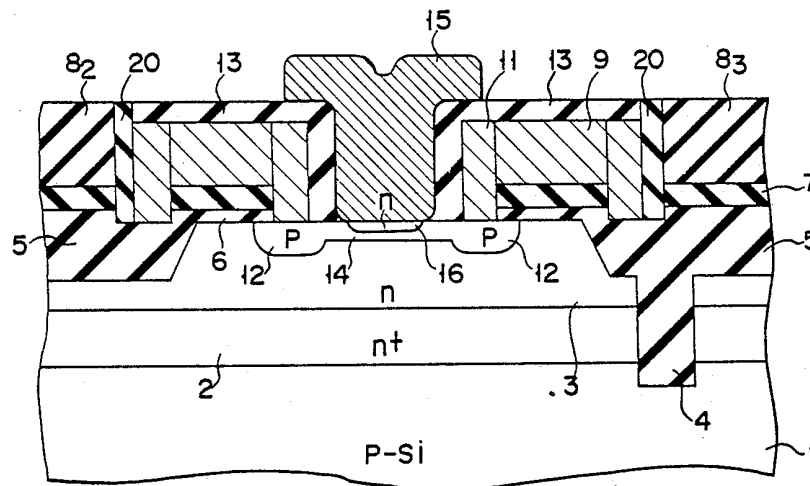
Konaka, S. et al., "A 30-ps Si Bipolar IC . . .", *IEEE Trans. Elect. Devices*, vol. ED-33, No. 4, Apr. 1986, pp. 526-531.

Kikuchi, K. et al., "A High-Speed Bipolar LSI Process . . .", *IEEE-IEDM Tech. Digest*, 1986, pp. 420-423.

Primary Examiner—Brian E. Hearn

Assistant Examiner—T. N. Quach

19 Claims, 16 Drawing Sheets



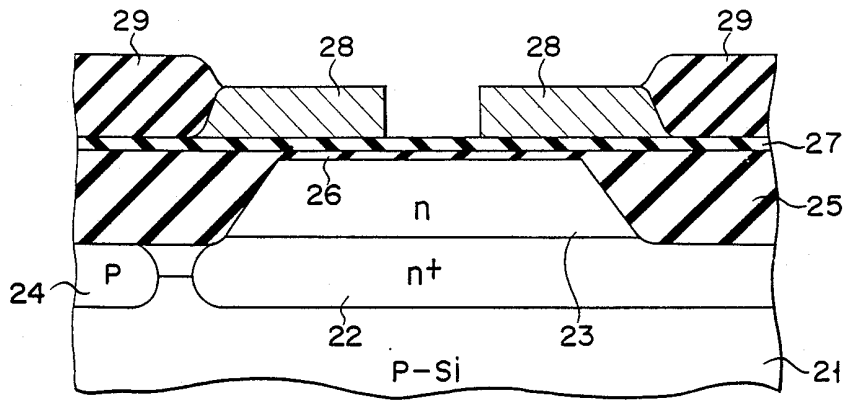


FIG. 1A (PRIOR ART)

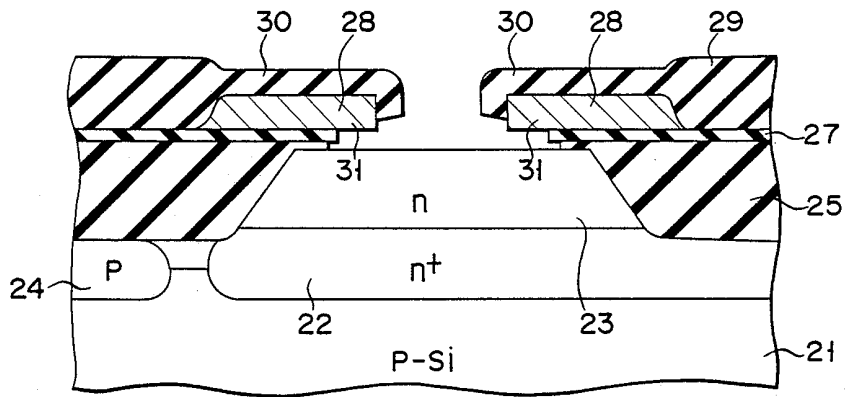


FIG. 1B (PRIOR ART)

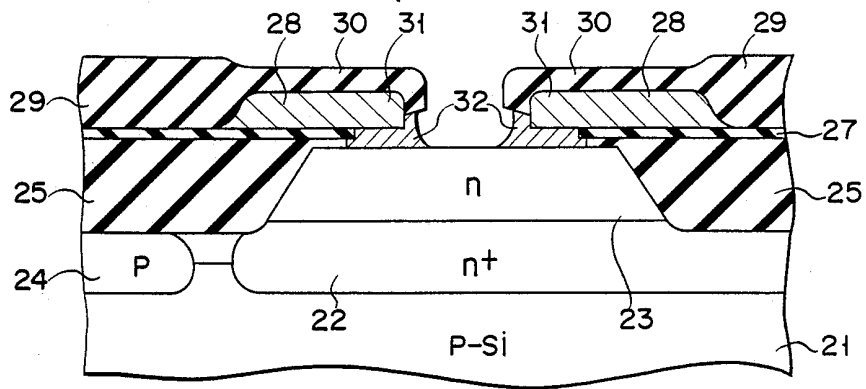


FIG. 1C (PRIOR ART)

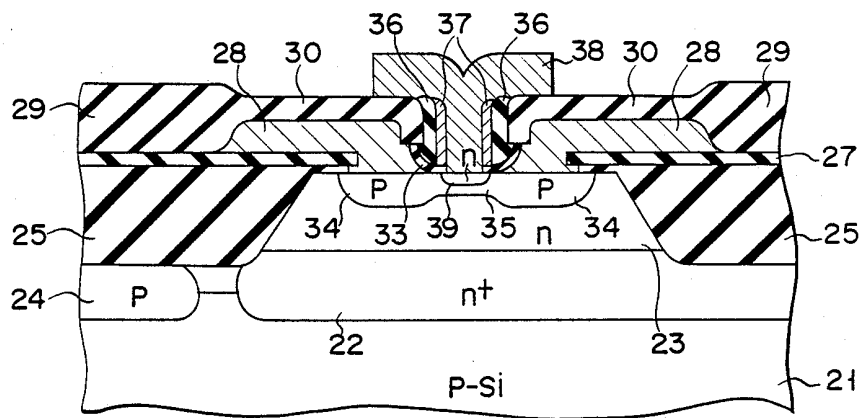


FIG. 1D (PRIOR ART)

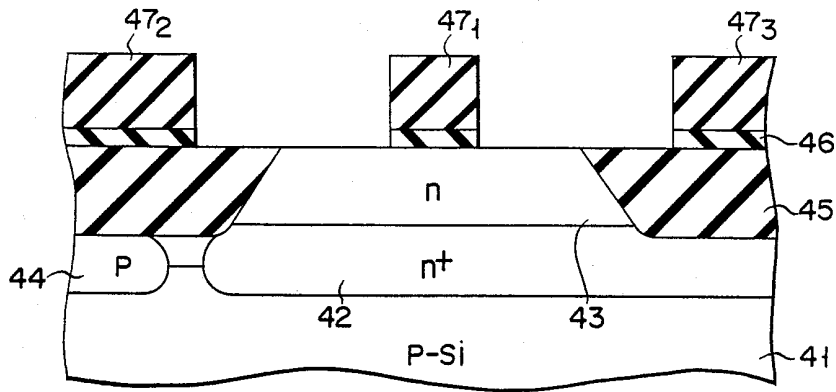


FIG. 2A (PRIOR ART)

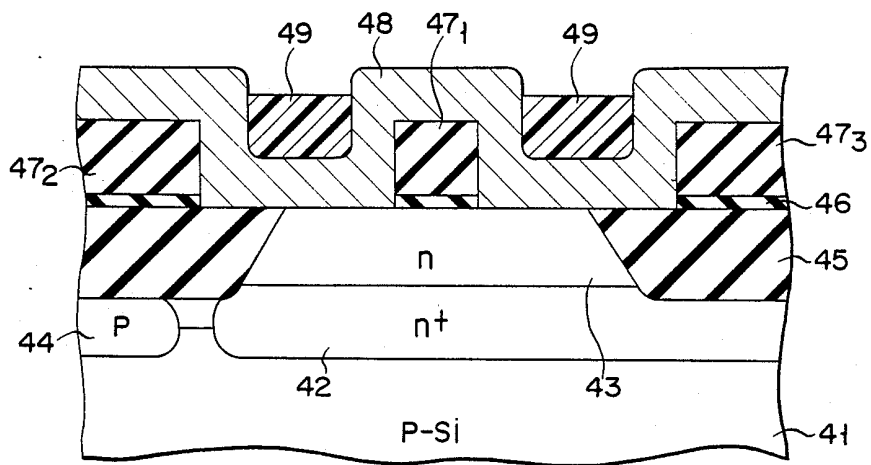


FIG. 2B (PRIOR ART)

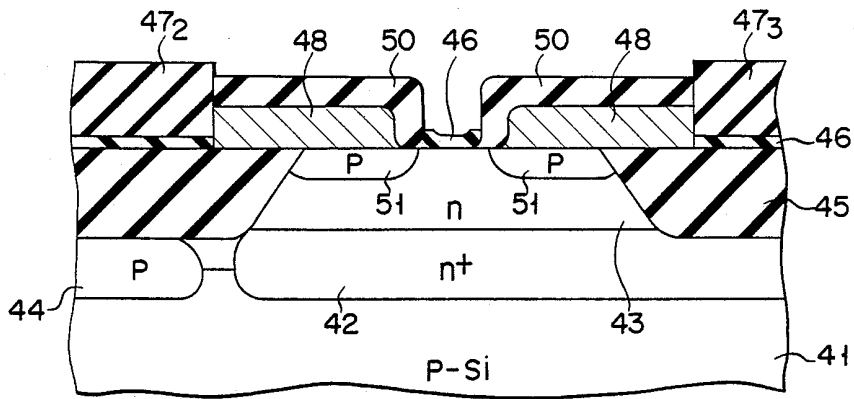


FIG. 2C (PRIOR ART)

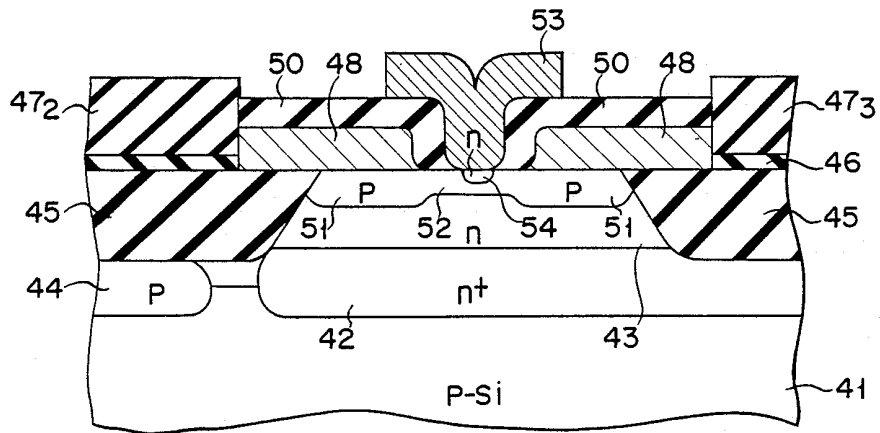


FIG. 2D (PRIOR ART)

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.