US005160998A

United States Patent [19]

Itoh et al.

[11] Patent Number: 5,160,998

[45] Date of Patent: Nov. 3, 1992

[54] SEMICONDUCTOR DEVICE AND METHOD OF MANUFACTURING THE SAME

[75] Inventors: **Junichi Itoh**, Inagi; **Kazuyuki Kurita**, Yokohama, both of Japan

[73] Assignee: **Fujitsu Limited**, Kanagawa, Japan

[21] Appl. No.: **780,564**

[22] Filed: **Oct. 21, 1991**

Related U.S. Application Data

[63] Continuation of Ser. No. 233,108, Aug. 15, 1988, abandoned.

[30] **Foreign Application Priority Data**

Aug. 18, 1987 [JP] Japan 62-203483

[51] **Int. Cl.**[5] **H01L 29/34**

[52] **U.S. Cl.** **257/760**; 257/633

[58] **Field of Search** 357/71, 54, 52, 40, 357/65

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,135,954	1/1979	Chang et al.	357/54 X
4,365,264	12/1982	Mukai et al.	357/52 X
4,446,194	5/1984	Candelaria et al.	357/54
4,455,568	6/1984	Shiota	357/54
4,654,689	3/1987	Fujii	357/40
4,825,277	4/1989	Mattox et al.	357/54 X

FOREIGN PATENT DOCUMENTS

0152794	8/1985	European Pat. Off.	357/71
0252179A1	1/1988	European Pat. Off. .	
51-117887	10/1976	Japan .	
52-28870	3/1977	Japan .	
52-115785	9/1977	Japan .	
55-19850	2/1980	Japan .	
57-45931	3/1982	Japan .	
0190043	11/1983	Japan	357/71
61-279132	12/1986	Japan .	

OTHER PUBLICATIONS

Ghandhi, S. *VLSI Fabrication Principles*, John Wiley and Sons, 1983, pp. 582–585.

Claassen, W. A. P. "Ion Bombardment-Induced Mechanical Stress in Plasma-Enhanced Deposited Silicon Nitride and Silicon Oxynitride Films." *Plasma Chemistry and Plasma Processing*, vol. 7, No. 1 (Mar. 1987), pp. 109–124.

Machida, Katsuyuki and Hideo Oikawa. "New Planarization Technology Using Bias-ECR Plasma Deposition." *Japanese Journal of Applied Physics*. supplements 17th Conf. on Solid State Devices and Materials Aug. 25–27, 1985, pp. 329–332.

Patent Abstracts of Japan, vol. 6, No. 119 (E-116) [997], Jul. 3 1982; and JP-A-57 45 931 (Fujitsu K. K.) Mar. 16, 1982.

Patent Abstracts of Japan, vol. 11, No. 138 (E-503)[2585], May 2, 1987; and JP-A-61 279 132 (Sony Corp.) Dec. 9, 1986.

Extended Abstracts, vol. 87-1, No. 1, Spring 1987, pp. 366–367, No. 254, Philiadelphia, Pa. U.S.; M. Doki et al.: "ECR Plasma CVD of Insulator Films-Low Temperature Process for Ulsi-".

Patent Abstracts of Japan, vol. 11, No. 390 (E-567) [2837], Dec. 19, 1987; and JP-A-62 154 642 (Matsushita Electronics Corp.) Sep. 7, 1987.

Primary Examiner—Andrew J. James
Assistant Examiner—Sara W. Crane
Attorney, Agent, or Firm—Nikaido, Marmelstein, Murray & Oram

[57] **ABSTRACT**

A semiconductor device including a semiconductor substrate; a metal wiring layer formed on the semiconductor substrate; a first insulation layer formed on the metal wiring layer, the first insulation layer being formed by a tensile stress insulation layer having a contracting characteristic relative to the substrate; and a second insulation layer formed on the first insulation layer, the second insulation layer being formed by a compressive stress insulation layer having an expanding characteristic relative to the substrate. The tensile stress insulation layer is produced by thermal chemical vapor deposition or plasma assisted chemical vapor deposition which is performed in a discharge frequency range higher than 2 megahertz; and the compressive stress insulation layer is produced by plasma assisted chemical vapor deposition which is performed in a discharge frequency range lower than 2 megahertz.

5 Claims, 6 Drawing Sheets

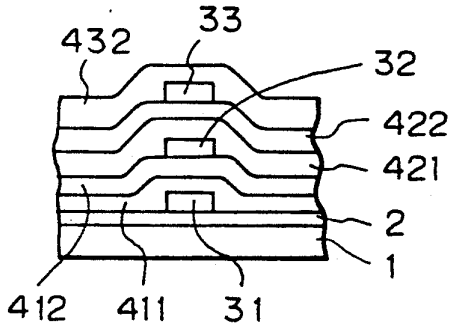


Fig. 1

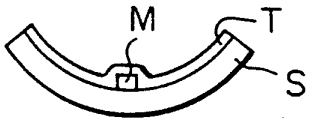


Fig. 2

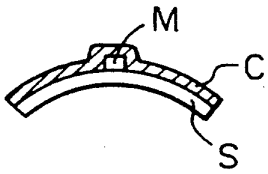


Fig. 3

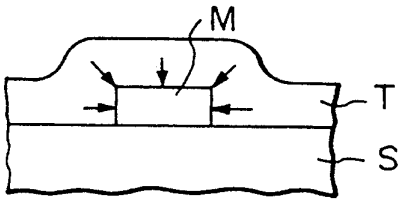


Fig. 4

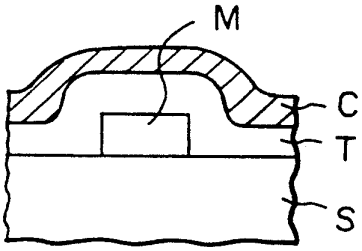


Fig. 6

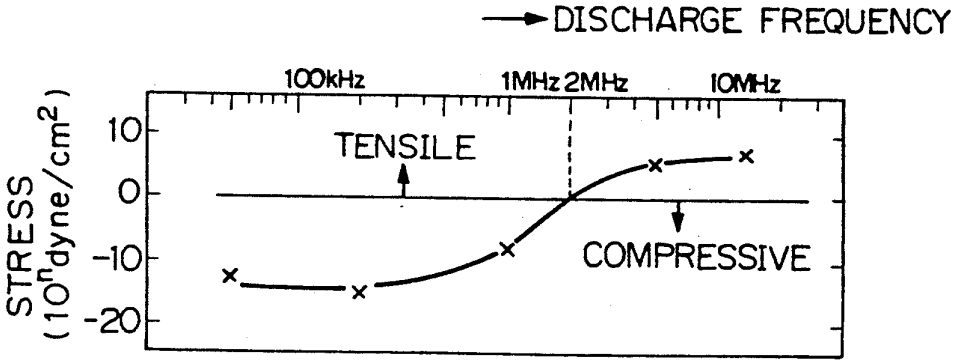


Fig. 5(a)

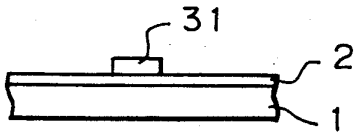


Fig. 5(b)

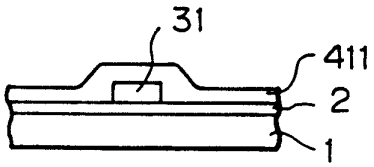


Fig. 5(c)

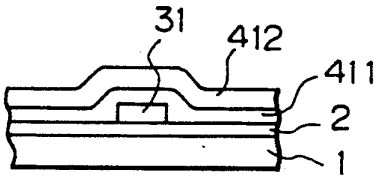


Fig. 5(d)

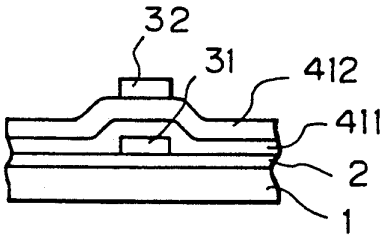


Fig. 5(e)

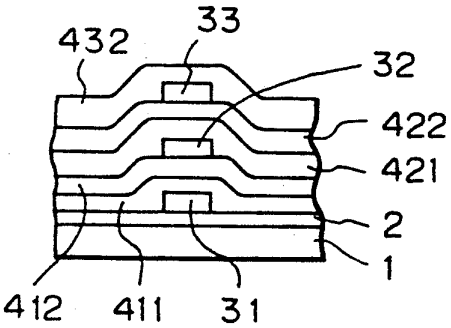


Fig. 7(a)

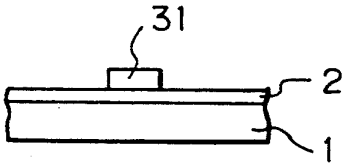


Fig. 7(b)

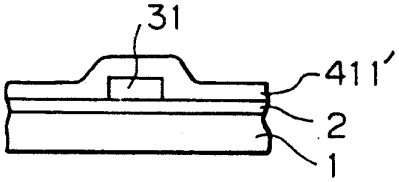


Fig. 7(b')

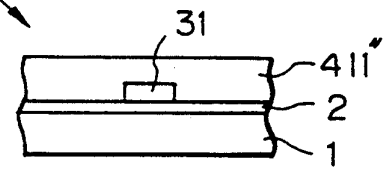


Fig. 7(c)

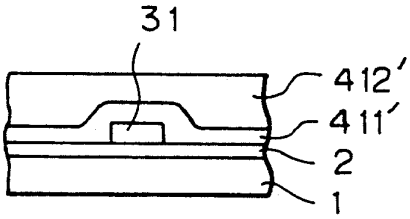


Fig. 7(c')

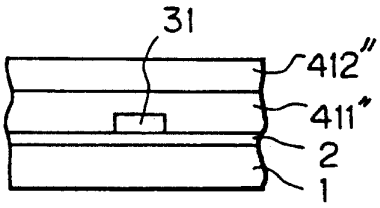


Fig. 7(d)

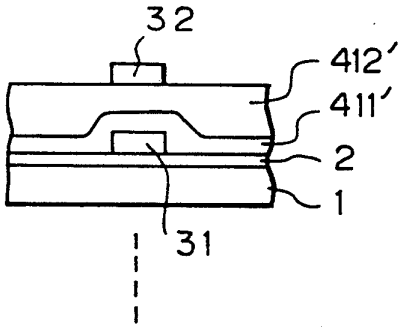


Fig. 7(d')

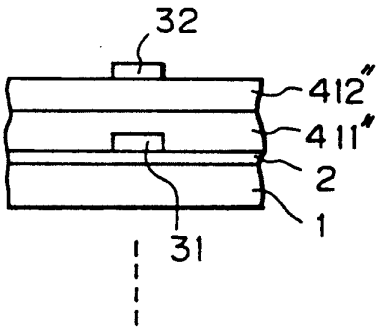


Fig. 8 (a)

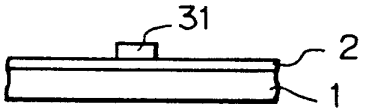


Fig. 8 (b)

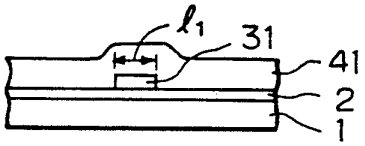


Fig. 8 (c)

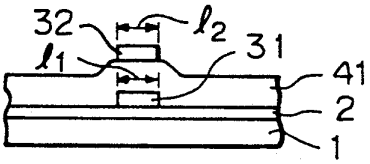


Fig. 8 (d)

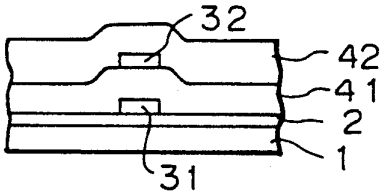


Fig. 8 (e)

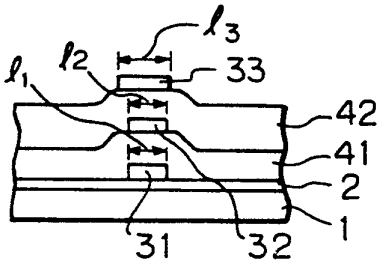


Fig. 8 (f)

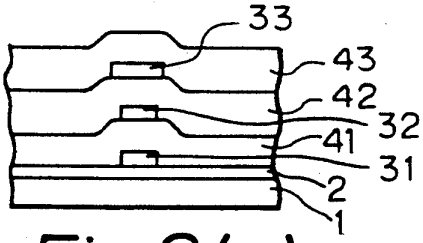


Fig. 8 (g)

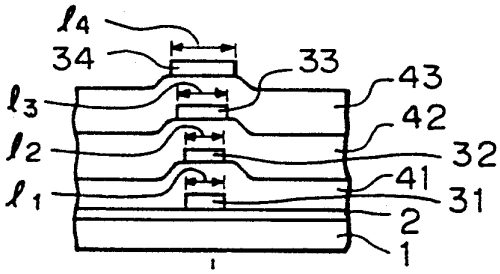


Fig. 8 (h)

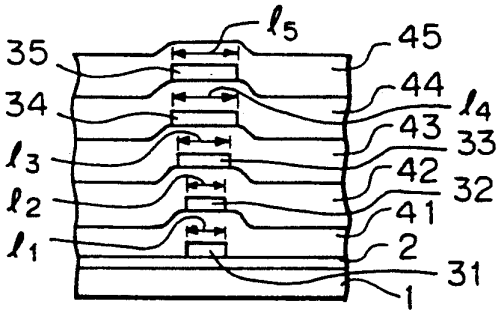
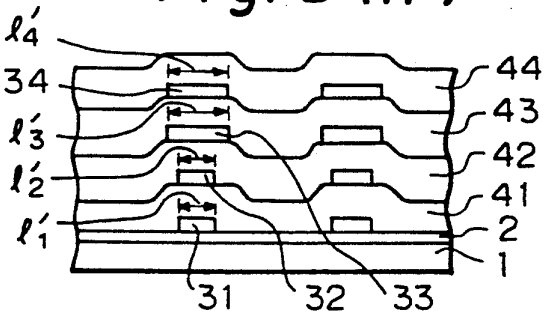


Fig. 8 (h')



DOCKET ALARM

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.