US007358554B2

(12) **United States Patent**
Basceri

(10) **Patent No.: US 7,358,554 B2**
(45) **Date of Patent: Apr. 15, 2008**

(54) **SEMICONDUCTOR MANUFACTURING APPARATUS FOR MODIFYING-IN-FILM STRESS OF THIN FILMS, AND PRODUCT FORMED THEREBY**

(75) Inventor: **Cem Basceri**, Boise, ID (US)

(73) Assignee: **Micron Technology, Inc.**, Boise, ID (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 231 days.

(21) Appl. No.: **11/083,169**

(22) Filed: **Mar. 17, 2005**

(65) **Prior Publication Data**

US 2005/0161818 A1 Jul. 28, 2005

Related U.S. Application Data

(62) Division of application No. 10/391,876, filed on Mar. 18, 2003, now Pat. No. 6,884,718.

(51) **Int. Cl.**
H01L 21/30 (2006.01)

(52) **U.S. Cl.** **257/296**; 438/452; 438/677; 438/782

(58) **Field of Classification Search** .... 257/296, 257/415, 418; 438/457, 677, 782, 974, FOR. 119
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,808,674 A 5/1974 Francombe et al.
3,856,647 A 12/1974 Blachman
4,830,984 A 5/1989 Purdes
4,874,438 A 10/1989 Oshita et al.
5,893,760 A 4/1999 Mikata et al.
5,994,217 A * 11/1999 Ng 438/636
6,156,623 A * 12/2000 Hendrix et al. 438/457
6,500,759 B1 * 12/2002 Asakawa 438/683
6,514,835 B1 2/2003 Hendrix et al.
6,531,193 B2 * 3/2003 Fonash et al. 427/579
6,585,876 B2 7/2003 Dordi et al.

FOREIGN PATENT DOCUMENTS

JP 01059809 A 3/1989

OTHER PUBLICATIONS

Roman et al., "Process Characterization of LPCVD Silicon Nitride and the Consequential Fabrication of Low Stress Microcantilevers", pp. 28-29.
Suo et al., "Mechanics of Rollable and Foldable Film-On-Foil Electronics", 1999, pp. 1177-1179, vol. 74, Issue 8, American Institute of Physics.

(Continued)

Primary Examiner—Matthew E. Warren
(74) *Attorney, Agent, or Firm*—Dinsmore & Shohl LLP

(57) **ABSTRACT**

An apparatus for depositing a thin film on a substrate and product produced thereby are disclosed. In particular, deposition of the thin film is carried out on the substrate having an applied pressure. This applied pressure flexes the substrate to reduce in-plane stresses, wherein removal of the applied pressure after deposition of the thin film modifies the in-film stress for the thin film. With the above-described arrangement, it is possible to minimize the deterioration of electric characteristics of a semiconductor device and the occurrence of defects, such as film delamination, substrate cracks, and the like.

40 Claims, 4 Drawing Sheets