



US007241656B2

(12) **United States Patent**  
**Cross et al.**

(10) **Patent No.:** **US 7,241,656 B2**  
(45) **Date of Patent:** **Jul. 10, 2007**

(54) **SEMICONDUCTOR DEVICE AND ITS MANUFACTURE METHOD, AND MEASUREMENT FIXTURE FOR THE SEMICONDUCTOR DEVICE**

(75) Inventors: **Jeffrey Scott Cross**, Kawasaki (JP);  
**Minoharu Tsukada**, Kawasaki (JP);  
**Yoshimasa Horii**, Kawasaki (JP);  
**Alexei Gruverman**, Raleigh, NC (US);  
**Angus Kingon**, Raleigh, NC (US)

(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/440,061**

(22) Filed: **May 25, 2006**

(65) **Prior Publication Data**

US 2006/0211156 A1 Sep. 21, 2006

**Related U.S. Application Data**

(62) Division of application No. 10/716,878, filed on Nov. 20, 2003, now Pat. No. 7,075,135.

(30) **Foreign Application Priority Data**

Nov. 21, 2002 (JP) ..... 2002-338307

(51) **Int. Cl.**  
**H01L 21/8242** (2006.01)

(52) **U.S. Cl.** ..... **438/240**; 438/253; 438/396

(58) **Field of Classification Search** ..... 438/3, 438/240, 253, 254, 396, 397

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,621,606 A \* 4/1997 Hwang ..... 361/321.4  
6,348,368 B1 2/2002 Yamazaki et al.  
6,432,767 B2 8/2002 Torii et al.

\* cited by examiner

*Primary Examiner*—Hoai Pham

(74) *Attorney, Agent, or Firm*—Westerman, Hattori, Daniels & Adrian, LLP.

(57) **ABSTRACT**

A semiconductor device comprises a substrate, a ferroelectric capacitor which includes a ferroelectric film on the substrate, and a stress application layer which applies tensile or compressive stress to the ferroelectric film of the ferroelectric capacitor by applying stress to the substrate.

**1 Claim, 18 Drawing Sheets**

