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United States Patent [19]

Sawin et al.

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[45] **Date of Patent: Sep. 12, 1995**

[54] **APPARATUS AND METHOD FOR REAL-TIME MEASUREMENT OF THIN FILM LAYER THICKNESS AND CHANGES THEREOF**

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[21] Appl. No.: **70,118**

[22] Filed: **May 28, 1993**

[51] **Int. Cl.**⁶ **G01B 11/06**; H01L 21/00

[52] **U.S. Cl.** **356/382**; 356/357; 156/626.1

[58] **Field of Search** 356/381, 382, 355, 357, 356/345, 445; 250/560; 156/601, 612, 626, 627

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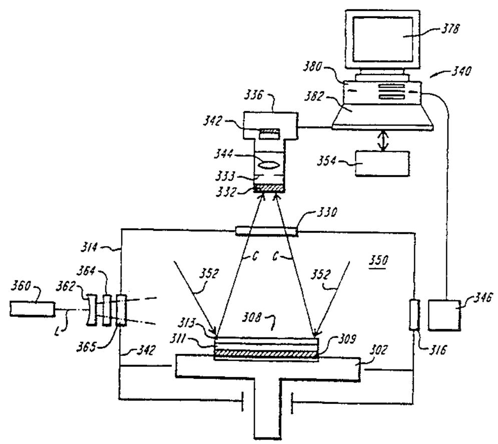
Attorney, Agent, or Firm—Steven J. Weissburg

[57] **ABSTRACT**

A new technique has been developed to measure etching or deposition rate uniformity in situ using a CCD camera which views the wafer during plasma processing. The technique records the temporal modulation of plasma emission or laser illumination reflected from the wafer; this modulation is caused by interferometry as thin films are etched or deposited. The measured etching rates compare very well with those determined by Helium-Neon laser interference. This technique is capable of measuring etching rates across 100-mm or larger wafers. It can resolve etch rate variations across a wafer or within a die. The invention can also be used to make endpoint determinations in etching operations as well as measuring the absolute thickness of thin films.

29 Claims, 13 Drawing Sheets



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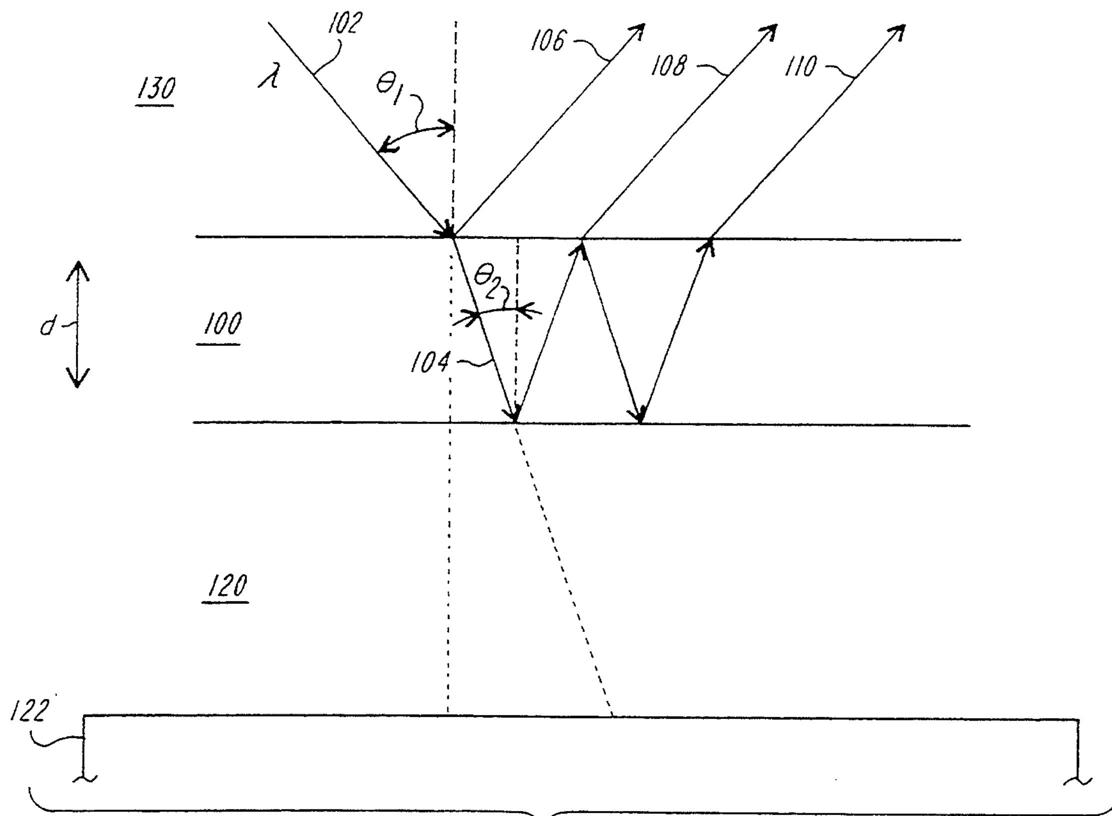

FIG. 1
(PRIOR ART)

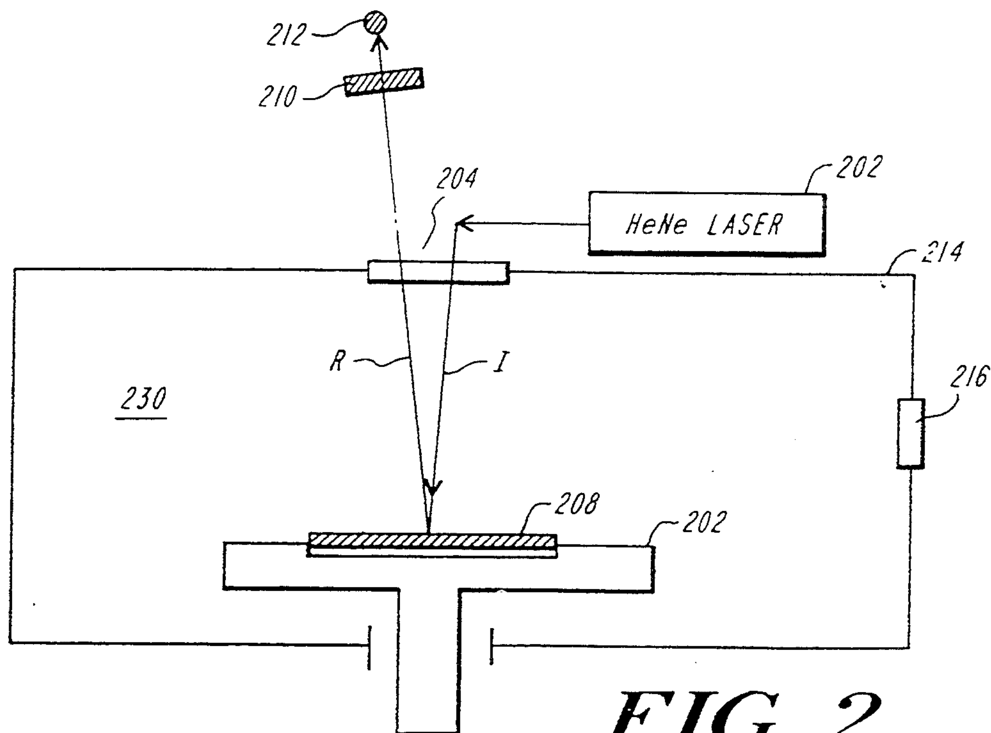

FIG. 2
(PRIOR ART)

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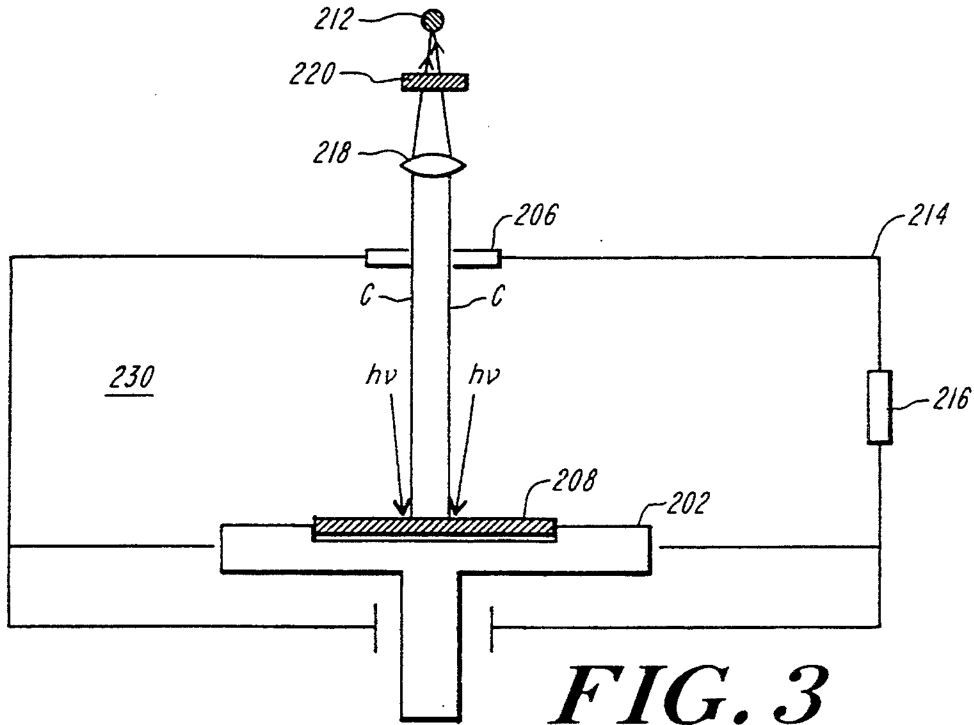
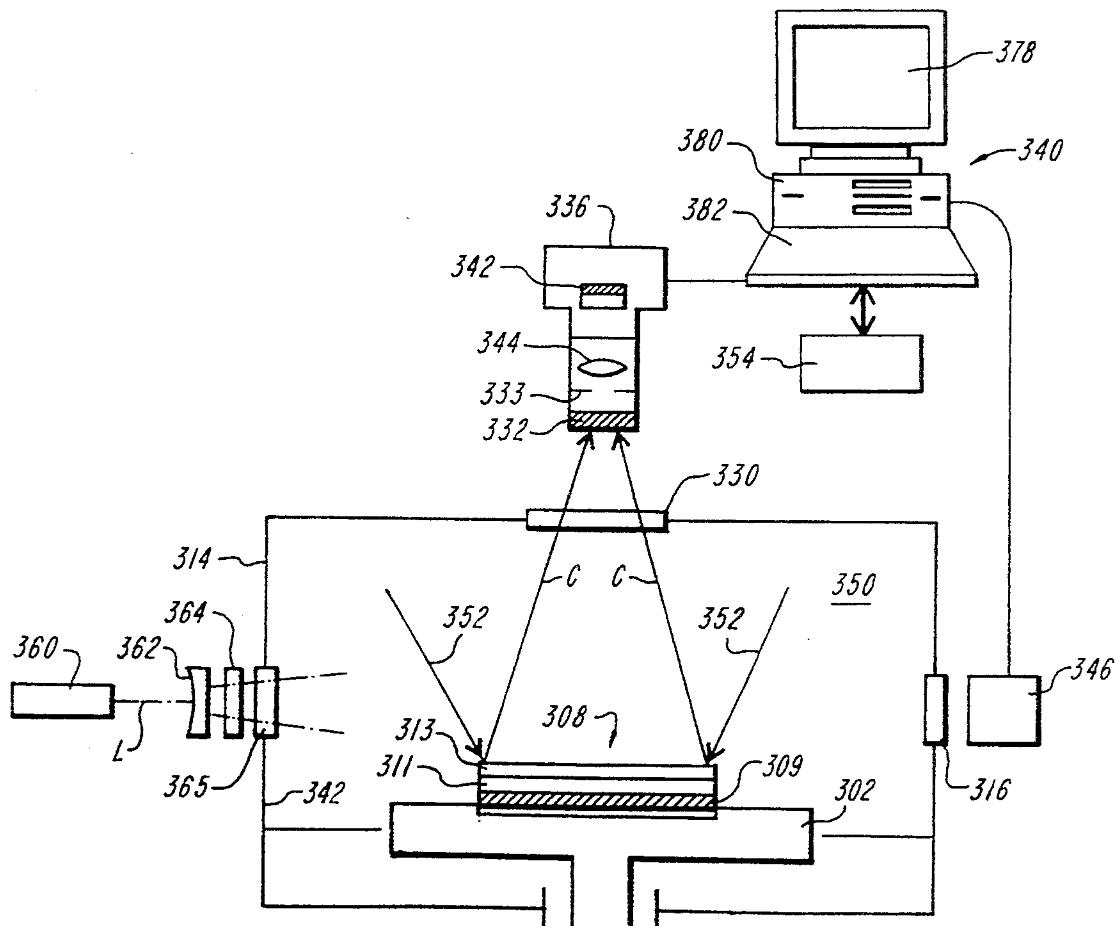


FIG. 3
(PRIOR ART)



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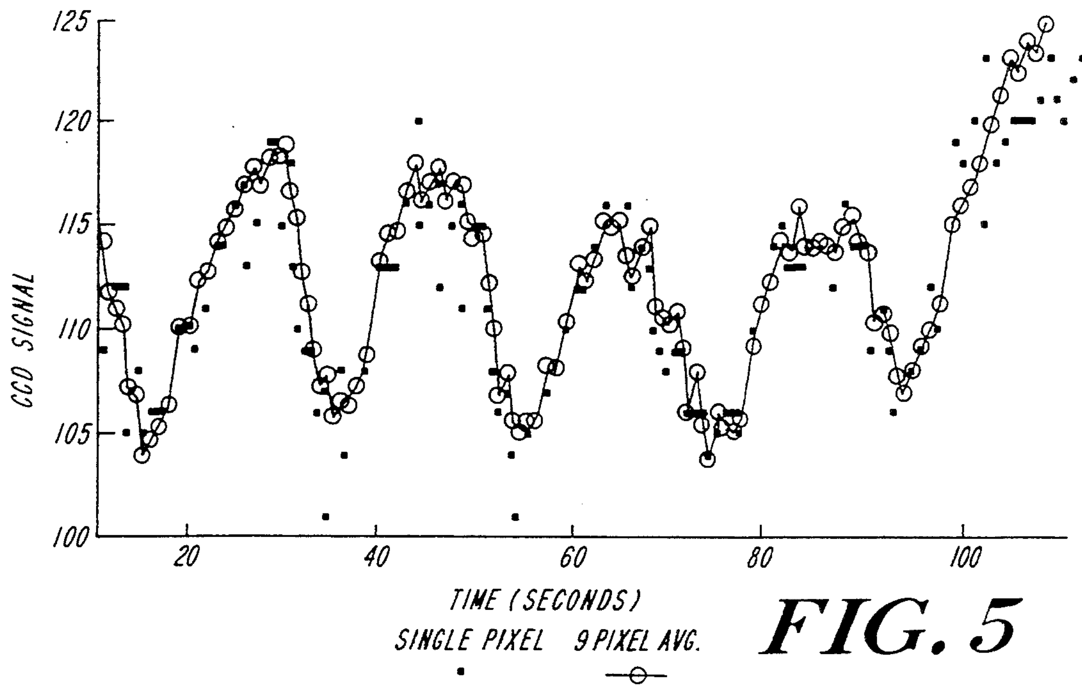

FIG. 5

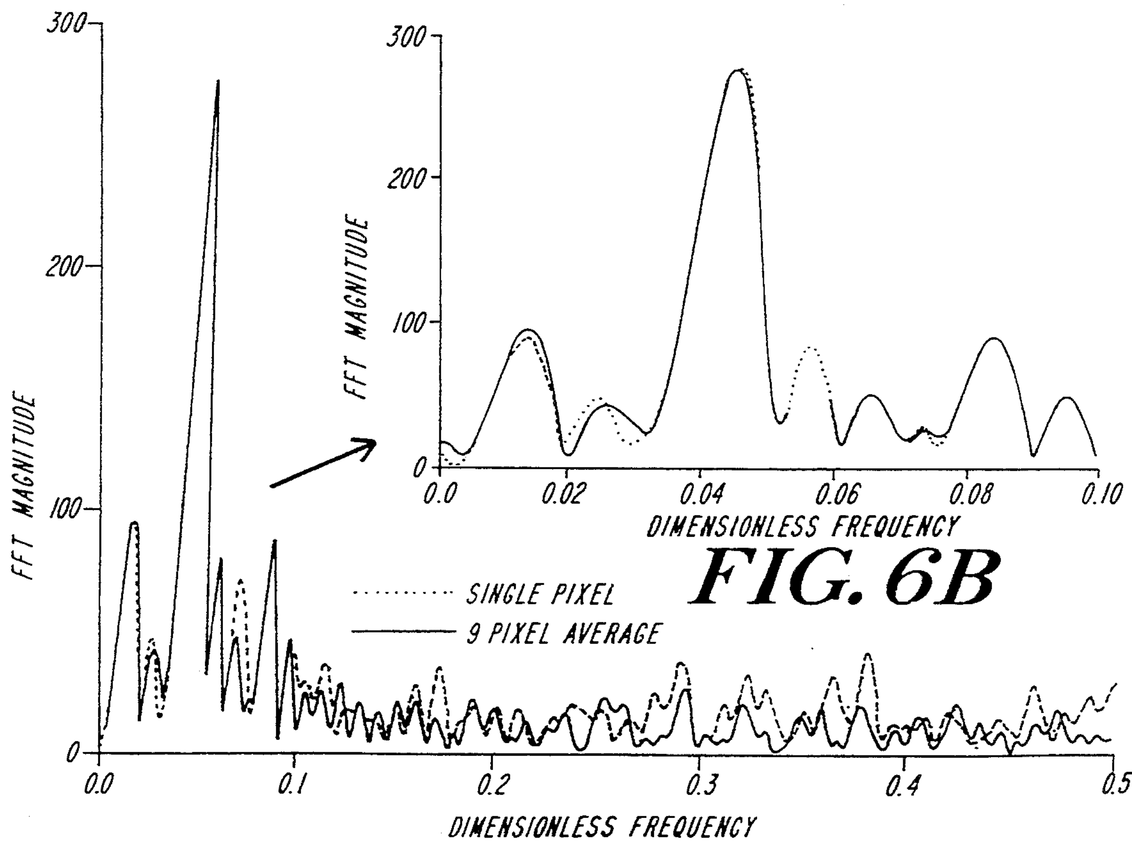

FIG. 6B

FIG. 6A

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