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United States Patent [19]

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Barnes et al.

[45] **Date of Patent:** Apr. 9, 1996

[54] **ETCHING OF SILICON DIOXIDE SELECTIVELY TO SILICON NITRIDE AND POLYSILICON**

5,230,772 7/1993 Kadomura 156/643
5,282,925 2/1994 Jeng et al. 156/646

FOREIGN PATENT DOCUMENTS

58-056317 4/1983 Japan .
59-033833 2/1984 Japan .

OTHER PUBLICATIONS

“Plasma Chemical Aspects of Magnetron Ion Etching with CF₄/O₂ and CF₄/H₂”; Plasma Processing and Synthesis of Materials; Material Research Soc; XVI; 1987; abstract only; Bright et al.

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[51] **Int. Cl.⁶** H01L 21/00

[52] **U.S. Cl.** 156/662.1; 156/643.1; 156/646.1; 437/225

[58] **Field of Search** 156/643.1, 646.1, 156/662.1; 437/225

[57] ABSTRACT

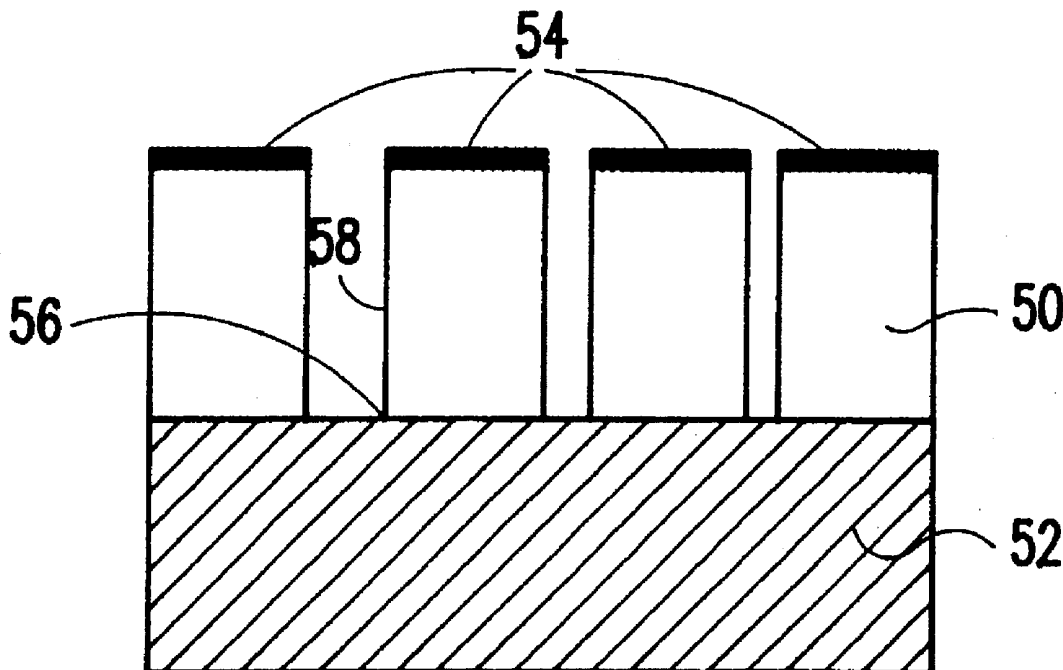
Silicon dioxide on a substrate is directionally etched using a hydrogen halide plasma which is created within an etch chamber. The method selectively etches silicon dioxide relative to polysilicon and silicon nitride. A substrate and the combination of NH₃ and NF₃ gases or the combination of CF₄ and O₂ gases mixed with H₂ and N₂ gases are located within an etch chamber. An electrical field is created within the etch chamber causing the gas mixture to form a plasma. The negative charge at the bottom of the chamber attracts the positively charged plasma, thereby etching the substrate in the downward direction. The result is an anisotropic product. The method is also shown to be effective in non-selectively etching thermal and deposited oxides, resulting in a similar etch rate for the different types of oxides.

[56] References Cited

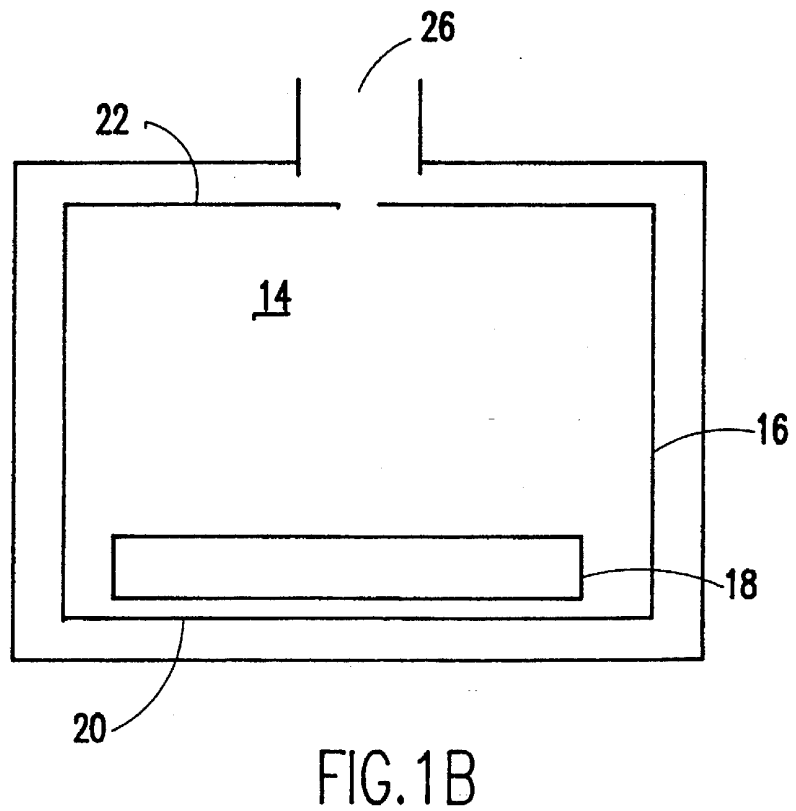
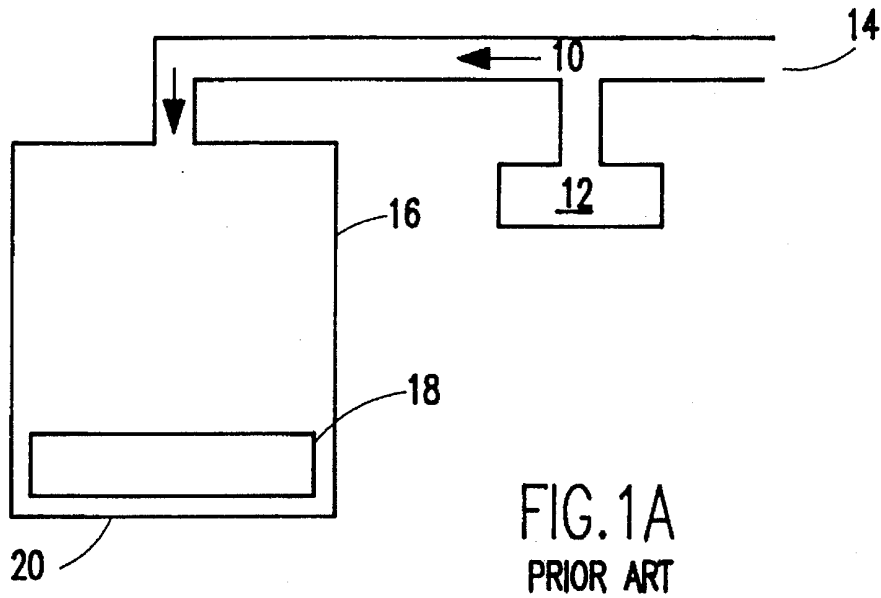
U.S. PATENT DOCUMENTS

4,352,724 10/1982 Sugishima et al. 156/643
4,615,764 10/1986 Bobbio et al. 156/643
4,711,698 12/1987 Douglas 156/643
4,807,016 2/1989 Douglas 357/67
5,030,319 7/1991 Nishino et al. 156/635
5,122,225 6/1992 Douglas 156/643
5,128,744 7/1992 Asano et al. 357/54
5,173,151 12/1992 Namose 156/643

15 Claims, 7 Drawing Sheets



IP Bridge Exhibit 2227



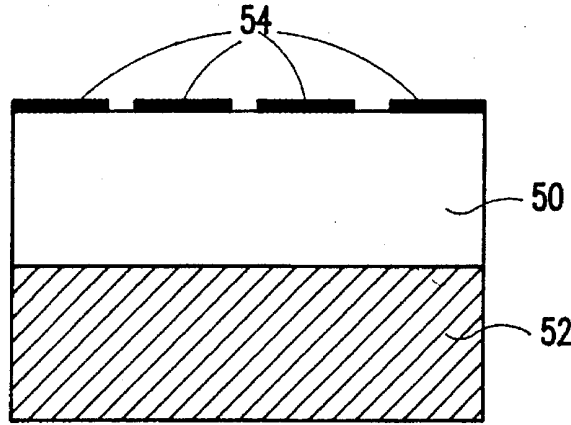


FIG. 2A

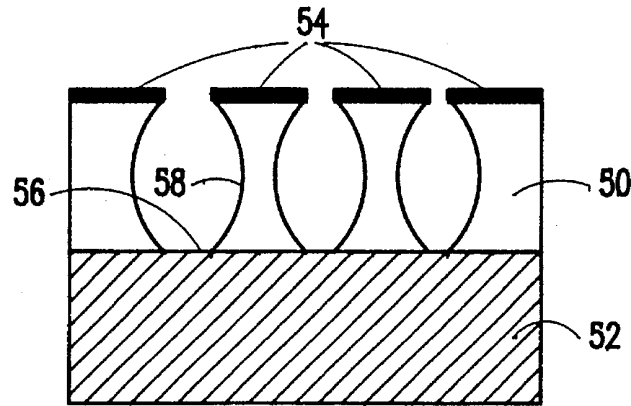


FIG. 2B
PRIOR ART

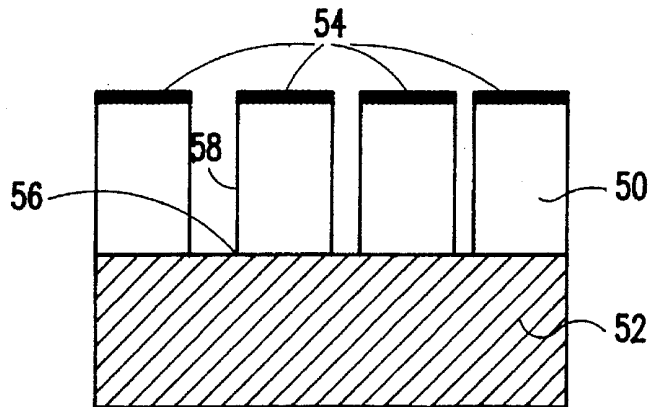


FIG. 2C

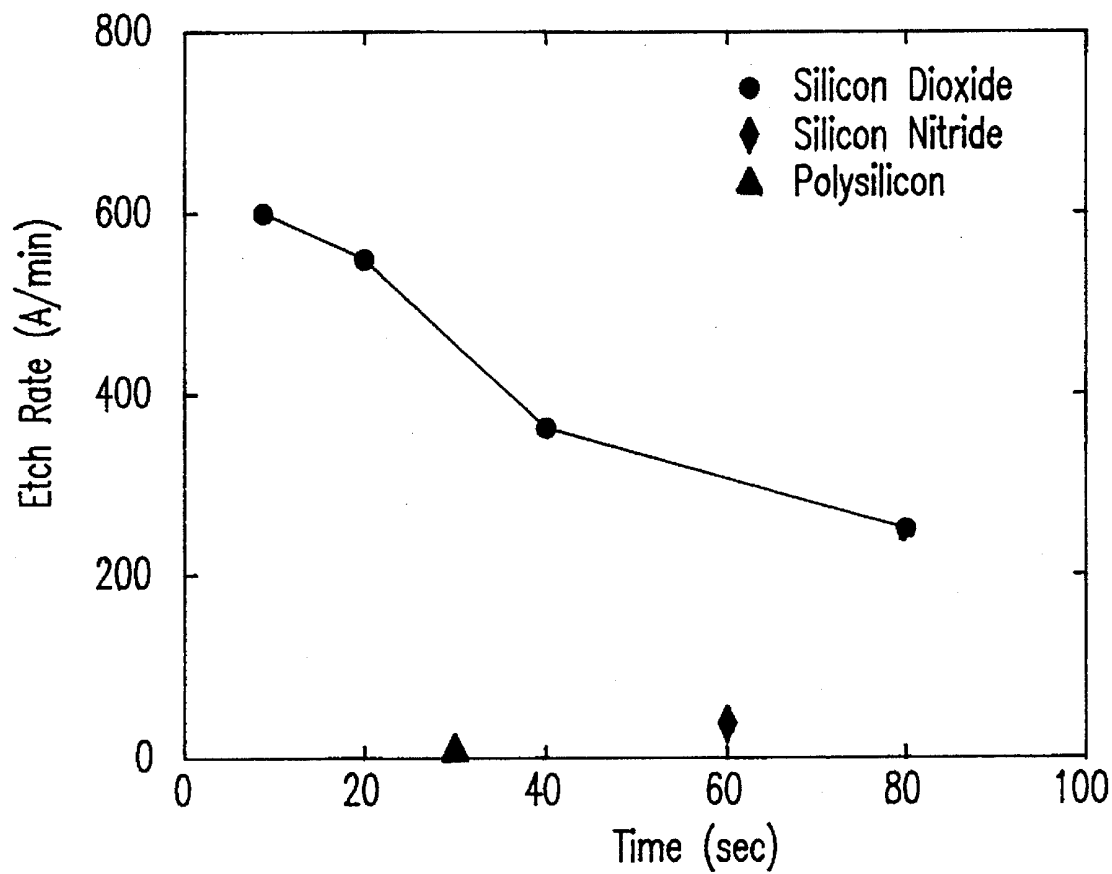


FIG.3

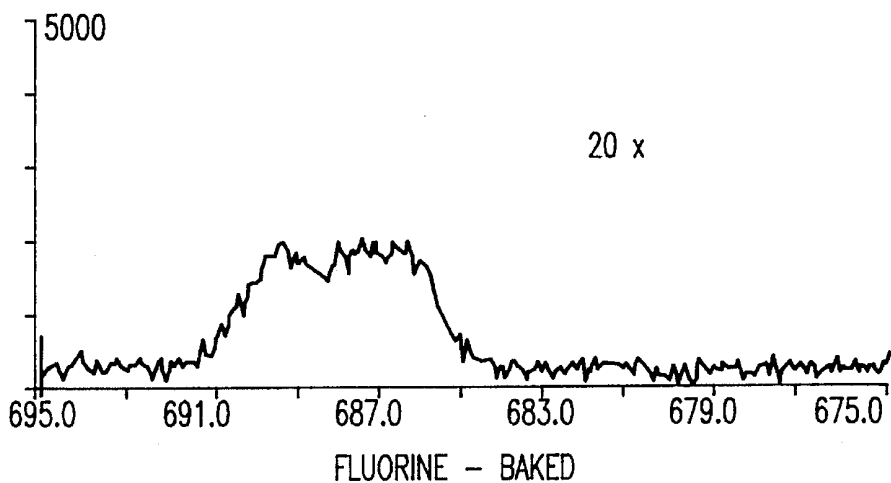
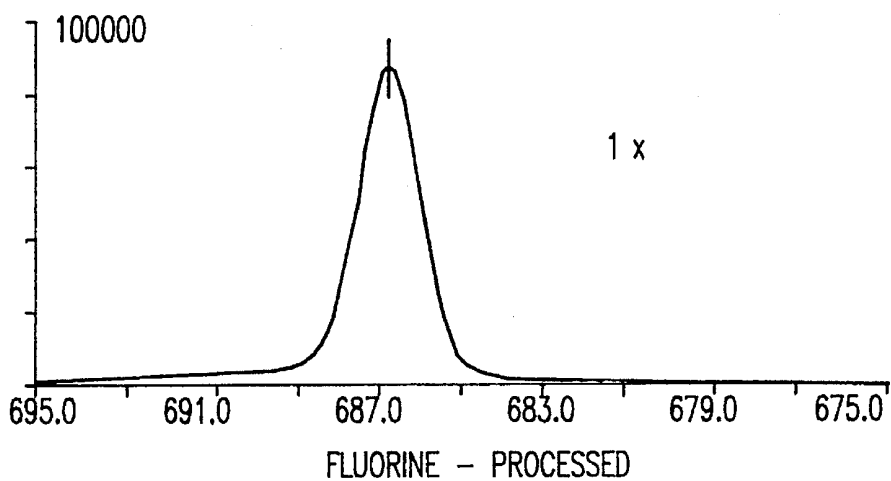
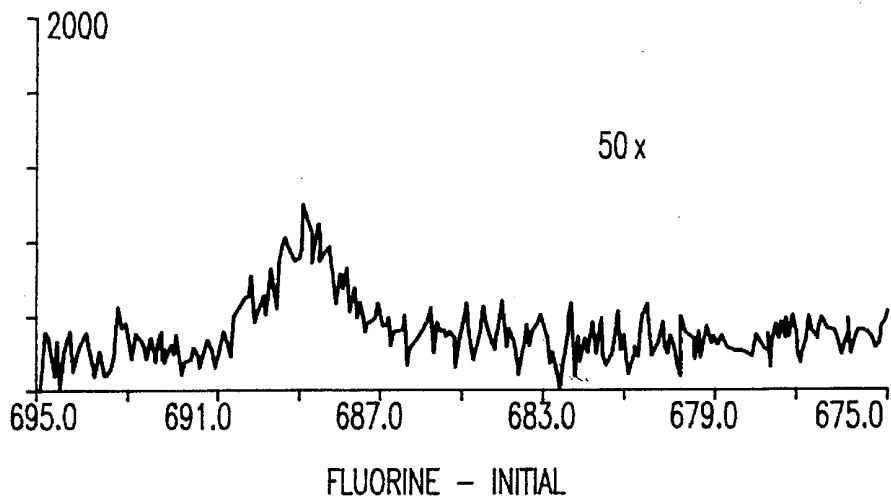


FIG.4A

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