

The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte CHRISTOPHER F. LYONS, PHILIP A. FISHER,
RICHARD J. HUANG, AND CYRUS E. TABERY

Appeal No. 2006-1284
Application No. 10/170,984

ON BRIEF

Before OWENS, BAHR, and NAPPI, *Administrative Patent Judges*.

OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

This appeal is from a rejection of claims 1-20, which are all of the pending claims.

THE INVENTION

The appellants claim a method for using amorphous carbon spacers for critical dimension reduction. Claim 1 is illustrative:

1. A method of using carbon spacers for critical dimension reduction, the method comprising:

providing a patterned photoresist layer above a substrate, the patterned photoresist layer having an aperture with a first width;

depositing an amorphous carbon film over the photoresist layer and etching the deposited amorphous carbon film to form spacers on lateral side walls of the aperture of the patterned photoresist layer;

etching the substrate using the formed spacers and patterned photoresist layer as a pattern to form a trench having a second width; and

removing the patterned photoresist layer and formed spacers using an oxidizing etch.

THE REFERENCES

Giammarco et al. (Giammarco)	4,707,218	Nov. 17, 1987
Hori et al. (Hori)	5,445,710	Aug. 29, 1995
Smith et al. (Smith)	2001/0035558	Nov. 1, 2001
Fairbairn et al. (Fairbairn)	2003/0091938 (effective filing date Jun. 8, 2000)	May 15, 2003

THE REJECTIONS

The claims stand rejected under 35 U.S.C. § 103 as follows:
claims 1-3, 8-11 and 13-19 over Giammarco in view of Smith and Fairbairn, and claims 4-7, 12 and 20 over Giammarco in view of Smith, Fairbairn and Hori.

OPINION

The rejections are affirmed as to claims 1, 2, 4-7, 9, 10, 12, 13, 15 and 17-20, and reversed as to claims 3, 8, 11, 14 and 16.

Claims 1, 2, 4-7, 9, 10, 12, 13, 15 and 17-20

Giammarco discloses "a method of reducing the size of a lithographic image by establishing a sidewall on the interior of the opening in the lighographic [sic] mask material used to obtain the image" (col. 1, lines 45-48). On a substrate (10)

which may be glass, Giamarco forms a patterned photosensitive layer (14) having an opening (16) therein having a first width (A) (col. 2, lines 55-58; col. 3, lines 8-14; figure 1). “[T]he width A may be the smallest dimension that is achievable by pushing lithography (which includes x-ray, electron-beam, etc.) to its highest resolution limit” (col. 3, lines 22-25). To reduce the size of the opening, a conformal layer (22) is formed over the patterned photosensitive layer and is etched to form spacers (24) on lateral side walls of the opening (col. 4, lines 15-18). “In general, the conformal layer **22** may be any material which can be deposited at a temperature low enough as to not cause degradation of the patterned photosensitive layer **14**. A preferred material for forming layer 22 is Si_xO_y obtained by hexamethyldisilizane (HDMS) plasma deposition” (col. 4, lines 20-25). “The lower limit for the thickness [B] of layer **22** is dictated by the requirements of good step coverage associated with the substantially vertical wall profile **20** in layer **14** and viability of the layer 22 as a thin film” (col. 4, lines 39-43). “The percentage reduction in the opening size is governed by the factor $2B/A$. In other words, if the size of the opening is 3 microns, in order to achieve a 66.6% reduction in the size of

the hole **16** (or an actual reduction of the hole size to 1 micron), a 1 micron thick HDMS layer **22** is deposited" (col. 4, lines 46-51). "The photosensitive mask in combination with the sidewalls **24** fabricated in this manner constitutes a new mask (or stencil) having openings of a substantially reduced dimension than obtainable by lithography alone" (col. 5, lines 3-7). The new mask can be used "as an etch mask to etch extremely narrow deep/shallow trenches in the substrate **10**" (col. 5, lines 11-12).

After the intended use of the new mask is complete, it is removed, along with a release layer (12) between the new mask and the substrate, by a suitable etchant which can be a hot oxidizing acid (col. 5, lines 22-28).

Fairbairn fabricates an integrated circuit using an amorphous carbon film as a hard mask (¶ 0016). A pattern defined by the amorphous carbon film is transferred to an underlying silicon dioxide layer (202) using the amorphous carbon layer as a hard mask (¶ 0049). After the silicon dioxide layer is patterned, the amorphous carbon layer can be stripped by etching it in an ozone, oxygen or ammonia plasma (¶ 0050).

In the fabrication of an integrated circuit, Smith forms an amorphous carbon sidewall spacer region (68) alongside a gate electrode (60) and a photoresist layer (64) (¶ 0022-24).

The appellants argue that Giammarco does not provide support for using amorphous carbon as a spacer material (brief, page 8).

Giammarco discloses that the spacer material can be "any material which can be deposited at a temperature low enough as to not cause degradation of the patterned photoresist layer **14**" (col. 4, lines 21-23). Smith indicates that amorphous carbon is such a material (¶ 0022-24).

The appellants argue that Fairbairn would have suggested, to one of ordinary skill in the art, using amorphous carbon as a hard mask only when the amorphous carbon is used with an intermediate layer (reply brief, page 3). The appellants' claims do not exclude an intermediate layer. Regardless, Fairbairn discloses that the amorphous carbon layer, without the intermediate layer, is used to pattern a silicon dioxide layer (¶ 0050). Hence, Fairbairn would have fairly suggested, to one of ordinary skill in the art, the use of amorphous carbon as a hardmask to etch Giammarco's substrate made of a material similar to silicon dioxide, i.e., glass (col. 2, lines 55-58).

The appellants, therefore, have not convinced us of reversible error in the examiner's rejection of claims 1, 2, 4-7, 9, 10, 12, 13, 15 and 17-20. Accordingly, we affirm the rejections of those claims.

Claims 3, 8, 11, 14 and 16

The examiner argues that the appellants' 100 nm or less trench width, 500-1,000 Å photoresist layer thickness, and 50 nm carbon film thickness would have been obtainable by one of ordinary skill in the art at the time of the appellants' invention through routine experimentation and optimization (answer, page 10). The examiner, however, has not provided evidence in support of that argument. The examiner's mere speculation to that effect is insufficient for establishing a *prima facie* case of obviousness. See *In re Warner*, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967), cert. denied, 389 U.S. 1057 (1968); *In re Sporck*, 301 F.2d 686, 690, 133 USPQ 360, 364 (CCPA 1962). The examiner argues that the appellants have not shown that the dimensions are critical or produce an unexpected result (answer, page 8). The examiner has the initial burden of establishing a *prima facie* case of obviousness, and the examiner has not met that initial burden. Consequently, the appellants

need not provide the showing required by the examiner. See *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984); *In re Rinehart*, 531 F.2d 1048, 1051, 189 USPQ 143, 147 (CCPA 1976).

We therefore reverse the rejections of claims 3, 8, 11, 14 and 16.

DECISION

The rejections under 35 U.S.C. § 103 of claims 1-3, 8-11 and 13-19 over Giammarco in view of Smith and Fairbairn, and claims 4-7, 12 and 20 over Giammarco in view of Smith, Fairbairn and Hori, are affirmed as to claims 1, 2, 4-7, 9, 10, 12, 13, 15 and 17-20, and reversed as to claims 3, 8, 11, 14 and 16.

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No time period for taking any subsequent action in connection with this appeal
may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

TERRY J. OWENS)
Administrative Patent Judge)
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) BOARD OF PATENT
JENNIFER D. BAHR) APPEALS
Administrative Patent Judge) AND
) INTERFERENCES
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ROBERT NAPPI)
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