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

Paper No. 33

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte GARRY ANTHONY MERCALDI and DON CARL POWELL

Appeal No. 2003-1269
Application 09/041,913

ON BRIEF

Before OWENS, DELMENDO and JEFFREY T. SMITH, *Administrative Patent Judges*.

OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

This appeal is from the final rejection of claims 1, 4-8 and 10-25. Claims 2, 3, 9 and 127-175 have been canceled, and claims 26-126 stand withdrawn from consideration by the examiner as claiming a nonelected invention.

THE INVENTION

The appellants claim a process for depositing a layer on a semiconductor substrate in a reaction chamber wherein the temperature in the reaction chamber is varied during the deposition. Claims 1 and 7 are illustrative:

1. A process for forming a material layer on a semiconductor substrate, comprising:

placing the semiconductor substrate into a reaction chamber;

varying temperature within said reaction chamber; and

introducing matter of a type to promote formation of said material layer into said reaction chamber in proximity to an exposed surface of the semiconductor substrate while varying the temperature so as to form said material layer to exhibit at least one substantially uniform property comprising at least one of sheet resistivity, reflectivity, transmissivity, absorptivity, etch characteristics, dopant distribution, and dielectric constant.

7. A process for forming a material layer on a semiconductor substrate, comprising:

placing the semiconductor substrate into a reaction chamber;

varying temperature within said reaction chamber by increasing or decreasing the temperature;

cycling the temperature within said reaction chamber following said increasing or decreasing, said cycling including decreasing and re-increasing or increasing and re-decreasing the temperature within said reaction chamber at least once; and

introducing matter of a type to promote formation of said material layer into said reaction chamber in proximity to an exposed surface of the semiconductor substrate while varying or cycling the temperature.

THE REFERENCES

Roy	4,742,020	May 3, 1988
Parker	5,231,356	Jul. 27, 1993
Lee	5,970,383	Oct. 19, 1999 (filed Dec. 17, 1997)

THE REJECTIONS

The claims stand rejected under 35 U.S.C. § 103 as follows: claims 1, 4, 6-8, 10 and 13-25 over Roy in view of Parker; claims 1, 4-8, 19-21 and 23-25 over Lee in view of Parker; and claims 11 and 12 over Roy in view of Parker and Lee.

OPINION

The rejection over Roy in view of Parker is affirmed as to claims 7, 10, 13-19 and 22 and reversed as to claims 1, 4, 6, 8, 20, 21 and 23-25. The rejection over Lee in view of Parker is affirmed as to claims 1, 4-6, 8, 19 and 23-25 and reversed as to claims 7, 20 and 21. The rejection over Roy in view of Parker and Lee is reversed.

The appellants state that claims 5, 24 and 25 stand or fall with claim 1, and that claims 13 and 14 stand or fall with claim 10 (brief, page 7). Hence, among claims 1, 5, 10, 13, 14, 24 and 25, and also claim 4 which is not separately argued, we

limit our discussion to claims 1 and 10. We address the claims other than claims 1 and 10 to the extent justified by the appellants' arguments. *See In re Ochiai*, 71 F.3d 1565, 1566 n.2, 37 USPQ2d 1127, 1129 n.2 (Fed. Cir. 1995); 37 CFR § 1.192(c)(7)(1997).

Rejection over Roy in view of Parker

Claims 7 and 10

Roy discloses a process for controlling warpage of a silicon wafer by using, to grow polysilicon, a multilayering technique which periodically oscillates growth parameters during polysilicon deposition (col. 2, lines 63-66; col. 4, lines 19-22). The process provides "both accommodation and reduction of the growth stress generated during polysilicon deposition" (col. 3, lines 6-8). "Stress accommodation is achieved by substructural layering to create pseudo interfaces in the support structure by deliberate, periodic oscillations in a selected growth parameter during polysilicon deposition. Stress reduction is achieved by utilizing a substantial part of the growth stress to initiate strain-induced recrystallization in the nucleation layer which is caused by lattice instabilities and strain fields

set up during multilayering" (col. 3, lines 8-16). The growth parameters which may be oscillated during polysilicon deposition include temperature (col. 3, lines 3-4).[1]

The appellants argue that Roy does not disclose oscillating the growth parameters while matter is introduced therein (brief, page 11). This argument is not correct because Roy discloses "deliberate periodic oscillations in growth parameters during polysilicon deposition" (col. 4, lines 21-22) and discloses ramping the temperature up and down during the oscillatory growth period (col. 8, lines 15-22).

The appellants argue that Roy is limited to changing the temperature within a reaction chamber between the formation of different polysilicon layers, with each polysilicon layer being formed at a constant temperature (brief, page 12). This argument is not persuasive because Roy discloses ramping the temperature up and down during polysilicon layer formation (col. 8, lines 15-22).

[1] It is undisputed that Roy's process takes place in a reaction chamber.

For the above reasons we affirm the rejection of claims 7, 10, 13 and 14 over Roy in view of Parker.[2]

Claims 15-18

Roy discloses formation of a nucleation layer that comprises a relatively coherent and continuous film so that subsequent polysilicon growth during the oscillatory growth period will occur on a nearly continuous sheet of nucleation centers rather than on more isolated, energetically favored, discrete sites (col. 5, lines 38-43), and discloses that perturbations in the deposition during the oscillatory growth period can be effected by changing the amplitude and frequency of the oscillation (col. 5, lines 60-62). Hence, the appellants' arguments that Roy does not disclose altering the frequency or magnitude of the oscillating, and does not disclose optimizing a magnitude of the oscillating in response to an initial growth pattern to enhance uniformity of a property (i.e., stress) of the polysilicon layer (brief, pages 15-16), are not well taken.

We therefore affirm the rejection of claims 15-18 over Roy in view of Parker.

[2] A discussion of Parker is not necessary to our decision.

Claims 19 and 22

The appellants' claim 19 requires varying the reaction chamber temperature and monitoring an initial growth pattern of the material layer, and claim 22 requires cycling the reaction chamber temperature following the varying. It reasonably appears that Roy's teaching that the nucleation layer must comprise a relatively coherent and continuous film (col. 5, lines 38-39) would have indicated to one of ordinary skill in the art that the initial growth pattern of the nucleation layer is to be monitored.

The appellants' only argument regarding claims 19 and 22 is that neither Roy nor Parker teaches or suggests forming a material layer while a temperature within a reaction chamber is being varied (brief, page 17). As discussed above regarding the rejection of claims 7 and 10, Roy discloses varying the temperature as the polysilicon layer is being deposited.

Hence, we affirm the rejection of claims 19 and 22 over Roy in view of Parker.

Claims 1, 4, 6, 8 and 23-25

The appellants' claim 1 requires "varying the temperature so as to form said material layer to exhibit at least one substantially uniform property comprising at least one of sheet resistivity, reflectivity, transmissivity, absorptivity, etch characteristics, dopant distribution, and dielectric constant."

The examiner argues that Roy's process enhances uniformity of a property of the layer such as thickness, and that sheet resistivity is a function of the layer thickness (answer, pages 4 and 8). This argument is deficient in that the examiner has not established, by pointing to a relevant disclosure in Roy or by another means, that Roy's process enhances uniformity of the layer thickness. Roy teaches that his process accommodates and reduces the growth stress of the polysilicon layer (col. 3, lines 6-16), but the examiner has not established that there is a correlation between growth stress accommodation or reduction and thickness uniformity.

The examiner, therefore, has not carried the burden of establishing a *prima facie* case of obviousness over Roy in view of Parker of the process claimed in the appellants' claim 1. Accordingly, we reverse the rejection over Roy in view of Parker of this claim and claims 4, 6, 8 and 23-25 that depend therefrom.

Claims 20 and 21

Claims 20 and 21, which depend from claim 19, require, respectively, that the temperature and the rate of varying are altered in response to the monitoring of the initial growth pattern of the material layer.

The examiner argues, regarding claim 20, that "Roy teaches altering an overall temperature trend from a first phase (lower temperature limit) to a second phase (upper temperature limit) (col. 5, lines 44-50)" (answer, page 10). The periodic oscillation discussed in the portion of Roy relied upon by the examiner occurs following formation of the nucleation layer. The examiner has not established that the oscillation is in response to monitoring of the initial growth pattern of the polysilicon. The examiner provides no argument regarding claim 21.

Accordingly, we reverse the rejection over Roy in view of Parker of claims 20 and 21.

Rejection over Lee in view of Parker

Claims 1, 4-6, 8, 19 and 23-25

Lee discloses a method for providing uniformity of the thickness of a chemical vapor deposition layer, such as silicon dioxide, on a semiconductor wafer by either increasing or decreasing the wafer temperature during deposition to alter the

deposition rate (abstract; col. 5, lines 40-41; col. 6, lines 1-65). Because the entire layer has the same composition and the layer has uniform thickness, it reasonably appears that the layer has uniform intrinsic properties such as sheet resistivity and dielectric constant.

The appellants argue that “Lee teaches a process by which the thickness of layers on different substrates are more consistent with one another” (brief, page 18). This argument is not convincing because Lee discloses applying the process for obtaining layer thickness uniformity to “one or more wafers” (col. 6, line 19).

The appellants argue that Lee and Parker are combinable only by hindsight in view of the appellants’ application (brief, page 18). It reasonably appears that the disclosure by Lee of increasing or decreasing the temperature during deposition would have fairly suggested, to one of ordinary skill in the art, the subject matter of the appellants’ claims 1, 6 and 8. Regarding claim 19, Lee’s disclosure that the deposition is uniform (col. 6, lines 8-9) would have fairly suggested, to one of ordinary skill in the art, monitoring the growth pattern of the layer, including the initial growth pattern, to make sure that the desired deposition uniformity is being obtained. As for

claim 23, Lee's teaching that the temperature is monitored (col. 6, lines 45-58) would have fairly suggested, to one of ordinary skill in the art, monitoring the temperature of all portions of the wafer surface. The appellants' claim 23 is open to the selected portions of the substrate being all portions.

We therefore conclude that the processes claimed in the appellants' claims 1, 6, 8, 19 and 23 would have been obvious to one of ordinary skill in the art over the combined teachings of Lee and Parker. Hence, we affirm the rejection over Lee in view of Parker of these claims and claims 4, 5, 24 and 25 that stand or fall with claim 1.[3]

Claim 7

The appellants' claim 7 requires that the temperature is cycled.

The examiner argues that Lee's "varying comprises periodically and alternately increasing and decreasing the temperature within the reaction chamber (col. 6, lines 8-11)". The portion of Lee relied upon by the examiner, however, discloses that to obtain uniform deposition, the temperature is increased or decreased. Lee does not disclose using a

[3] A discussion of Parker is not necessary to our decision.

combination of a temperature increase and a temperature decrease, and the examiner has not established that Lee would have fairly suggested such a combination to one of ordinary skill in the art. Consequently, we reverse the rejection of claim 7 over Lee in view of Parker.

Claims 20 and 21

Claims 20 and 21, which depend from claim 19, require, respectively, that the temperature and the rate of varying are altered in response to the monitoring of the initial growth pattern of the material layer.

The examiner argues, regarding claim 20, that "Lee teaches altering an overall temperature trend from a first phase (lower temperature limit) to a second phase (upper temperature limit) (col. 5, lines 44-50)" (answer, page 10). The examiner, however, has not established that the altering is in response to monitoring of the initial growth pattern of the polysilicon. The examiner provides no argument regarding claim 21.

We therefore reverse the rejection over Lee in view of Parker of claims 20 and 21.

Rejection over Roy in view of Parker and Lee

The appellants' claims 11 and 12, which depend from claim 10, require, respectively, oscillating during a heat-up

phase prior to forming the material layer and during a cool-down phase subsequent to forming the material layer.

The examiner argues that “it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the step of oscillating temperature of Roy during the heating-up and the cooling-down phases as taught by Lee, since by doing so one would be able to control temperatures with minimum fluctuations during the heating-up and cooling-down stages, which, in turn, would result in uniform properties of the deposited material layer” (answer, page 6).

Both Roy’s temperature oscillation (col. 4, lines 21-22) and Lee’s temperature increase or decrease (col. 6, lines 7-10) take place during deposition. The oscillations required by the appellants’ claims 11 and 12, however, take place, respectively, before and after deposition. The examiner has not explained why the disclosures of Roy and Lee pertaining to temperature variation during deposition would have fairly suggested, to one of ordinary skill in the art, carrying out those variations before or after deposition. The examiner’s argument that doing so would permit temperature control with minimum fluctuations is not supported by the evidence relied upon by the examiner.

Accordingly, we reverse the rejection of claims 11 and 12.

DECISION

The rejection over Roy in view of Parker is affirmed as to claims 7, 10, 13-19 and 22 and reversed as to claims 1, 4, 6, 8, 20, 21 and 23-25. The rejection over Lee in view of Parker is affirmed as to claims 1, 4-6, 8, 19 and 23-25 and reversed as to claims 7, 20 and 21. The rejection over Roy in view of Parker and Lee is reversed.

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	)
ROMULO H. DELMENDO Administrative Patent Judge	) BOARD OF PATENT) APPEALS AND) INTERFERENCES
JEFFREY T. SMITH Administrative Patent Judge	)

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