

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.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. 34

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte THOMAS A. FIGURA

Appeal No. 2002-0677
Application 09/257,899

ON BRIEF

Before GARRIS, OWENS and DELMENDO, *Administrative Patent Judges*.
OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

This appeal is from the final rejection of claims 18-25, 28, 32 and 46-50, which are all of the claims remaining in the application.

THE INVENTION

The appellant's claimed invention is directed toward a method for forming a roughened surface on a polysilicon layer of a capacitor. Claim 18 is illustrative:

18. A method for forming a roughened polysilicon surface on a substrate, comprising:

forming a first polysilicon layer on the substrate;

subsequent to forming the first polysilicon layer, forming a second polysilicon layer at a temperature and a pressure selected to form a hemispherical grained surface supported by the first polysilicon layer, wherein the hemispherical grained surface has a plurality of grains; and

removing a portion of the second polysilicon layer, thereby decreasing a size of the grains and increasing a distance between adjacent grains while maintaining continuity of the first polysilicon layer.

THE REFERENCES

Fazan et al. (Fazan)	5,130,885	Jul. 14, 1992
Ko et al. (Ko)	5,350,707	Sep. 27, 1994
Hirota et al. (Hirota)	5,372,962	Dec. 13, 1994

THE REJECTION

The claims stand rejected under 35 U.S.C. § 103 as being obvious over the combination of Hirota, Ko, Fazan and the appellant's admitted prior art.¹

OPINION

We reverse the aforementioned rejection.

Hirota discloses a method for increasing capacitance by

¹ In the answer (page 5) the examiner relies upon U.S. patent 5,256,587 to Jun et al. Because this reference is not included in the statement of the rejection, it is not properly before us. See *In re Hoch*, 428 F.2d 1341, 1342 n.3, 166 USPQ 406, 407 n.3 (CCPA 1970). Accordingly, we do not further discuss this reference.

roughening the surface of the lower electrode of a capacitor, thereby increasing the surface area of the lower electrode (abstract). The disclosed roughening techniques include anodic oxidation, wet etching and dry etching. See *id.* Hirota also discloses that the inventors in that patent have proposed two methods for making a lower capacitor electrode having a surface of hemispherical grains (col. 2, line 58 - col. 3, line 27). In the first method dense hemispherical silicon grains are formed using low pressure chemical vapor deposition and are patterned using dry etching (col. 2, line 58 - col. 3, line 7). In the second method a smooth amorphous silicon layer is deposited on a substrate, patterned using lithography and etching, and heated to form a crystallized, rough surface (col. 3, lines 8-27).

The portion of Fazan relied upon by the examiner discloses a lower capacitor electrode formed by depositing a polycrystalline silicon-germanium alloy ($\text{Si}_x\text{Ge}_{1-x}$) coating on a conformal polysilicon layer by rapid thermal chemical vapor deposition using SiH_2Cl_2 and GeH_4 as precursor gases and H_2 as a carrier gas under conditions that favor macroscopic islanding of the deposited alloy crystals (col. 4, line 46 - col. 5, line 5).

The portion of Ko relied upon by the examiner pertains to the appellant's claim 32 which recites treating an amorphous silicon layer overlying a polysilicon layer to form a polysilicon surface having grains thereon. The relied-upon portion of Ko discloses making a capacitor layer of materials which can be amorphous silicon (col. 3, lines 58-64).

The admitted prior art relied upon by the examiner is a disclosure that it was known in the art to form hemispherical grain polysilicon at a critical temperature and pressure at which an anomalous nucleation occurs, and that the grains are so close together that a dielectric layer deposited over them bridges between the grains (specification, page 4, line 21 - page 5, line 10).

The appellant's independent claims require 1) deposition of a silicon or polysilicon layer on a substrate before deposition of the layer from which the hemispherical grains are formed, and 2) etching or removing part of the hemispherical grain-containing layer to decrease the size of the grains or increase the surface area. The examiner argues that the appellant's admitted prior art and Hirota show that forming hemispherical grains was known

in the art,² and relies upon Fazan for a teaching of forming hemispherical grains on a polysilicon layer (answer, page 4). Fazan, however, teaches that his polycrystalline silicon-germanium alloy grains are deposited as macroscopic islands having diameters which are sufficiently large relative to a subsequently-applied dielectric layer that the dielectric layer does not bridge the gaps between the islands (col. 4, line 46 - col. 5, line 5). Fazan does not disclose etching the macroscopic islands.

² In support of this argument the examiner relies upon the above-discussed portion of Hirota and also Hirota's fourth, fifth, thirteenth and fourteenth embodiments (answer, page 4). In the fourth embodiment a doped polysilicon film is annealed and then etched with phosphoric acid to form microrecesses in the film (col. 11, lines 18-48). In the fifth embodiment a method similar to that in the fourth embodiment is disclosed, and a method is disclosed wherein an amorphous silicon film is annealed to form silicon crystal grains and the film is then etched with phosphoric acid to produce microrecesses therein (col. 11, line 50 - col. 12, line 11). In the thirteenth embodiment a porous silicon is annealed to recrystallize the silicon and thereby form grains which, compared to the original grains, have larger sizes and larger microrecesses between them (col. 17, lines 5-24). In the fourteenth embodiment an amorphous silicon film which has been formed partially on a single crystal silicon substrate and partially on a silicon oxide film is annealed to form hemispherical grains and is then etched with phosphoric acid to decrease the microrecess size and increase the surface area (col. 17, line 26 - col. 18, line 9).

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To arrive at the appellant's claimed methods by combining the applied references as proposed by the examiner, one of ordinary skill in the art would have had to substitute Fazan's polycrystalline silicon-germanium alloy macroscopic island layer/polysilicon layer combination for Hirota's polysilicon hemispherical grain layer, and then apply Hirota's etching step to Fazan's macroscopic islands. The examiner has not provided the required explanation as to why the applied prior art itself would have provided one of ordinary skill in the art with a motivation to make this substitution and a reasonable expectation of success in doing so. See *In re Vaeck*, 947 F.2d 488, 493, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991); *In re O'Farrell*, 853 F.2d 894, 902, 7 USPQ2d 1673, 1680 (Fed. Cir. 1988). The examiner's argument that "the motivation is found in the knowledge generally available to one of ordinary skill in the art" (answer, page 6) is not sufficient for carrying this burden; nor is the examiner's argument that one of ordinary skill in the art would have made the proposed substitution "with an anticipation of an expected result" (answer, pages 4 and 5).

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The examiner, therefore, has not carried the burden of establishing a *prima facie* case of obviousness of the method recited in any of the appellant's claims.³ Accordingly, we reverse the examiner's rejection.

DECISION

The rejection under 35 U.S.C. § 103 as being obvious over the combination of Hirota, Ko, Fazan and the appellant's admitted prior art is reversed.

REVERSED

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BRADLEY R. GARRIS)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
TERRY J. OWENS)	
Administrative Patent Judge)	APPEALS AND
)	
)	INTERFERENCES
)	
ROMULO H. DELMENDO)	
Administrative Patent Judge)	

³ Ko and the appellant's admitted prior art are not relied upon by the examiner for a teaching which remedies the above-discussed deficiency in Hirota and Fazan.

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