Paper No. 41

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MITSUFUMI CODAMA,
KAZUSHI SUGIURA, YUKIO YAMAUCHI,
NAOYA SAKAMOTO, and MICHIO ARAI

Appeal No. 1999-1647
Application 08/934,088[1]

HEARD: December 12, 2001

Before BARRETT, GROSS, and LEVY, Administrative Patent Judges.

BARRETT, Administrative Patent Judge.

[1] Application for patent filed September 19, 1997, entitled "Semiconductor Device and Method for Operating the Same," which is a continuation of Application 08/577,390, filed December 22, 1995, now abandoned, which is a continuation of Application 08/328,411, filed October 25, 1994, now abandoned, which claims the foreign filing priority benefit under 35 U.S.C. § 119 of Japanese Application 5-297492, filed November 2, 1993.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claims 17-23.

We reverse.

BACKGROUND

The invention relates to a monolithic semiconductor image sensor device that comprises both photo-sensitive thin film transistors (TFTs) and drive element TFTs on a single substrate. According to the invention, the gate insulation film of the photo-sensitive TFTs is thicker than the gate insulation film of the associated drive circuit TFTs; see Fig. 3(C).

Claim 17 is reproduced below.

> 17. A semiconductor image sensor device comprising a plurality of thin film transistors provided on an insulating surface, wherein,
>
> a part of said plurality of thin film transistors comprises an image sensor element which outputs an electric signal in accordance with a light irradiated thereto, and
>
> another part of said plurality of thin film transistors comprises a driver element to drive said image sensor element,

wherein said image sensor element and said driver element have respective active layers made from the same semiconductor film,

wherein each of said plurality of thin film transistors includes a semiconductor island having an upper surface and side surfaces and a gate insulating film covering said upper surface and side surfaces of said semiconductor island, and

wherein said gate insulating film of said part of the plurality of thin film transistor is thicker than said gate insulating film of said another part of the plurality of thin film transistor.

The Examiner relies on the following references:

Tasch, Jr. et al. (Tasch) 4,409,724 October 18, 1983
Wieder et al. (Wieder) 4,823,180 April 18, 1989
Okamoto et al. (Okamoto) 5,343,066 August 30, 1994

Claims 17-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Wieder and Tasch.

Claims 21-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Wieder, Tasch, and Okamoto.

We refer to the final rejection (Paper No. 28) (pages referred to as "FR__") and the examiner's answer (Paper No. 33) (pages referred to as "EA__") for a statement of the Examiner's position, and to the brief (Paper No. 32) (pages referred to as "Br__") and the reply brief (Paper No. 35)

(pages referred to as "RBr__") for a statement of Appellants' arguments thereagainst.

OPINION

Claims 17-20

The Examiner finds that Wieder discloses a phototransistor which can be used in VLSI (very large scale integration) circuits, but does not disclose integrating phototransistors and peripheral drive circuit transistors on the same substrate. The Examiner finds that Tasch teaches providing display element transistors and peripheral circuit transistors on the same structure with both types of devices fabricated from the same layer of material (FR2). The Examiner concludes that it would have been obvious to provide the phototransistors of Wieder and the associated drive circuitry on the same substrate given the suggestion in Tasch (FR2-3). This obviousness conclusion is not contested and is, therefore, not at issue on appeal. Nevertheless, we agree that forming phototransistors and drive transistors on the same substrate would have been obvious in view of Tasch. Tasch discloses fabricating liquid crystal- or electrochromic-type display elements (including address

transistors 22 connected to row and column conductive strips 32 and 23 and to display electrodes 30) and peripheral circuits (such as a microprocessor 43, memory 44, and driver circuitry) from islands of active material on the same substrate to form a monolithic display (abstract; col. 11, lines 28-34). Although Tasch does not disclose image sensor elements, Tasch expressly teaches one of ordinary skill in the art that peripheral drive elements and the elements they control can be fabricated from islands of the same semiconductor film as a monolithic device.

At issue is the limitation that the gate insulation film of image sensor TFTs is thicker than the gate insulation film of the associated driver element TFTs. As disclosed, a silicon oxide film 44 is deposited over islands of crystalline silicon film 43 to a thickness of 100 nm by an LPCVD process and then removed everywhere except for the image sensor element portion to provide a gate insulating film for the image sensor element portion (specification, p. 14, line 15 to p. 15, line 2). Then a silicon oxide film is formed by thermal oxidation over both the image sensor element portion and the driver circuit portion. The silicon oxide film 45

constitutes the gate insulating film of the driver circuit portion (specification, p. 15, lines 13-15). The gate insulating film 44' of the image sensor element portion comprises a laminate of a 100 nm thick silicon oxide film deposited by LPCVD and a 100 nm thick silicon oxide film formed by thermal oxidation (specification, p. 15, lines 6-13). "The electric characteristics of each of the gate insulating films for the image sensor element portion and the driver circuit portion can be set optimally by thus providing each of them with specified silicon oxide films." (Specification, p. 15, lines 16-19). The gate insulating films preferably have a thickness of 20 nm to 300 nm (specification, p. 16, lines 1-11).

Appellants argue that a larger optical output is obtained by using a relatively thick gate insulating film for the image sensor element, while high speed for the peripheral drive element portion is achieved by using a relatively thin gate insulating film for the driver element (Br4; RBr3-4). Appellants argue the "significant unobvious advantages" (Br8) of the relative thicknesses and the "attendant advantages, or

'synergistic effect' thereof (assured favorable optical response and high speed operation)" (RBr4).

The specification states that the inventive device satisfies four requirements including "(3) a favorable optical response is assured, and is capable of high speed operation" (specification, p. 5). The specification does not expressly state that these properties are due to the relative thicknesses of the gate insulating film, but we assume the properties flow from the gate insulating film thicknesses because the specification states that different thicknesses of gate insulating films allow for optimum electric characteristics. Since no specific criteria are described for the gate insulating film of the image sensor versus that for the driver element, this suggests that knowledge of the thicknesses for optimum electrical characteristics is within the knowledge of those of ordinary skill in the art. Nevertheless, Appellants argue that the limitation of the gate insulating film of the image sensor element being thicker than the gate insulating film of the driver element is their invention and it is not taught or suggested by the combination of Wieder and Tasch. Therefore, it is the Examiner's burden

to provide factual evidence to demonstrate the obviousness of the limitation.

The Examiner finds that "phototransistors and the other FET devices are subject to different gate design choices . . . [and,] [i]n general, different transistors will have different gate oxide thicknesses" (FR2; EA3-4). The Examiner states (EA6): "Applicant states that the Examiner explained that phototransistors and other transistors have different gate oxide thicknesses but that the fact was not shown in prior art. It is, however, clear that such design choices are known in the art and are regularly practice[d] by those performing device design." As to Appellants' argument (at Br7) that the fact that different gate oxide thicknesses are possible does not render obvious a phototransistor gate insulating film with a greater thickness than a drive transistor gate insulating film, the Examiner states (EA6-7): "Note that, in any case, the relationship of the two oxide thicknesses is in the position of less than, equal to or greater than. It is claimed, by the Examiner, that it is [sic, was] known in the state of the art to combine drive transistors with

phototransistors with any of these relationships and that any of the relationships are [sic, would have been] obvious."

Appellants have specifically challenged that the cited art does not demonstrate the obviousness of the claimed relative thicknesses of gate insulating films. Therefore, it is not sufficient for the Examiner to rely merely on possibility, speculation, or design choice for establishing the obviousness of the limitation of the gate insulating film of the image sensor element being thicker than the gate insulating film of the driver element. Even if we were aware that it was within the knowledge of those skilled in the art that it was desirable to make the gate insulating film of image sensor TFTs thicker than the gate insulating film of driver TFTs, this would not satisfy the requirement for evidence. See In re Zurko, 258 F.3d 1379, 1386, 59 USPQ2d 1693, 1697 (Fed. Cir. 2001) ("With respect to core factual findings in a determination of patentability, however, the Board cannot simply reach conclusions based on its own understanding or experience | or on its assessment of what would be basic knowledge or common sense."). What is needed is some evidence that it was known or desirable for thin film

transistors of the image sensor type to have thicker gate insulating films than thin film driver transistors. The claims do not recite how the gate insulating films are made, e.g., by using two layers for the image sensor elements or by using a thermal oxide film, so only the relative film thickness is at issue. The Examiner has not cited any prior art evidence that would establish the obviousness of the relative thickness limitation. Thus, we conclude that the Examiner has failed to establish a prima facie case of obviousness. The rejection of claims 17-20 is reversed.

Claims 21-23

The similar issue with claim 21 is whether the combination of Wieder, Tasch, and Okamoto supports the obviousness of the limitation "wherein a thickness of said gate insulating film of said photo-sensitive thin film transistors is thicker than a thickness of [said gate insulating film of] said driving thin film transistors." The combination of Wieder and Tasch has been discussed with respect to claim 17. We consider here the effect of the added reference to Okamoto.

The Examiner states that Okamoto is applied to show that the gate oxide thickness is varied to meet different design requirements (EA7). Appellants argue that Okamoto is a memory cell, not an image sensor (Br9). It is argued that Okamoto shows the peripheral driver transistors having a thicker gate insulating layer than the memory cell transistors, which is opposite to the claimed arrangement, where the peripheral drive transistors have a thinner gate insulating layer (Br9: RBr4). The Examiner states that it is not understood how this conclusion can be reached since there is no comparison between phototransistors and driver transistors in Okamoto (EA7).

Okamoto does not disclose image sensor transistors and, so, it is not helpful in establishing the specific fact at issue: whether it was known for thin film transistors of the image sensor type to have thicker gate insulating films than thin film driver transistors. What is at issue is the relative thicknesses of gate insulating films of photo-sensitive TFTs and driving TFTs and the Examiner has not cited any prior art <u>evidence</u> that would establish the obviousness of this limitation. The fact that gate insulating films of different devices can have different thicknesses does

not show what the thicknesses are for the specific devices claimed. Accordingly, we conclude that the Examiner has failed to establish a prima facie case of obviousness. The rejection of claims 21-23 is reversed.

CONCLUSION

The rejections of claims 17-23 are reversed.

REVERSED

LEE E. BARRETT Administrative Patent Judge	)	
ANITA PELLMAN GROSS Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
STUART S. LEVY Administrative Patent Judge	)	

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