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EXAMINER

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte, SHUNPEI YAMAZAKI and
YASUHIKO TAKEMURA¹

Appeal 2011-003965
Application 10/199,514
Technology Center 2800

Before, SCOTT R. BOALICK, KEVIN F. TURNER, and
LYNNE E. PETTIGREW, *Administrative Patent Judges*.

TURNER, *Administrative Patent Judge*.

DECISION ON APPEAL

¹ SEMICONDUCTOR ENERGY LABORATORY CO., LTD. is the real party in interest (App. Br. 3).

STATEMENT OF CASE²

Appellants appeal under 35 U.S.C. § 134 from a final rejection of claims 28-30, 32-42, 44-60, 62-160, 162, 164, 165, 167-171, 176, 177, 179-181, and 183. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

THE INVENTION

Appellants' disclosure relates to doping in a semiconductor memory device (Abs.). The methodology for creating the device seeks to reduce diffusion problems associated with the customary doping processes (Spec. pp. 1-4).

Claim 28, reproduced below, is illustrative of the claimed subject matter:

28. A semiconductor device comprising:
- a semiconductor substrate;
 - a floating gate formed over said semiconductor substrate;
 - a control gate formed over and insulated from said floating gate;
 - at least first and second impurity regions formed in said semiconductor substrate with a channel forming region therebetween wherein said first impurity region has a depth not larger than 0.1 μm ,
 - wherein a bottom face of said floating gate is located over a level of a top surface of said first impurity region,

² Our decision will make reference to the Appellants' Appeal Brief ("App. Br.," filed August 30, 2010) and Reply Brief ("Reply Br.," filed January 6, 2011), and the Examiner's Answer ("Ans.," mailed October 14, 2010).

wherein a channel length of said semiconductor device is 0.3 μm or less and said floating gate does not overlap said first impurity region, and

wherein said first impurity region is formed by using said control gate as a mask.

(App. Br., Claims Appendix 54).

RELATED APPEALS

This application is related to reexamination control No. 90/007,872, involving U.S. Patent No. 6,424,008 B1, where an appeal from final rejection of the claims in that proceeding was taken, Appeal No. 2010-002325, with a decision reversing the Examiner's rejection, mailed on October 26, 2010.

CLAIM REJECTIONS

The prior art references relied upon by the Examiner in rejecting the claims are:

Riseman	US 4,419,809	Dec. 13, 1983
Nishizawa	US 4,660,062	Apr. 21, 1987
Mukherjee	US 4,698,787	Oct. 6, 1987
Wu	US 4,794,565	Dec. 27, 1988
Hsu	US 4,841,347	Jun. 20, 1989

W.J. Spencer & T.E. Seidel, "*National Technology Roadmaps: the U.S. Semiconductor Experience*," 4th Int'l Conference on Solid-State and Integrated Circuit Tech. 211-220 (October 24-28, 1995) ("Spencer").

Paul S. Peercy, "*The Drive to Miniaturization*," 406 Nature 1023-1026 (August 31, 2000) ("Peercy").

Lidia Lukasiak et al., “*Silicon microelectronics: where we have come from and where we are heading*,” J. Telecomm. & Info. Tech. 7-14 (January 2004) (“Lukasiak”).

The Examiner makes the following rejections:

Claims 28-30, 32-42, 44-60, 62-160, 162, 164, 165, 167-171, 176, 177, 179-181, and 183 rejected under 35 U.S.C. § 101 as being inoperative and therefore lacking in utility (Ans. 4-5);

Claims 28-30, 32-42, 44-60, 62-160, 162, 164, 165, 167-171, 176, 177, 179-181, and 183 rejected under 35 U.S.C. § 112, second paragraph, as being indefinite (Ans. 5); and

Claims 28-30, 32-42, 44-60, 62-160, 162, 164, 165, 167-171, 176, 177, 179-181, and 183 rejected under 35 U.S.C. § 103(a) as unpatentable over Mukherjee, Riseman, Wu, Nishizawa and Hsu, considered with Percy, Lukasiak, and Spencer (Ans. 5-13).

ISSUES³

We take claim 28 as representative of all of the pending claims. *See* 37 C.F.R. § 41.67(c)(1)(vii).

1. Is the structure recited in claim 28 inoperative and thus lacking in utility under 35 U.S.C. § 101?
2. Is claim 28 indefinite under 35 U.S.C. § 112, second paragraph?

³ We have considered in this decision only those arguments that Appellants actually raised in the Briefs. Arguments which Appellants could have made but chose not to make in the Briefs are deemed to be waived. *See* 37 C.F.R. § 41.37(c)(1)(vii).

3. Does the combination of Mukherjee, Riseman, Wu, Nishizawa and Hsu, considered with Peercy, Lukasiak, and Spencer, teach or suggest the subject matter of claim 28 under 35 U.S.C. § 103(a)?

FINDINGS OF FACT

1. The Specification of the instant application is directed to semiconductor memory devices having floating gates, where the methodology for creating the devices seeks to reduce diffusion problems associated with the customary doping processes (Spec. pp. 1-4; Abs.).
2. The Specification of the instant application provides that the “present invention enables stable fabrication of MOS devices having a channel length of 1.0 μm or less, typically from 0.1 to 0.3 μm , and a shallow impurity region 0.1 μm or less in depth.” (Spec. p. 20).
3. Claim 28 recites, in part, a semiconductor memory device having a first impurity region with a depth not larger “than 0.1 μm ,” and that the “channel length of said semiconductor device is 0.3 μm or less” (Br. Claim App’x 54).
4. Mukherjee is directed to an electrically erasable programmable memory device which is programmable in the manner of an EPROM and erasable in the manner of an EEPROM (Abs.).
5. Riseman is directed to a method of producing a sub-micron gate length field effect transistor device (Abs.), where the channel

- length can be 0.3 microns or less (col. 6, ll. 18-44) and having an impurity region less than 0.1 microns in depth (col. 7, l. 45).
6. Wu is directed to an electrically programmable memory device employing source side injection, where the channel length is 1 micron or less (col. 6, ll. 12-13).
 7. Nishizawa is directed to an insulated gate transistor having reduced channel length (Abs.). In one embodiment, the source and drain regions are formed as very shallow regions with 100 Å to 1,000 Å in depth (col. 9, ll. 3-5). Channel lengths as short as 400 to 500 Å can be produced (col. 8, ll. 61-64).
 8. Hsu is directed to a MOSFET with very shallow source and drain regions (Abs.). The depths are disclosed to less than 100 nm (col. 1, ll. 44-49).

PRINCIPLES OF LAW

“Section 103 forbids issuance of a patent when ‘the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.’” *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007).

“[A] court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions.” *Id.* at 417.

When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable

solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

Id. at 420.

ANALYSIS

Rejection under 35 U.S.C. § 101

The Examiner finds that all of the claims, including claim 28, recite that the limitation of “a channel length of said semiconductor device is 0.3 μm or less” reads on a channel length of zero or close to zero, such that the device claimed is inoperative if the channel length is zero (Ans. 4-5).

Appellants argue that the Examiner is interpreting the claims in a manner inconsistent with the Specification (Reply Br. 11). We agree with Appellants.

While the Examiner emphasizes that the Specification provides no evidence of an operative embodiment therein “which can operate in the entire claimed range of ‘0.3 microns or less’” (Ans. 16-17), that is not a requirement for utility. There is no requirement that a full range recited in a claim must be supported by working embodiments. As the predecessor of our reviewing court stated:

[C]laims are not to be considered in a vacuum, “but always in light of the teachings of the prior art and of the particular application disclosure as it would be interpreted by one possessing the ordinary level of skill in the pertinent art.” When considered in the light of the prior art and the specification, claims otherwise indefinite may be found reasonably definite.

In re Kroekel, 504 F.2d 1143, 1146 (CCPA 1974)(citing *In re Moore*, 439 F.2d 1232 (CCPA 1971)).

A rejection based on indefiniteness, or utility, is not necessarily valid simply because the “claims may be read in theory to include compositions that are impossible in fact to formulate.” *Id.* The fact that claim 28 could be made to read upon a device with a zero or close to zero channel length, i.e., an inoperative device, does not require that the claim be found to have no utility. Read in the context of the Specification (FF 3), a practical range less than 0.3 microns can be determined, such that one of ordinary skill in the art would not have viewed the claim as reading upon non-working embodiments. As such, we conclude that claim 28 is not inoperative and thus does not lack utility under 35 U.S.C. § 101.

Rejection under 35 U.S.C. § 112, second paragraph

The Examiner finds that claim 28 is indefinite because it is unclear whether or if the claim limitation “channel length” is related to the recited “channel forming region,” or that the claim is indefinite because the channel length is not recited to have a “lower limit” (Ans. 5, 16-18). Appellants argue that one of ordinary skill in the art would have understood that a channel is formed in a channel forming region of the device (Reply Br. 12). We agree with Appellants.

While it may be clearer to have claim 28 recite, for example, “a channel length of a channel, formed by said channel forming region, is 0.3 μm or less,” or some other formulation, we conclude that ordinarily skilled artisans would have understood that the channel is formed in the channel

forming region, and that the channel length is the length of that channel. While the Examiner argues that the claims, and thus claim 28, do not require that the “channel length” refer to the specific transistor recited in claims, i.e., it could be the length of a channel in some other transistor in the same semiconductor device (Ans. 19-20), we conclude that this goes to the breadth of the claim, not to the definiteness of the claim. The fact that the Examiner can read the channel length onto some other transistor in the device means that that claim is broad enough to read upon such devices, and is an invitation to the Examiner to find prior art that would fit under such a broad interpretation. It does not mean that the claims, and hence claim 28, is indefinite because of such breadth.

With respect to the “lower limit” of the channel length, we have addressed the same argument in the above section and need not repeat it here. As such, we conclude that claim 28 is not indefinite under 35 U.S.C. § 112, second paragraph.

Rejection under 35 U.S.C. § 103(a)

Appellants argue that the “Official Action has not set forth sufficient reasons why one of skill in the art at the time of the present invention would have had a reason to combine the prior art of record to achieve the features of the present invention” (App. Br. 36). Appellants argue that the miniaturization of semiconductor devices requires more than making the components of the device smaller (App. Br. 39-40). The Examiner finds that “[i]t is well known in the art to reduce the depths of the source and drain regions and the widths of the channel regions, subjected to routine

experimentation and optimization. Therefore, the result of reducing these parameters is expected.” (Ans. 29). We agree with Appellant.

The Examiner relies upon Peercy, Lukasiak, and Spencer to show that market forces and design need in the semiconductor industry was toward miniaturization. Even accepting that proposition, a semiconductor device is not miniaturized through rote reduction, as would be performed on a copy machine. As Appellants have argued, “a simple generalized assertion that the device could be scaled in size falls far short of providing sufficient motivation and a reasonable expectation of success to one of ordinary skill in the art contemplating such changes” (App. Br. 39). In other words, finding that devices likely will continue to miniaturize, does not provide motivation of how to do that specifically. Additionally, to simply say that things are going to get smaller and to look at trend lines after the fact does not establish how the process actually occurs.

As Appellants have pointed out (App. Br. 38-39), the device in Mukherjee has layers with specific areas and thicknesses, and unforeseen affects can occur through mere reduction in the sizes of all of those layers. The semiconductor art is replete with patents directed to methods and devices that allow for more devices to be placed on a semiconductor surface and resolve the consequences of further integration. While we have no doubt that the device in Mukherjee could be reduced in size, perhaps even in view of Riseman, Wu, Nishizawa and Hsu, we find no provision for *why* such a reduction would occur, other than the market forces and design need in the semiconductor industry provided by the Examiner.

As Appellants have argued: “Moore’s Law does not tell one of ordinary skill in the art at the time of the present invention how to miniaturize a device” (App. Br. 40). The Examiner does not find this argument to be persuasive (Ans. 29), but we find the analogy to be apt and helpful. Like Moore’s Law, the trends and market forces relied upon by the Examiner predict results without providing a basis for reaching those results. Purveyors and consumers of science fiction literature and cinema no doubt could have some idea of what our world would look like in a hundred years, but that would provide no roadmap for reaching such a possible future. The Examiner's reliance on such general trends to show specific changes is not sufficient here to show obviousness under 35 U.S.C. § 103.

The Examiner also finds that making a device smaller is obvious and cites several cases to buttress that point (Ans. 28). However, the citations are directed to improvements which are “technology-independent,” as argued by Appellants (Reply Br. 9-10). In fact, the court in *Leapfrog* (*Leapfrog Enterprises, Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1161 (Fed. Cir. 2007) stated that “Leapfrog presents no evidence that the [improvement] was uniquely challenging or difficult for one of ordinary skill in the art.” *Id.* at 1162. In the instant case, Appellants have provided many obstacles that would need to be overcome to accomplish the miniaturization, (App. Br. 20-24), which the Examiner has not countered. The suggestion that electronic devices will continue to miniaturize does not provide an explanation of how the process is accomplished. As such, we conclude that trends in miniaturization do not compel the modifications envisioned by the Examiner in the prior art rejection of the claims.

Given that we do not find the trends (Percy, Lukasiak, and Spencer) relied upon by the Examiner to be sufficient, we do not find the Examiner's assertion that source/drain regions of Mukherjee (FF 4) can be reduced to "not larger than 0.1 μm ," in view of Riseman, Wu, Nishizawa and Hsu (FF 5-8) to be supported.

We also do not find it dispositive that Riseman and Nishizawa teach that diffusion regions can have the depths disclosed in those references (FF 5, 7). The existence of diffusion regions having such depths does not establish obviousness without some reason to incorporate such depths into Mukherjee. "[I]nventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." *KSR*, 550 U.S. at 418-419.

We note that we need not address whether Percy, Lukasiak, and Spencer are prior art to the instant claim, since their application to show a bare trend does not provide a motivation required by the rejections.

CONCLUSIONS

1. The structure recited in claim 28 is not *per se* inoperative and thus it does not lack utility under 35 U.S.C. § 101;
2. Claim 28 is not indefinite under 35 U.S.C. § 112, second paragraph;
and
3. The combination of Mukherjee, Riseman, Wu, Nishizawa and Hsu, considered with Percy, Lukasiak, and Spencer, does not render claim 28

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obvious under 35 U.S.C. § 103(a) under the analysis of the Examiner in the final rejection.

DECISION

We reverse the Examiner's rejection of claims 28-30, 32-42, 44-60, 62-160, 162, 164, 165, 167-171, 176, 177, 179-181, and 183.

REVERSED

Vsh