

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.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. 11

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOSEPH T. EVANS, JR.,
WILLIAM L. WARREN, and
BRUCE A. TUTTLE

Appeal No. 1997-3915
Application No. 08/640,572

ON BRIEF

Before THOMAS, JERRY SMITH, and GROSS, Administrative Patent Judges.

GROSS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claim 1, which is the only claim pending in this application.

Appellants' invention relates to a ferroelectric FET structure having a ferroelectric layer doped to reduce retention loss. In particular, the ferroelectric layer has a perovskite structure with A and B sites and has a chemical composition of

Appeal No. 1997-3915
Application No. 08/640,572

ABO₃, the B-sites being filled with a dopant element that has an oxidation state greater than +4. Claim 1 is illustrative of the claimed invention, and it reads as follows:

1. An improved ferroelectric FET structure comprising:

a semiconductor layer having first and second contacts thereon, said first and second contacts being separated from one another;

a bottom electrode; and

a ferroelectric layer sandwiched between said semiconductor layer and said bottom electrode, said ferroelectric layer comprising a perovskite structure having A and B sites and having a chemical composition ABO₃, wherein said B-sites are filled with a first element, a second element, or a dopant element that has an oxidation state greater than +4, said dopant element being present in said ferroelectric layer in sufficient concentration to impede shifts in the resistance measured between the first and second contacts with time, wherein all of said first, second and dopant elements are present in said ferroelectric layer.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Miller et al. (Miller) 1992	5,116,643	May 26,
Swartz et al. (Swartz) 1993	5,198,269	Mar. 30,
Shirasaki ¹	Sho 58-46680	Mar. 18, 1983

¹ Our understanding of this reference is based upon a translation provided by the Scientific and Technical Information Center of the Patent and Trademark Office. A copy of the translation is enclosed with this decision.

Appeal No. 1997-3915
Application No. 08/640,572

(Japanese Kokai patent publication)

Claim 1 stands rejected under 35 U.S.C. § 103 as being unpatentable over Shirasaki in view of Miller and Swartz.²

Reference is made to the Examiner's Answer (Paper No. 10, mailed May 9, 1997) for the examiner's complete reasoning in support of the rejection, and to appellants' Brief (Paper No. 9, filed March 17, 1997) for appellants' arguments thereagainst.

OPINION

We have carefully considered the claims, the applied prior art references, and the respective positions articulated by appellants and the examiner. As a consequence of our review, we will reverse the obviousness rejection of claim 1.

Shirasaki discloses (translation, page 6) a ferroelectric FET memory element, with a ferroelectric layer of Ym_nO_3 , $E_rM_nO_3$, $H_oM_nO_3$, $T_mM_nO_3$, YbM_nO_3 , or $L_uM_nO_3$. Miller suggests that ferroelectric thin films with a perovskite structure having a chemical formula of ABO_3 where B has an oxidation state of +5

² We note that a rejection of claim 1 made in the Final Rejection (page 2) under the judicially created doctrine of double patenting over claims 1 through 3 of U.S. Patent No. 5,578,846 was not repeated nor explicitly withdrawn in the Examiner's Answer. We consider the rejection to have been withdrawn without prejudice, presumably because of appellants' offer (Brief, pages 4-5) to file a terminal disclaimer.

Appeal No. 1997-3915
Application No. 08/640,572

(which is greater than +4) are particularly useful for electrical devices such as random access memory devices. (See column 1, lines 13-18, and column 2, lines 43-64.) Similarly, Swartz discloses (column 1, lines 15-18 and 41-44) that ferroelectric thin films with perovskite structures are useful for nonvolatile semiconductor memories. Swartz further lists as particular examples PbTiO_3 or SrTiO_3 with PZT, PbZrO_3 , $(\text{Pb},\text{La})\text{TiO}_3$, or $(\text{Pb},\text{La})\text{ZrO}_3$, when the ferroelectric layer is to be used in a nonvolatile semiconductor memory.

Appeal No. 1997-3915
Application No. 08/640,572

The examiner states (Answer, page 4) that it would have been obvious in view of Miller and Swartz to use $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ for the ferroelectric material of Shirasaki, as Swartz also lists $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ as a known PLZT ferroelectric material. The examiner points to $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ because it includes niobium (one of the materials disclosed by appellants as an appropriate dopant). Appellants argue (Brief, page 3) that neither Swartz nor Miller provides motivation for using any of the compositions taught therein in a ferroelectric FET memory device such as that of Shirasaki. However, though all recitations of $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ and other materials including niobium, tantalum, or tungsten (appellants' disclosed dopants) are for applications other than memory devices, as stated above, both Swartz and Miller indicate that certain compositions are useful for memory structures. Accordingly, although we agree that neither Swartz nor Miller suggests using $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$, or other compositions including niobium, tantalum, or tungsten, in a ferroelectric FET memory device, it would have been obvious to combine the compositions of Swartz and Miller disclosed as being appropriate for memory devices with Shirasaki's FET memory device.

Appeal No. 1997-3915
Application No. 08/640,572

Nonetheless, as pointed out by appellants (Brief, pages 3-4) none of the references discuss the concentration of a dopant with an oxidation state greater than +4, and thus none suggest a concentration sufficient to meet the claimed condition of "to impede shifts in the resistance measured between the first and second contacts with time." The examiner (Answer, page 5) considers the limitation "to be merely functional," asserting that "both the claimed structure and claimed materials are obvious over the collective teachings of the prior art references to Shirasaki, Miller et al. and Swartz et al." However, the requirement that the concentration be sufficient to impede shifts in resistance is not functional, but rather, defines the structure. Thus, in the absence of a discussion as to the concentration and/or the shifting of resistance in any of the references, the examiner has failed to show the claimed structure.

The examiner relies (Answer, page 6) on the niobium in the material $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ as providing a means for impeding shifts in resistance. However, as explained above, we find no motivation in the references for using materials with niobium in the memory device. Since the examiner has pointed to no

Appeal No. 1997-3915
Application No. 08/640,572

discussion in the references of the dopants and their concentrations, nor to any disclosure regarding the shifts in resistance, the examiner has failed to establish a prima facie case of obviousness. Consequently, we cannot sustain the obviousness rejection of claim 1.

CONCLUSION

The decision of the examiner rejecting claim 1 under 35 U.S.C. § 103 is reversed.

REVERSED

JAMES D. THOMAS)	
Administrative Patent Judge)	
)	
)	
)	
)	BOARD OF PATENT
JERRY SMITH)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
)	
)	
)	
ANITA PELLMAN GROSS)	
Administrative Patent Judge)	

APG:clm

Appeal No. 1997-3915
Application No. 08/640,572

Calvin B. Ward
18 Crow Canyon Court #305
San Ramon, CA 94583