Harvard Model Congress
Boston 2024

KIWI SEMICONDUCTOR V. VALLEY NANOELECTRONICS CORPORATION

By Joel Rakhamimov

UNITED STATES DISTRICT COURT
Justice Joel Rakhamimov Presiding

KIWI SEMICONDUCTOR Plaintiff	)
v.	) Case No. HMC-DC-2024-RAKHAMIMOV
VALLEY NANOELECTRONICS CORPORATION Defendant	)

SUMMARY OF FACTS STIPULATED

Kiwi Semiconductor (also known as **Kiwi Semi**), a prominent integrated circuit manufacturer based in the state of New York, has accused a competitor, **Valley Nanoelectronics Corporation** (also known as **VNC**), of patent infringement. The Plaintiff alleges that **VNC** has intentionally made use of **Kiwi Semi**'s patent without permission or compensation.

Patent Background

The contested patent, hereafter referred to as the **'250 patent**, was granted by the United States Patent Office in late **2020**. The patent protects from infringement, a modification of a specific type of transistor known as a fin-shaped field effect transistor (FinFET). A transistor is a device that allows electric current in a device to be controlled precisely with an applied voltage.

Manufacturing a transistor's structure such that it stuck upwards into "fins" was a significant advancement because it improved the device's efficiency and performance substantially, to the point where FinFETs are the preferred type of transistor in the modern day, with billions per computer chip.

The '250 patent innovates a specific kind of FinFET, the distinguishing feature being the different thicknesses of what are known as "gate dielectrics" in the FinFET. The "gate" is one of the fins on a FinFET, and a "dielectric" is an insulator, a material that totally blocks electric current, usually made of some oxide compound. The gate dielectrics are crucial to the functioning of the device because they are formed over the fins themselves, preventing disastrous leakage of current. Changing the thickness of the gate dielectric is equivalent to modulating the current that the transistor allows, by way of changing a parameter known as "oxide capacitance." As a result, the specification of the gate dielectrics will make or break a technology process.

Most FinFETs have multiple gates, but the **'250 patent** uniquely provides for different thicknesses of the dielectric on each gate. This is a useful technique because the previous standard was to use different materials of similar thickness on different gates, which was expensive and slow from a manufacturing standpoint. Instead, the same material is applied over all the gates, with the process being repeated multiple times on selected gates to make some of their dielectrics thicker. This is because one can change the thickness of the gate dielectric appropriately instead of changing the dielectric material and it will achieve a similar effect.

Suit Details

On **September 5, 2022**, **Kiwi Semi** sent a cease-and-desist letter to **VNC** notifying them of the patent and their infringement. The letter alleges that **VNC** uses the exact same process and configuration of FinFET that is outlined in the patent. Specifically, **Kiwi Semi** accuses **VNC** of copying their technique of multiple dielectric thicknesses on FinFET gates. **Kiwi Semi** filed an official complaint with the United States government for patent infringement a week later, on **September 12, 2022**. (The way that **Kiwi Semi** originally discovered the alleged infringement is confidential for the purposes of this trial and will not be disclosed, nor is it admissible as evidence.)

Pretrial Discovery

As part of pre-trial discovery, data of FinFET properties and parameters from each company's "14 nanometer" technology process was obtained, with both companies' consent and cooperation. This data is confirmed to be true and accurate.

Since transistors exist in many different configurations, FinFETs with three gates were examined and focused on for consistency of comparison. It was found that **VNC**'s manufacturing equipment was configured to repeat the oxide application process for gate dielectrics in the case of higher thicknesses, as outlined in **Kiwi Semi**'s patent. Consistent with this, FinFET thicknesses were measured and found to be obtained in similar ways between both companies. Microscopic analysis of transistors showed that gate oxides were formed multiple times on some fins to achieve a larger thickness.

Both **VNC** and **Kiwi Semi** use the material known as hafnium dioxide (HfO_2) for the gate oxide of the majority of their FinFET transistors. Among the other materials used are the original silicon dioxide (SiO_2), tungsten-based compounds, and more. Virtually all semiconductor foundries as large as **Kiwi Semi** and **VNC** have a similar material distribution for their gate dielectrics. However, in **October 2018**, as a response to promising academic research in materials science, **Kiwi Semi** publicly announced a research and development (R&D) program investigating the use of titanium dioxide (TiO_2) as a gate dielectric, due to its unprecedented dielectric strength. It is known from pretrial discovery that **VNC** started up a similar, internal R&D program into similar titanium gate technology in late **2019**. Currently, specialized chips for trusted customers at both companies utilize titanium dioxide in their FinFETs. Most competitors of both companies are not seriously investigating titanium-based materials for use as gate dielectrics.

Related Background

Valley Nanoelectronics Corporation is the largest semiconductor foundry in the world by several metrics, including product output and total revenue. While **Kiwi Semiconductor** is a major player in the semiconductor industry and has several semiconductor fabrication facilities (known as 'fabs') in the Northeastern United States, it is a substantially smaller company than **VNC**. **VNC** has approximately ten times the revenue and five times the employees of **Kiwi Semi**. Nonetheless, both companies' client lists include the top technology corporations, such as cell phone and personal computer manufacturers.

Each new semiconductor fabrication process is known as a "technology node," and refers to specific generations of device manufacturing. A technology node is usually named "X nanometer" where X is some number, getting smaller with each generation, indicating the smaller dimensions of the technology's devices. The current state of the art is the "4 nanometer" process. The nodes at issue in the case are the 14 through 28 nanometer nodes.

INDICTMENT

The Plaintiff alleges the following on information and belief.

The company known as **Valley Nanoelectronics Corporation** has willfully and continuously infringed the lawful '250 patent of **Kiwi Semiconductor** without permission nor payment from the latter, in violation of 35 U.S. Code § 271. **Kiwi Semiconductor** has suffered and continues to suffer damages as a result of the Defendant's infringement of the patent.

Claim for Relief

WHEREFORE, the Plaintiff respectfully requests an award of actual damages to **Kiwi Semiconductor** of $1,000,000,000 or in excess, under 35 U.S.C. § 284, as determined by the court for lost past and future profits caused by the willful infringement of the '250 patent by the **Valley Nanoelectronics Corporation.**

The Plaintiff hereby demands trial by jury on all claims and issues so triable.

APPLICABLE STATUTES

35 U.S. Code § 271 - Infringement of Patent

(a) Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefore, infringes the patent....
(c) Whoever offers to sell or sells within the United States or imports into the United States a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial non-infringing use, shall be liable as a contributory infringer...
(d) No patent owner otherwise entitled to relief for infringement or contributory infringement of a patent shall be denied relief or deemed guilty of misuse or illegal extension of the patent right by reason of his having done one or more of the following: (1) derived revenue from acts which if performed by another without his consent would constitute contributory infringement of the patent; (2) licensed or authorized another to perform acts which if performed without his consent would constitute contributory infringement of the patent; (3) sought to enforce his patent rights against infringement or contributory infringement; (4) refused to license or use any rights to the patent; or (5) conditioned the license of any rights to the patent or the sale of the patented product on the acquisition of a license to rights in another patent or purchase of a separate product, unless, in view of the circumstances, the patent owner has market power in the relevant market for the patent or patented product on which the license or sale is conditioned.

35 U.S. Code § 103 - Conditions for patentability; non-obvious subject matter

A patent for a claimed invention may not be obtained... if the differences between the claimed invention and the prior art are such that the claimed invention as a whole

would have been obvious… to a person having ordinary skill in the art to which the claimed invention pertains.

APPLICABLE CASE LAW

Graver Tank & Mfg. Co. v. Linde Air Products Co., 339 U.S. 605 (1950)

In 1950, a company called Linde Air Products Co. sued Graver Tank & Mfg. Co. for patent infringement of a welding process owned by Linde. The patent provides that manganese silicate will be used as part of the process. The alleged infringers, Graver companies and associated, instead used the same materials except manganese silicate was replaced by magnesium silicate. Although magnesium and manganese are two different chemical elements, the difference in the compounds used "was so insubstantial, in view of the technology and the prior art, that the patent was infringed under the doctrine of equivalents."

The **doctrine of equivalents** is a legal principle in patent law that states: "if two devices do the same work in substantially the same way and accomplish substantially the same result, they are the same, even though they differ in name, form or shape." It exists because there may be methods or techniques of accomplishing a task or manufacturing a device that are substantially and verifiably different, but nevertheless result in a virtually identical output.

Importantly, the Court considered "whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was" and found that "chemists familiar with the two fluxes testified that manganese and magnesium were similar in many of their reactions." It must be that a person learned in the field in question would identify substantially similar results.

Alza Corp. v. Mylan Laboratories, Inc., 310 F. Supp. 2d 610 (D. Vt. 2004)

A patent infringement case between two pharmaceutical companies where the patent was a method of administration of a certain drug. A special issue in the case was validity of the patent and whether the patent was obvious or not to a skilled person.

The final opinion in the case noted: "to prevent the use of hindsight based on the invention itself to invalidate the patent, this Court must be able to discern 'reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed.'"

PRE-TRIAL MOTIONS

1. **Kiwi Semiconductor** informed **Valley Nanoelectronics Corporation** of potential patent infringement by sending an official cease-and-desist notice on **September 5, 2022,** by way of mail.

2. **Kiwi Semiconductor** accused **Valley Nanoelectronics Corporation** of patent infringement on a patent concerning semiconductor device fabrication by filing suit on **September 12, 2022**.
3. **Valley Nanoelectronics Corporation** officially denied any such infringement.

POST-SUMMATION JURY INSTRUCTIONS

Kiwi Semiconductor has accused the defendant, **Valley Nanoelectronics Corporation**, of **patent infringement**, in violation of 35 U.S.C. § 271.

For you to rule in favor of the Plaintiff, the Plaintiff must accumulate a *preponderance of the evidence* that displays it is highly probable each of the following elements are true, in accordance with the legal elements of patent infringement:

1. The claim of **Kiwi Semiconductor**'s '250 patent is valid and enforceable.
2. **Valley Nanoelectronics Corporation** willfully and directly infringed **Kiwi Semiconductor**'s '250 patent either by
    a. literal infringement or
    b. by the Doctrine of Equivalents.

The "claim" of the '250 patent refers to its technique of repeated applications of gate oxide to increase its thickness. Additionally, for a patent to be valid, it must be non-obvious, whereby obviousness is defined above as in 35 U.S. Code § 103.

WITNESS LIST

Plaintiff:
Emmy Hughes
Jun Goh
Charlie Huffman

Defense:
Nikita Zekowski
Avery Shannon
Riley Lempel

Note on the Order and Gender of Witnesses

The order of witnesses specified above is random and not binding. Teams should feel free to present witnesses in whatever order they deem most rewarding. Also, no gender is officially implied; teams may choose a person of any identity to represent any witness.

AFFIDAVIT OF EMMY HUGHES

Witness for the Plaintiff

My name is Dr. Emmy Hughes, and I am the current CEO of Kiwi Semiconductor. I am 56 years old and possess a doctoral degree in chemical engineering with a substantial research focus in semiconductor technology. I was with Kiwi Semiconductor before it was founded, as it started as an offshoot of another, bigger technology company. We went ahead and began building fabs, building up the company, and now look where we are. So, it was a sign that we were doing things right when we noticed that our patented technology was being stolen by Valley.

They use the same method that Dr. Goh, an employee of Kiwi Semi, patented! I mean, it is quite easy and efficient to just run your process again on selected gates to get a thicker dielectric… Notwithstanding the brilliance of Dr. Goh, throughout this suit I have wondered sometimes why no one else had thought of it. It is quite a simple improvement that doesn't involve special knowledge. But then again it took hundreds of thousands of years for us to invent agriculture, and that wasn't obvious or trivial at all. Nor is the way we make our gate oxides thicker and thinner than others on the same chip.

Not to mention VNC's obvious investigation of titanium oxide… I mean, they could have copied from a bunch of different companies to make it seem less obvious and not just us. Well, they might be doing that. Nobody outside of academia except Kiwi Semi even thinks titanium oxide is viable as a dielectric for FinFETs, but for some reason VNC seems convinced as well.

You seem a little confused, let me explain: we were granted a patent by the glorious United States government, VNC was found unequivocally to be using it in their technologies and processes, and so we are owed relief for the damages caused by this. Simple as that! You won't even see them deny that they use it! Not that they can, given that their machines have the same settings that ours do for the gate oxide.

We are David against Goliath, in a hard battle for ideas that are rightfully ours. I will not just sit and watch them take our inventions.

Emmy Hughes

Subscribed and sworn to me on this, the 29th day of June, 2021

Adrián Muñoz Krans

Adrián Muñoz Krans, Notary Public

AFFIDAVIT OF JUN GOH

Witness for the Plaintiff

Hi, I'm Jun Goh. I am employed as Director of Device Engineering at Kiwi Semiconductor. I have been working at Kiwi Semi for 26 years. I am an expert in process engineering, semiconductor manufacturing, and the specifics of the '250 patent and other patents of mine that are similar. My educational background is a doctorate in materials science from the University of Singapore.

It was my Device Engineering department that discovered the novel technique of using multiple thicknesses for gate dielectrics on FinFETs. We were spending a lot of manufacturing time on distinct dielectrics for each chip that we made. I failed macroeconomics in college, but I knew that that wasn't good for business. It turned out to be a good decision by our team! Honestly, it wasn't me that first thought of it, it was my top engineer, but I was leading the group, so I contributed to it. At first, I did think it was a little simple, to be sure, but it seemed to work out! It did take more persuasion than I'm used to for the patent office to realize that our invention was noteworthy, but they came around in the end. When you see the result of how much manufacturing time and money this saved us, you'll see this isn't a small thing at all.

To address the counterargument that this is an "obvious" thing to think about: most engineers I've talked to didn't think of this. Since we are in a non-technical context, the exact nature of the patent must be heavily simplified, so when you hear people saying that the patent amounts to nothing more than a trivial change of practice, they are oversimplifying it to protect their own interests. Semiconductor fabrication is perhaps the most complex process known to humanity, and one cannot just "add" more oxide to an existing layer without several other steps. Google the semiconductor process if you are skeptical.

VNC clearly has been shown to use the same exact process and method we use to achieve the same thing. I understand that they may use their transistors for other use cases, but it doesn't change the fact that the devices are made in the same way.

We don't use other companies' patents. Full stop. I know we aren't the largest company, but we still have the money and, more importantly, the integrity to afford ourselves our own technologies. The reason being, beyond our integrity, that it opens up a massive liability concern if we use processes that are even remotely similar to other intellectual properties.

Jun Goh

Subscribed and sworn to me on this, the 29th day of June, 2021

Adrián Muñoz Krans

Adrián Muñoz Krans, Notary Public

AFFIDAVIT OF CHARLIE HUFFMAN

Witness for the Plaintiff

My name is Charlie Huffman. I currently hold a Bachelor of Science in Electrical Engineering. I have been employed in the semiconductor industry for 22 years, currently at Marble Corporation, a small counterpart of Kiwi Semi. I am officially a Process Engineer, meaning I oversee our chip fabrication, specifically in photolithography. To be clear, while I do not work for Kiwi Semi, my company often collaborates with them on chip fabrication.

Years ago, the status quo in the industry was to use different materials and complicated fabrication to get different oxide capacitances. Honestly, FinFETs are younger than my kids, so there truly wasn't even a consensus on how to change the dielectric properties for them. In my eyes, the '250 patent is one of the first and only mainstream attempts to address this case. The oxide is what separates FinFETs from other transistors. I mean, the idea of electrically isolating the gate is what makes it the gate! Obviously, this is a crucial area to work on!

I must say that I concur with the Device Engineering team at Kiwi Semi when they state that the patent is more complex than it may first seem. There is a reason why it takes years of training to even get started in this industry. There are also reasons why our equipment costs millions of dollars. The single piece of equipment that actually deposits the oxide onto the chip where we want it to costs more than my house and car. It is not an easy thing to just add more oxide. You often become mired in the complications inherent to the fabrication process and so that's why this is worthy to be a patent.

It's quite clear that the combination of different oxide thicknesses and titanium or hafnium dioxide is considerable. As a result, any company that does not have this will be at a disadvantage, with respect to their FinFETs. It is incredibly important that the intellectual property of Kiwi Semi not be violated.

Charlie Huffman

Subscribed and sworn to me on this, the 29th day of June, 2021

Adrián Muñoz Krans

Adrián Muñoz Krans, Notary Public

AFFIDAVIT OF NIKITA ZEKOWSKI

Witness for the Defense

I am Nikita Zekowski, the Chief Technology Officer of Valley Nanoelectronics. I have a Master of Business Administration (MBA) and a PhD in chemical engineering. I was formerly an engineer at VNC for 15 years, before being promoted up the management ladder up to where I am now.

I'm not going to beat around the bush. I don't deny that we use this process. Legally, I can't deny it. But even if I could, I wouldn't, because it is ridiculous that we are being met with this accusation. So, I do not take issue with the engineering itself, but rather the nature of the accusation. This is not an advanced method. This '250 patent is clearly a small optimization that saves a decent amount of manufacturing time and resources. By no means is it a novel technique or method worthy of a patent. All you need to do is reprogram the machine that does photolithography to accept this. Well, it's not that simple, it takes a bit of effort and programming on the front end and back end, including the machine, but our processes are so complex at this point where any little change will require a large amount of overhead. The point is that I haven't been an engineer for many years and even I can see that this patent is quite simple to think of. I don't know why it's being protected as a patent when it's likely that most of our competitors do the same thing. Just guessing since I don't have direct knowledge of any other company's fabrication process.

I'm not sure how familiar you are with this industry since it's quite new. And I know this specific thing is not at issue here, but everyone uses hafnium dioxide! It's literally the industry standard for gate dielectrics. And those guys at Kiwi aren't special for reading the latest research from MIT. We have both R&D and committed engineers, just like they do. Titanium was getting noticed as well. What, with a dielectric constant that high, I'm shocked that there isn't more focus on it currently.

It'd be a lot easier if the government had more of a say in these patents- that way we don't need to resort to these little squabbles.

Nikita Zekowski

Subscribed and sworn to me on this, the 29th day of June, 2021

Adrián Muñoz Krans

Adrián Muñoz Krans, Notary Public

AFFIDAVIT OF AVERY SHANNON

Witness for the Defense

My name is Avery Shannon. I am one of the engineering fellows who oversees the 14 nanometer FinFET manufacturing process at VNC. I have a PhD in applied physics with a substantial research focus in materials science and two-dimensional structures. I've been at several semiconductor companies over the years and have 32 years of industry experience.

To be clear with you, we do modulate the thicknesses of our gate oxides. So what? I don't agree with your questioning. Even if we wanted to, applying a constant thickness everywhere for the gate oxide is inefficient, assuming we don't have the right process. Not telling you what processes we do or do not have, by the way. I wouldn't call the choice to repeat the process to get another oxide layer a "design choice." That implies that alternative choices bring significant advantages and disadvantages. It's more of an efficiency choice where only one option wins. What else are you meant to do besides layer on more oxide? The only way to have different oxides is to pick a fin, then add or subtract. If you want to subtract, why didn't you just put on less oxide earlier? Then this leaves adding more oxide.

The other benefit of this is that when you add more oxide, you can add other things to the rest of the chip on the same layer. So, you can keep improving the chip. If we wanted to use different materials, then it'd be more costly, since we might only be using this material on a few certain FinFET gates. So, you can see why this option was obvious and clear to us.

I'm the author of a few patents and I'm honestly surprised the Patent Office allowed this to slide under the radar. I'm happy for those engineers at Kiwi that they thought of the same thing we did. They honestly have good people over there and that's why they're a competitor, despite being so much smaller. However, I am unhappy that this is being claimed as a new invention when it is just a machine's optimization. No doubt it is helpful, which is presumably why those at Kiwi want it only for themselves.

Avery Shannon

Subscribed and sworn to me on this, the 29th day of June, 2021

Adrián Muñoz Krans

Adrián Muñoz Krans, Notary Public

AFFIDAVIT OF RILEY LEMPEL

Witness for the Defense

I'm Riley Lempel. I've been an electrical engineering and applied physics professor at the Massachusetts Institute of Technology (MIT) for 18 years. I research nanophysics and optics. One of the areas in which I am a subject matter expert is the semiconductor fabrication process, including the process by which FinFETs are manufactured. All integrated circuits today rely on photolithography, which is an optical process (relies on light) at its core.

I was asked by Valley Nanoelectronics Corporation to consult on this case. I want to declare no conflict of interest, since while I have been studying semiconductors since I was in undergrad, I have never worked for VNC or for Kiwi Semiconductor. My full disclosure requires me to state that I worked for VermontPower, a private venture that researched semiconductors, which is now defunct. However, many former employees at VermontPower are now working at VNC, which is how I am known.

Being a professor involves both research commitments and teaching commitments. Because of this, I have reviewed many different claimed inventions, discoveries, and patents before. I filed eight patent applications during my time at VermontPower; they are now expired. I'm old.

I heard about the '250 patent before this suit but I only studied it extensively after being consulted for the case. To my disappointment, no one has asked me about the beautiful and complex chemical and optical process that allows us to even create gate oxides, but rather people are more worried about who copied who. Well, I am glad I'm in academia now rather than at some company, promoting hyper-capitalism. Look at the community today, not caring about the physics which guides us to our computers… actually, now that you mention it, I have a cool derivation of Snell's Law—oh, yes, the case, the case…

I personally believe the '250 patent to be little more than a clever improvement in how the machines are programmed. There's no doubt that the advent of repeating the fabrication process for gate oxides is more efficient for changing the gate capacitance than using a whole new material. However, if you were to ask me, repeating the process to apply another gate oxide, while a good improvement which saves time and money, is an obvious manufacturing choice. Ask yourself: how do I change the gate oxide capacitance? Well, there's two ways, given the equation for oxide capacitance: either change the dielectric constant, which necessitates changing the material, or change the oxide thickness. Once you concede you cannot do the former, you observe the latter to be the appropriate option, by elimination. The final step is deciding to repeat the fabrication process to add more thickness. Now it is my turn to ask you, even only equipped with the knowledge that there is a machine that places a material with some thickness, how else do you achieve distinct thicknesses between fins? Maybe etching, but this is too costly and inefficient for that since it'd be a waste to waste a whole layer on etching. If you make etching work, that might deserve its own patent.

One last thing which I hope is insightful. From what I have seen in the semiconductor industry, these companies are all sharing tech in a grey area. It's just the nature of the industry–if every single actual semiconductor patent violation was enforced, there'd be no one left to make our chips. To be clear, I am stating the opinions and common beliefs

that I observed during my experience in the industry. It is believed to essentially mutually assured destruction, you see. Some people have made it clear to me that KiwiSemi has opened the floodgates with this suit, as it breaks the industry's longstanding precedent of turning the other way.

Riley Lempel

Subscribed and sworn to me on this, the 29th day of June, 2021

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