

Dear Titanium Lovers

Thank you for your interest on Titanium and Horie Corporation.

Horie Corporation is a unique company who is specialized on Titanium Processing and Surface Engineering Technology.

We are deeply attracted by Charms of Titanium, and aiming developing new Titanium Application Technology.

In order to help your understanding on Horie corporation, we would like to introduce Mr. Azusa Yamane' s article.

Mr. Yamane is proposing his Concept of New Industry named " Age of Metal collar" which means The age of Excellent Craftsman in Technology.

This article is summary translated from No.563 of Mr. Yamane's Series (Weekly Magazine " Shukan Post" Dec.13,2002) <Summary translated by Hiro Kotaki>

Please read this article and we hope you kindly understand Titanium and Horie

Also, we expect to cooperate on New Technology Development with you.

Yours Sincerely
Takuji Horie

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THE AGE OF EXCELLENT CRAFTSMAN

— Introduction of HORIE corporation —

From the series No.563 of "The Age of Excellent Craftsman in Technology" written by Mr.Kazuma Yamane

IN TECHNOLOGY

Small fabricating works HORIE is challenging to the new possibility of "New Material in 21 st century"

Titanium fabrication is changing future life better, such as: "Non-Burning Frying Pan", "Bad Smell Eliminating Lamp Shade" etc.



Kazuma Yamane

Mr. Yamane has been in producing the Japanese Creative technology developer=Craftsman who is leading the industry. For this purpose, Mr. Yamane has been continuing the series of report in a Japanese magazine named Shukan Posuto (=Weekly Post), As a series of The Age of Metal Collar = Introduction of Excellent Craftsman in Technology. Mr. Horie was introduced in Number 563 of the series. (For additional information, Mr. Koichi Tanaka awardee of 2002 year Novel Chemistry Prize was introduced in this series at No. 564 of this series.)

<Translated by Kotaki>

21 century is called the era of new materials. There are many new materials such as "carbon nano-tube which is expected as a core of complete new industry, but also some kinds of metals are watched as a supporter of new industry in future. Titanium is one of such important metals.

Titanium has stronger mechanical strength=double comparing to steel, six times of aluminum, and is small change against heat change, stronger anti-corrosion property, and light weight. So, titanium has been used in severe condition and places such as aircraft, aerospace, marine and nuclear energy.

But Titanium is considered as a special material for industrial metal because the refining and fabrication of titanium are difficult.

There is one leading company which is tackling titanium fabrication in the midst of rice field, at a corner of "a town of metal fabrication"=Tsubame City in Niigata Prefecture.



HORIE corporation

Takuji Horie

Born in Niigata, Japan at 1945.

Graduated Sanjo Industrial & Business High School Machinery Division (Night Session).

After graduating middle school, Mr. Horie had worked at many metalworking companies such as, Forging, Casting,

Pressing, Deep-Drawing, Wire-Drawing, and Heat-Treatment. And accumulated his technology experiences. Mr. Horie has met with galvanizing technology at his age of 20 years old. He had gone around as a works manager of many companies in Niigata prefecture and outside the prefectures from the latter half of his twenties. He established his own corporation of galvanizing precious metal in Tsubame City where he is now, at the latter half of his thirties. In the 1990s, Mr. Horie has challenged to the fabrication and surface treatment of titanium metal, and finally succeeded to develop the coloring technology and welding technology of titanium. He is still developing the new usage of titanium now.

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Titanium is at first surface treated, and then dipped into special liquid, which is called "Magic Liquid" in this industry.

When electric current is charged, color comes out on titanium surface in a short time.

This technology is a result of Horie's technical development. Horie Corporation is a small company with only numbers of teen's member, but Horie has been keen to develop its technology using high price and high-grade analysis equipment.



This photo is an experiment showing how heat-conductivity of titanium is low.

In case of titanium frying pan we can grasp the edge of pan with bare hand, even when water is boiling in the pan.

Coloring can make 4960 different colors by changing the transparent rust film thickness.

Yamane: The reason of my visiting here is I have heard that the best person to ask on titanium is Mr. Horie.

Horie: You will understand our technology by looking this titanium color sample. Only our technology can produce such kinds of many colors.

(Mr. Horie showed a color sample sheet of titanium foils cut into small piece.)

Yamane: Oh, its title is "Horie Titanium Basic colors (124 colors)".

It looks like in a set of pastel colors: many kinds of color: from whitish silver to purple, blue, red, yellow, green etc.,,. Have you painted this beautiful color ?

Horie: This color is not painted but original color of metal itself. Even a child can make this color by applying "Anodizing Coloring Technique"

Yamane: Oh, why so easy?

Horie: Because it is titanium.

Yamane: Your answer is not the answer! (Laughing)

Horie: Color appears when you put the titanium sheet into an Electrolysis Bath, and making the titanium- oxide film on the surface.

Yamane: How to change the color?

Horie: Color changes by the thickness of oxide film on titanium surface.

Usually the oxide film on the metal is called "Rust".

For example, the rust of copper is called verdigris or patina. It is green.

The rust of steel is called red rust or black rust. The rust of aluminum is white.

And the rust of titanium is transparent.

Yamane: That means: according to the thickness of transparent titanium oxide, reflected and strengthened light wavelength is different, so, color comes out. In another word, it looks like a thin prism on the surface of titanium?

Horie: That's right.

By controlling the time of electricity current in the Electrolysis Bath, we can change the thickness of oxide film and get the color as we want.

Yamane: Can we get even more than ten thousands colors by changing thickness of transparent film?

Horie: Yes. There are 124 colors in our sample sheet, but we can divide one color into four.

Yamane: That means $124 \times 40 = 4960$ colors.

Horie: Strictly speaking, yes. But human eye cannot see the difference of them.

Yamane: It's surprising. How about the thickness of the film?

Horie: The order of several hundreds thousandth.

Yamane: Is it the fabrication technology of Nano level?

Horie: Yes. We control 200 nano-meters level, and make intended color.

So, my job is "metal color"!

- Yamane: Oh, coincidentally, my series is named "Metal Collar"!
 By the way, these colors are all so bright. Are there any different tone colors ?
- Horie: Yes, when we use more rough surface titanium, we can get darker color.
 At first stage, when I found the titanium color, I have made so gaily colored signboards, but now I am using more restrained hue.
 Titanium is also light, so we are trying to use it as a changeable outside panel of portable phone (celphone).
- Yamane: It's wonderful! Are there any other applications ?
- Horie: There are so many possibilities of using for many products, because this metal can make many colors without using paints. For example, look at this one.
- Yamane: It looks like a toy windmill or pinwheel The title is " Torikonite- titan."
 What is this?
- Horie: When we set this at the kitchen garden, bird will not come. We can avoid the undesirable birds from field or fruit tree. "Birds shoo away".
- Yamane: Why?
- Horie: We must ask birds on the true reason. But I suppose that birds feel this color as something other animals, because the color is not painted.
- Yamane: Is it the product for sale?
- Horie: Yes, truly it is, unit price is \2,700. By the way, please enjoy a cup of coffee.
- Yamane: Oh this mug cup is very light. Is it also made of titanium?
- Horie: Yes, everything in my house is titanium. (Laughing!)
 Titanium is not allergy even touching to the skin. So, it is best for pierced earrings. We are manufacturing body pierced ring as well.
- Yamane: Do you have pierced ring on your navel?
- Horie: To my regret, no! But our pierced rings are safe for the body.
 Titanium has another characteristic, that is: when we grasp titanium we do not feel the coldness of metal.

Titanium wire burns even in the water. Titanium fire will be applied for distress signal in the accident.

- Yamane: Is heat transfer of titanium different from other metal?
- Horie: Yes. Comparing to heat transfer of iron is 0.18, that of titanium is 0.041. That means heat is less transferable in titanium. The example of the products using this characteristic is this frying pan.
- Yamane: What is the feature point of the pan?
- Horie: One feature is taste of cooked food. Food taste is very good.
 Second is ---please touch to the edge of frying pan. (In the frying pan, water is boiling.)
- Yamane: I'm afraid of getting burned.
- Horie: Don't worry, its all right. Look! (Mr. Horie grasps the edge of pan by bare hand.)
- Yamane: I'll try. Oh, it isn't hot. (See the photo)
- Horie: Water is boiling at the center of pan, but the edge has a low temperature. We can touch it.
 Because heat transfer coefficient of titanium is very low, heat of center position is not dispersed to edge. Heating to meat is effective and quick.
 That means the deliciousness of meat will not free away. We can cook the best steak. Energy usage is also low.



The color of titanium is made by oxide film of titanium surface. The thickness of oxide film is controlled within nano-meter unit. Horie has developed special surface treatment technology which makes self-colored titanium. The number of color from this technology is very big. So, new usage of titanium is expanding widely.

The left side of photo is trial model for detachable cover of celphone.

The right side of photo shows pierced earrings, as titanium is non-allergy material. Also, titanium is light, keeps heat long, it is used for beer-cup, mug cup, and many kinds of cooking equipment.

Lamp-shade and ornament on the table have deodorization effect, by application of photocatalytic of titanium.

In the medical area, bolt for fixing broken bone and replacing "meninges" or skull of head has been used. Horie Corporation is requested to color on this titanium.

Yamane: What is the name of the titanium pan?
Horie: "Energy Saving Titanium Steak Pan". List price is ¥10,000.
Yamane: I agree the good taste of steaks. But how can I say on the naming and price.
Horie: Titanium lampshade is also good.
Yamane: Is it because beautiful?
Horie: Because of "photocatalytic"
Yamane: Oh, I have heard that titanium oxide has photocatalytic feature. I have heard about it from Dr. Toshiya Watanabe before.
Dr. Watanabe was a researcher of a company named TOTO at that time, but he has got the position of the professor of Tokyo university by this great discovery.
Horie: This photocatalytic feature erases bad smell. But because ultra-violet light is necessary, we need fluorescent lighting. Even a cat sleeping in my study, the room does not smell.
Yamane: There's a pretty stray cat!
Horie: It looks like an American short hair.
Yamane: Oh, sorry. It's a precious cat.
Horie: Actually, it has come in to my room from outside. (laughing). So I feed him.
Yamane: By the way, I have thought titanium is a new material, which helps Japanese industry. But I only see frying pan, Bird shoo away pin wheel, pierced earrings.....
Horie: You want to say my products are not relating to industry?
Yamane: Oh, No, I believe it's an important industrial new material in 21 St century!
Horie: Then I show you an example for industrial usage. This titanium is a trial manufacture for the order from a big manufacturer.
I received the order of 100 thousand pieces, but I cannot disclose the usage. Please refrain photograph. The Order Company requests us secrecy.
Yamane: We cannot expect from where new industrial product appears.
It's a big secret. I understand. (laughing)
Horie: This figure looks like a silk hat. It was made by 8 process of press from one flat sheet. Pressing technology is a secret know-how of our company.
We can make color on titanium without painting, so titanium can keep beautiful color in severe condition such as heating. It's a great feature of titanium.
Yamane: You want to say, there are unlimited possibilities on the surface treatment of metals.
Horie: Basic technology is same as electric gilding. By application of this technology, we can insert special material between titanium metal surface and oxide film.
Yamane: Such a wonderful technology!
Horie: Titanium oxide is not water repellent.
Yamane: It because the water molecule in the atmosphere spreads out on the surface of titanium oxide. The thickness of the molecule layer is almost same as several pieces of molecules.
Horie: By using this principle, we can make a special sheet, which has very small air resistance.
Yamane: That will be useful for the body of aircraft and Shinkansen.

- Horie: Laboratory experiment was succeeded. But it is not disclosed because it is protected by severe patent license.
I think this principle is good for the hull of ship than for aircraft body, because the water resistance will become very small.
- Yamane: The ship speed becomes very high and save energy.
- Horie: When we see the fish swimming, we don't see so many bubbles around fish.
The reason is, I think, the skin of surface has strong affinity with water, so, whirl not occur, and resistance to water is so small.
You don't see any bonito swimming with hard breathing, don't you?
- Yamane: May be, no! (laughing)
- Horie: Swimming athletes are breathing hard, even when they raise hand for victory.
I suppose titanium will probably be used for automobile, which have no wind sound. Possible very easily.
- Yamane: Titanium is so mysterious metal.
- Horie: Gold and platinum will not rust. That means no chemical reaction. Titanium is the same. When light hits titanium surface, some energy will be accumulated to only the surface area. When "something" comes to the surface, "something" will be dissolved. That is, I suppose, "photocatalytic"
- Yamane: Titanium is a frustrated metal.
- Horie: Titanium oxide dissolves organic material, and eliminate bad smell under the light. This effect is the same principle, I suppose.
I don't know about the academic theory, but titanium has taught me many things in the long time during I have worked with titanium.
I have only practiced as titanium taught me, then I have reached to the new world where anyone else has not reached.
- Yamane: Someone says when there is no academic theory, he will not make practicable.
But I do not agree with him.
Mr. Koichi Tanaka who was awarded by Nobel Prize said that true core part of his famous achievement is not theoretically explained at all.
- Horie: Yes. Academic theory is not always necessary for practicable work.
I have learnt from titanium for long years and final answer is that "titanium is nature" -----Fine, rain, fine, rain, repeating it.
Until now, technical development has been proceeded against the providence of nature. But from now on, we must develop the technology and practice method using the method which is obedient to the providence of nature.
- Yamane: Can we make titanium very, very thin into cloth?
- Horie: Oh, no. It's very dangerous. Titanium burns very strongly when it becomes very thin. Let's try. (Mr. Horie lit to the fine wire of titanium)
- Yamane: Wao! It burns with bright glaring light.
- Horie: We can use this titanium fire for distress signal. Titanium will fire even in the water.

Mr. Horie says " Titanium is a very pity material which comes out to public so late". Because titanium has been used mainly for military, titanium has been kept secret. At 1990, with the ending of the cold war, titanium development for non-military usage has started. The age of titanium will come soon. And good for us, the amount of natural resources of titanium is unlimited.