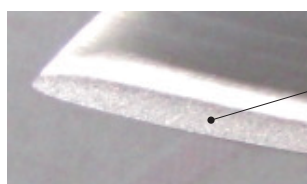


# Slicing Tomatoes Extremely Thinly by Using an Aircraft Engine Technology

**Introducing SAKON +, the stainless steel kitchen knife that cuts extremely well and features long-lasting self-reproducing cutting quality**

By applying a coating technology used for aircraft engine turbine blades, we have developed a kitchen knife that keeps its cutting quality. This technology uses electric discharge energy to fuse super-hard particles with the stainless steel metal structure so that extremely fine saw teeth (on the order of micrometers) are reproduced on the blade edge when the knife is used.



MSCoating



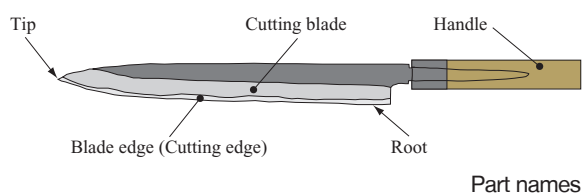
SAKON +

## SAKON +

In January 2010, the “Maison & Objet 2010” exhibition was held in Paris. At one of the booths, the SAKON + kitchen knife (manufactured by HOKIYAMA CUTLERY Co., Ltd. in Kochi Prefecture, Japan) was exhibited before its launch in the Japanese market. The knife’s excellent cutting quality attracted the attention of attendees.

In February, the kitchen knife was exhibited at the

International Gift Show 2010 held at Tokyo Big Sight. Its cutting quality and unique form with its stylish artificial marble handle were highly rated as they were in Paris. SAKON + has not only won accolades at exhibitions but is appreciated by chefs at Japanese restaurants in the United States and cooking school instructors in Los Angeles, and the knife is steadily increasing in popularity. With a sharp knife, one can easily thinly slice soft tomatoes as well as slice onions without tears. Knives cannot be made sharp



merely by making their blades sharp and hard. The blade edge must be thoroughly serrated from the tip to the base.

It is not well known that the shape of the blade edge is instrumental in determining the cutting quality of a knife. Even if the cutting blade is made of a hard material and/or sharpened to have a sharp angle, a knife with a straight blade edge does not cut well. A serrated blade edge is a decisive factor in determining cutting quality.

Did you ever cut your hand with a blade of grass when you were a child? Blades of grass are not hard nor do they have sharp cross-sections, yet they can cut one's hand easily. Close observation of the shape of a blade of grass reveals the reason. The magnified photograph demonstrates that the edge of the blade of grass is serrated. When one slides the blade of grass across one's hand, the blade of grass cuts the hand. Blades of grass are small, soft saws.

A knife cuts well if the blade has a sharp angle and a serrated edge. Most commercially available kitchen knives



Magnified photograph of cogon grass

	Ordinary kitchen knife		Kitchen knife with special coating	
	Cross-section of the cutting edge	Lateral side of the blade edge	Cross-section of the cutting edge	Lateral side of the blade edge
New				
After 240 cycles of the CATRA cutting quality test				

Shape of the blade edge (cutting edge)

initially cut well but become increasingly blunt with use. This is because abrasion blunts the cutting edge and at the same time the serrations on the blade edge are reduced.

To maintain cutting quality, kitchen knives for professional use are generally sharpened daily while those for home use are sharpened only at intervals of several months. Such sharpening not only restores the sharp angle but also reproduces the serrations on the blade edge. Therefore, knives must be grinded in the direction perpendicular to the blade edge. To maintain cutting quality as long as possible, kitchen knives are generally made of hard materials and/or have a coating of titanium carbide or other such hard material that slows abrasion. However, it is impossible to fully prevent abrasion regardless of the hardness of the material.

IHI focused on how to keep the serrations on the blade edge rather than on preventing abrasion.

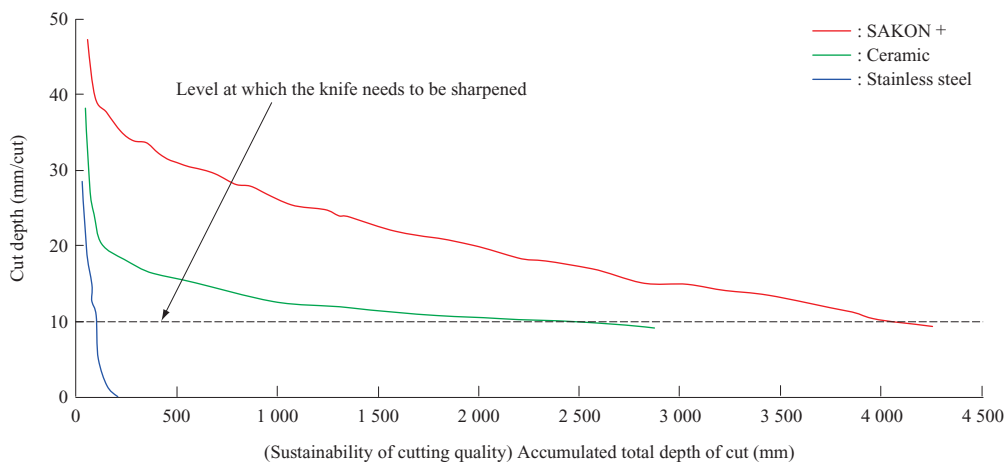
**vee-tech®**

IHI discovered that by applying a coating technology to kitchen knives, the serrations on the blade edge can be maintained, unlike the case for conventional coatings intended for hardening the surface. When such a coating is applied on one side of the cutting edge, the kitchen knife will cut well and keep its cutting quality.

This technology is achieved by repeatedly sparking the blade surface (this looks as if the blade is repeatedly being struck by tiny bolts of lightning) to mix the fine particles of the hard coating material with those of the knife's base material (stainless steel). This has three advantages.

First, the high discharge energy is used to shoot the super-hard particles of the coating material into a pool of molten stainless steel, fusing together the super-hard particles with the stainless steel and preventing the coating from peeling off. Second, this coating leaves many marks from the sparks applied to the blade surface, and these markings are tiny rough spots with a diameter of 50 μm or less and a depth of about 10 μm. These make the serrations on the blade edge. Third and most importantly, this coating creates a layer in which fine particles of materials of different hardness are mixed such that the softer materials wear away first, leaving the harder material. As a result, the serrations on the blade edge are reproduced repeatedly. HOKIYAMA CUTLERY has named this coating technology "vee-tech" after Vivid Edge Technology.

IHI began by preparing a sample by coating one side of a stainless steel plate and sharpening the other (uncoated) side before conducting a paper cutting test. Our results indicated that the shape of serrations on the blade edge and cutting quality vary depending on the spark applied. Through this trial and error process, we found the conditions for sharpening the knife as we intended and also maintaining such cutting quality. To allow the kitchen knife to be appreciated as an authentic kitchen knife, we had a public institution in the U. K. collect the required data.



Cutting quality test conducted by the ISO-accredited laboratory, CATRA, U. K.

## CATRA

A British public institution, the Cutlery and Allied Trades Research Association (CATRA), is the global authority on evaluating the cutting quality of knives. CATRA quantitatively evaluates the cutting quality of knives by testing the number of pieces of paper a knife can cut at one time as well as the sustainability of such cutting quality by measuring the accumulated number of pieces of paper that can be cut continuously.

The test uses special paper containing quartz. Ordinary kitchen knives suddenly become blunt after cutting such paper. This is because abrasion blunts the cutting edge and at the same time the blade edge loses its serrations and becomes straight.

Ceramic kitchen knives have the highest level of initial cutting quality but suddenly lose it after such cutting, leaving them with only a moderate level of cutting quality. This is because the serrations on the blade edge wear out, degrading the initial cutting quality, but the hardness of the ceramic impedes the cutting edge from becoming completely blunt and thereby prevents the blade edge from losing all its serrations.

When the angle is the same, SAKON + is far superior to stainless steel knives and comparable or superior to ceramic knives in initial cutting quality. In addition, SAKON + becomes blunt only very slowly. It can be used a large number of times before it becomes so blunt that sharpening is required. In terms of kitchen knife use in ordinary households, such knives require sharpening on average every 12 to 18 months.

The reason for the long-lasting cutting quality of SAKON + is that the serrations on the blade edge are repeatedly reproduced. This can be seen unambiguously from the magnified photographs taken before and after the test. Observation of the blade edge indicates that while ordinary kitchen knives lose their serrations, vee-tech

coated kitchen knives keep theirs.

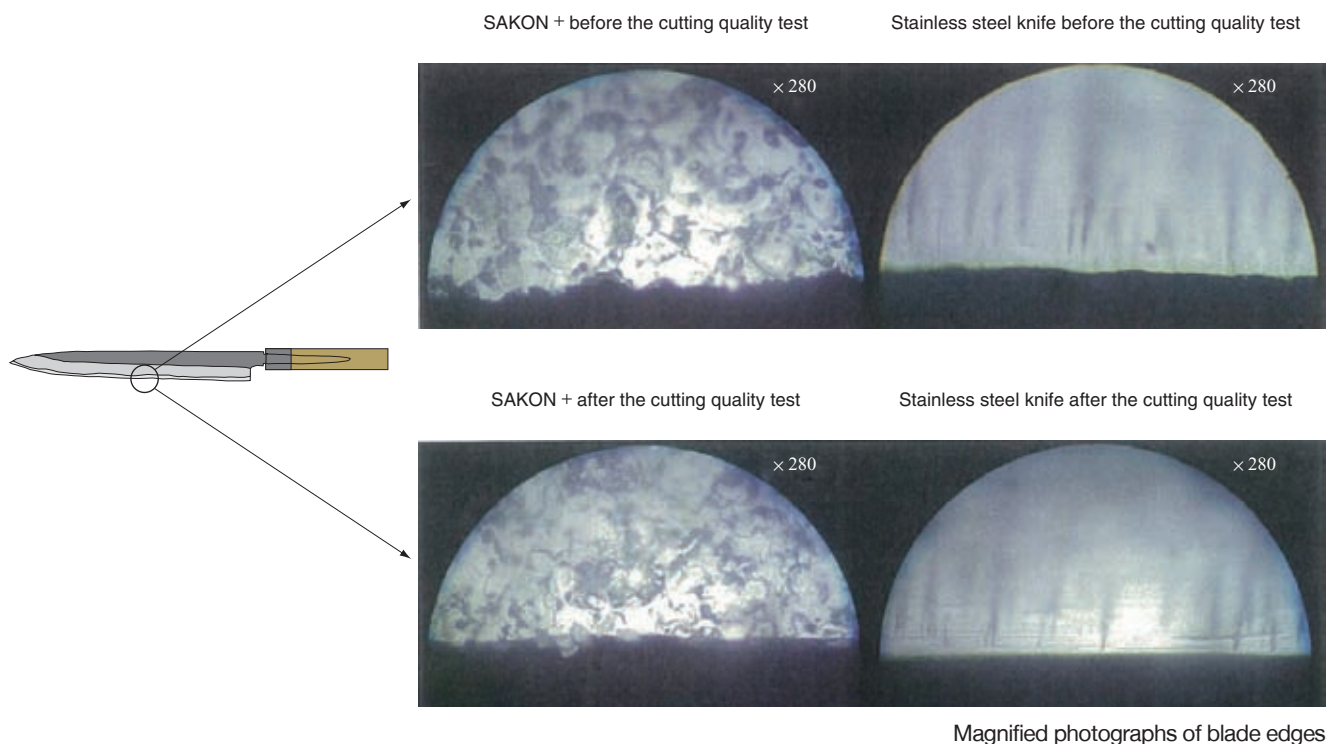
## MSCoating®

This coating technology was originally developed by IHI together with the Mitsubishi Electric Corporation to generate high-quality films for turbine blades and other parts of aircraft engines in order to improve their durability and abrasion resistance. The technology uses discharge energy for ceramic coatings in oil and for metal weld overlays and is called micro-spark coating (MSCoating).

IHI introduced this technology at various exhibitions to facilitate its broad application across a variety of industries. In 2003, MSCoating caught the attention of the Industrial Promotion Center of Kochi Prefecture which needed to establish a premium brand of kitchen knives to expand the knife manufacturing market of the local industry in Kochi Prefecture. To this end, they were searching for ways to develop kitchen knives that would be as durable as ceramic kitchen knives and cut well without chipping. They hoped that MSCoating could meet this need.

IHI began by applying MSCoating to stainless steel plates. The path leading to SAKON + was not always smooth. The largest problem was that the cutlery industry did not trust coatings, as various kinds of coated kitchen knives had been sold but all suffered from poor durability. The cutting quality of the kitchen knife presented by IHI which was not known as a cutlery professional, was not appreciated by the industry. Worse, it cost significant time and money to have CATRA collect data.

When the ceramic kitchen knives manufactured by HOKIYAMA CUTLERY were tested by CATRA, the stainless steel kitchen knives with MSCoating manufactured by IHI were incidentally given an opportunity to be tested. Six months later, we received very good results. Though the kitchen knife with MSCoating on one side was made of inexpensive stainless steel, the test reports indicated that the MSCoating kitchen knife



cut better than the kitchen knives of a famous brand and also had durability comparable to ceramic kitchen knives. HOKIYAMA CUTLERY was surprised at the unexpected results for our knives. They could not help but notice the benefits of MSCoating, and this was the start of a joint development between IHI and HOKIYAMA CUTLERY. Afterward, we improved the material, tip angle, and coating method before finally commercializing the kitchen knife.

To better fit the kitchen knife market, MSCoating was renamed to vee-tech and SAKON + was born. There are three types of SAKON +: versatile kitchen knives, fruit knives, and long, slender kitchen knives for slicing.

### The Future

Since the development of this kitchen knife, we have been promoting the application of this technology to various kinds of products, including scissors for hair cutting, Japanese flower arrangement scissors, surgeon's knives, lawnmower blades, and other daily necessities, as well as combine harvesters, cutting machine blades, and other industrial products. MSCoating was renamed to vee-tech for SAKON +. In the same manner, this technology will be called different names as new applications are found for it. We wonder how many different names MSCoating will have throughout the world.

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