INTRODUCTION OF CERAMIC COATING

NEOFLAM®

Bringing kitchens to life

CONTENTS

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1 Cookware Products in the Market

NONCOATED COOKWARE

PORCELAIN	GLASS
STAINLESS STEEL	NIKEL SILVER

1 Cookware Products in the Market

COATED COOKWARE

- PTFE COATING
- CERAMIC COATING
- ENAMEL COATING

2 Property Comparison of Coated Cookware Products

PROPERTIES

	Ceramic Coating	PTFE coating	Enamel Coating
Non-stick	Good	Very Good	None
Pencil Hardness	9H ↑	4H ↓	9H ↑
Abrasion Resistance	Very Strong	Weak	Very Strong
Coating Heat Resistance	> 450℃	< 250℃	> 450℃
Non-Stick Heat Resistance	350℃	250℃	None
Chemical Resistance	Strong	Normal	Very Strong
Scratch Resistance	Strong	Poor	Very Strong
Heat Capacity	High	Low	High
F-IR Emission (Black Body, 100%)	88% ~ 90%	None	88% ~ 90%

2 Comparison of Coated Cookware Products

SAFETY

	Ceramic Coating	PTFE coating	Enamel Coating
Flammability	NO	YES	NO
Combustibility	NO	YES	NO
PAH *(polycyclic aromatic hydrocarbon)*	PASS	PASS	PASS
FDA, LFGB	PASS	PASS	PASS
RoHS	PASS	PASS	PASS
PFOS	NO	YES	NO
PTFE	NO	YES	NO

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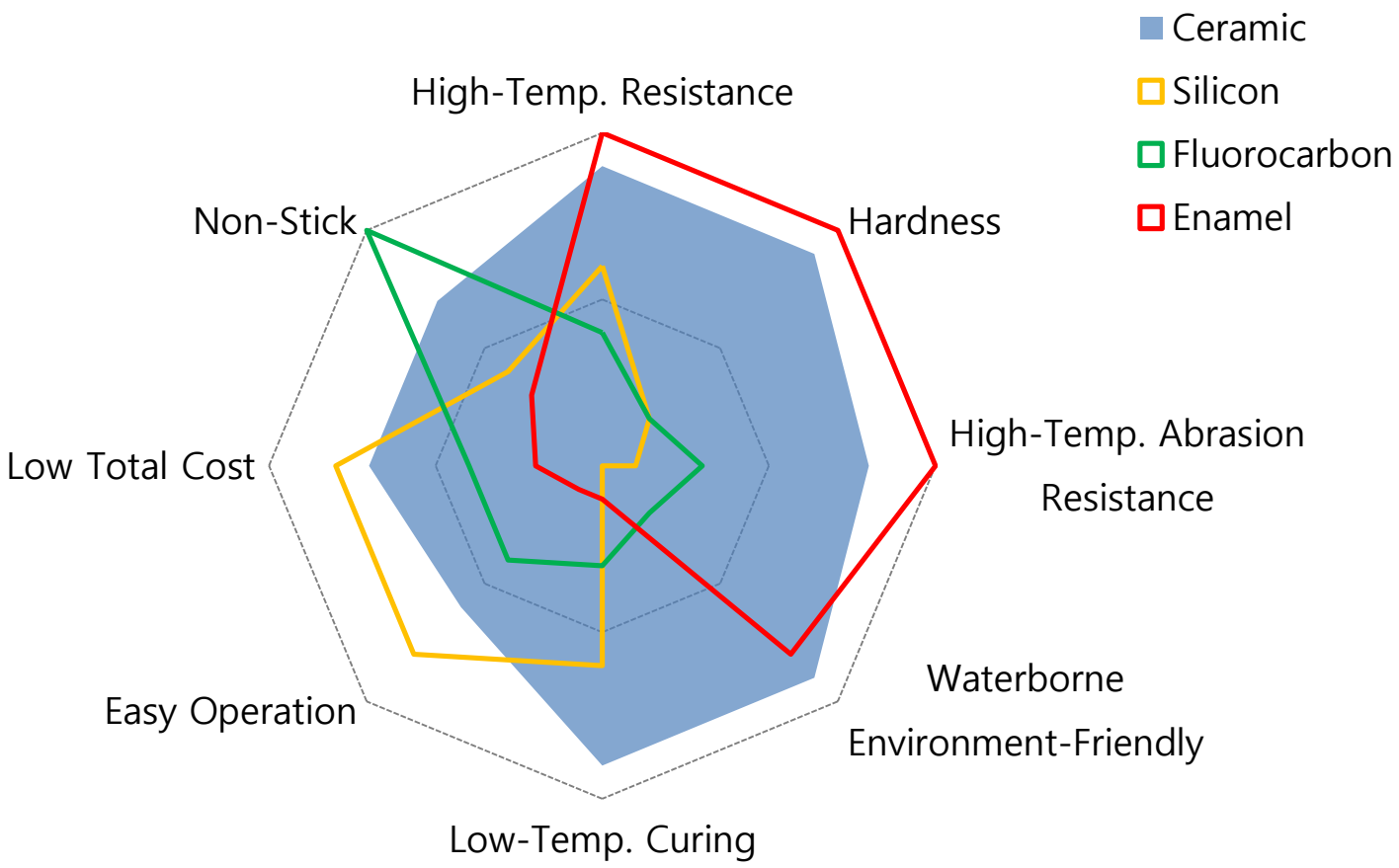
2 Comparison of Coated Cookware Products

PRODUCTION, ENVIRONMENT

	Ceramic Coating	PTFE coating	Enamel Coating
CO_2 emission	Low	High	Very High
Curing Temp	180 ~ 230℃	250 ~ 450℃	800℃ ↑
Multi-layers	1 ~ 2 layer (wet-on-wet)	2 ~ 3 layers, cured twice	2 ~ 3 layers
Spray method	Air pressure	Air pressure	-
Pre-heating	Yes	No	No
Cleaning agent	Water or Alcohol	Solvent	Water
Environment	Clean & no unpleasant smell	Contaminated & hazardous	Clean & no unpleasant smell

2 Comparison of Coated Cookware Products



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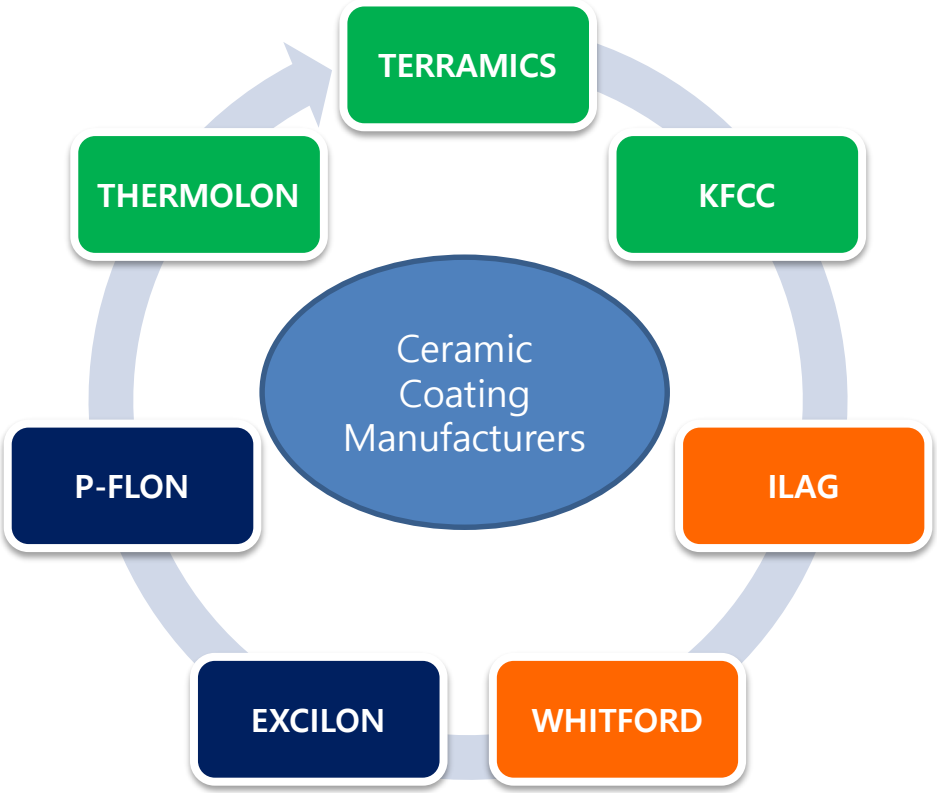
3 Ceramic Coating Manufacturers

CERAMIC COATING MANUFACTURERS



Terramics reliability and innovation
THERMOLON
KFCC Ceramica
ILAG NON STICK SWISS TECHNOLOGY
Whitford
PFLUON NON-STICK COATING
ECL excilon reliable ceramic coatings

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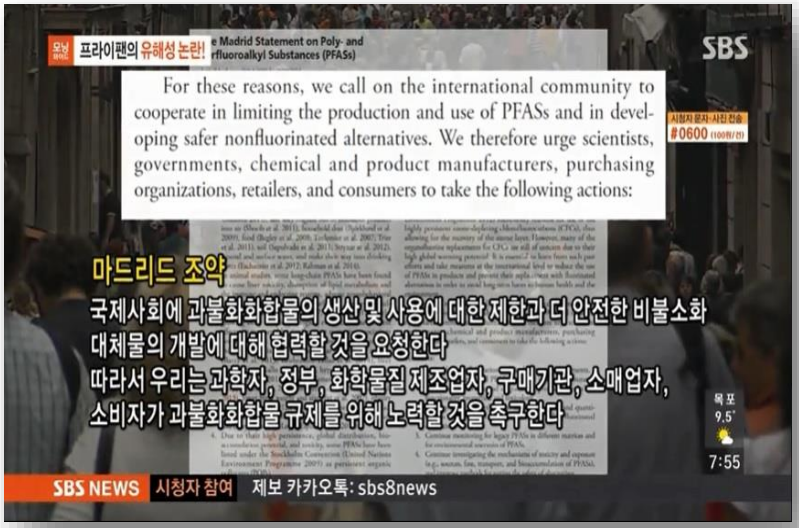
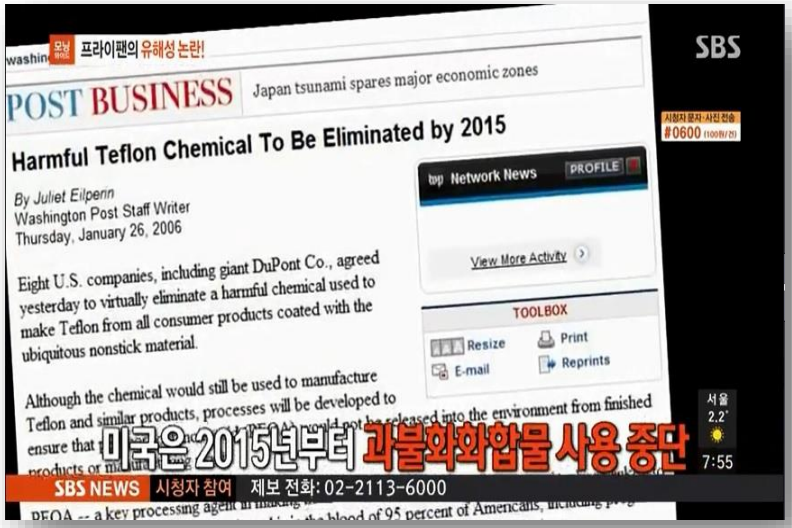
4 Maleficence Issue of PTFE and PFOA

◐ *Treaty of Madrid*

Scientists in the world make a public statement in Madrid about the Maleficennce of PTFE and PFOA and urge government, manufacturers and consumers to forbid using perfluorinated compounds.

" For these, we call on the international community to cooperate in limiting the production and use of PFASs and in developing safer nonfluorinated alternatives. We therefore urge scientists, governments, chemical and product manufacturers, purchasing organizations, retailers, and consumers to take the following action "





4 Maleficence Issue of PTFE and PFOA

EPA US Environmental Protection Agency

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You are here: EPA Home » News Releases » EPAs Actions to Restrict PFOA and Similar Chemicals Yield Significant Human Health and Environmental Benefits

News Releases from Headquarters › Chemical Safety and Pollution Prevention (OCSPP)

EPAs Actions to Restrict PFOA and Similar Chemicals Yield Significant Human Health and Environmental Benefits

01/15/2015

WASHINGTON – To further agency and industry achievements, the U.S. Environmental Protection Agency (EPA) today proposed measures to ensure that perfluorinated chemicals that have been phased out do not re-enter the marketplace without review.

- USA EPA announced in public what Te flon can cause cancer (Jun. 2005)
- Dupont company get agreement with 16million dollar penalty (Highest pen alty in EPA history)
- **EPA request Dupont to decrease PF OA amount to 95% within 2010 and e ject totally by 2015.**

Ref : https://www.epa.gov/newsreleases/epas-actions-restrict-pfoa-and-similar-chemicals-yield-significant-human-health-and

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5 Advantages of Ceramic Coating

ENVIRONMENT

. Environmental Friendly Coating from Natural Mineral

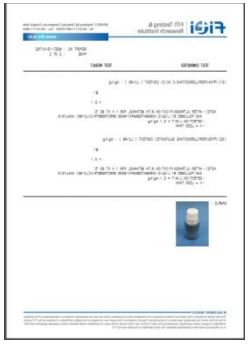
Natural
Raw Materials

Fewer VOC
Release

Safe in Disuse

Health in Use

From the nature to the nature



No PFOA & PFOS

No Heavy Metal

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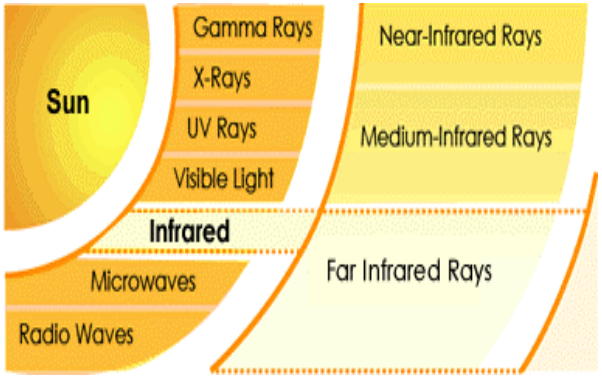
5 Advantages of Ceramic Coating

-FAR INFRARED RADIATION



· F-IR was found by William Herschel in 18th century
· F-IR is classified as near, mid and far infrared radiation
· The wave length of F-IR is very broad (0.75 ~ 1000 ㎛), and it is called as a heat radiation.
· I-IR is sorted as a electro-magnetic radiation
· 8~15㎛ wave length F-IR is very good for human body.

· Human body release 9.6㎛ wave length F-IR and it make resonance absorption when absorb 8~15㎛ radiation.

· 8 -15㎛ F-IR radiation make resonance with human body cell tissue and absorbed by soft body cell. This kind of absorption means increment of energy of molecules.

The molecul vibration in the body cell tissue activate body cell and generate ene rgy in the body.

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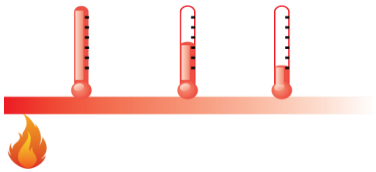
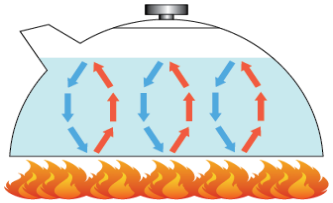
5 Advantages of Ceramic Coating

- F-IR EFFECT ON COOKWARE

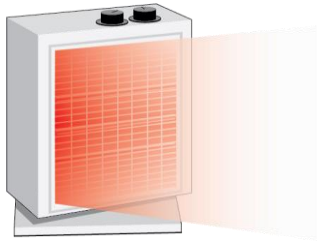
. Heat Transfer mechanism of Ceramic Coating Cookware



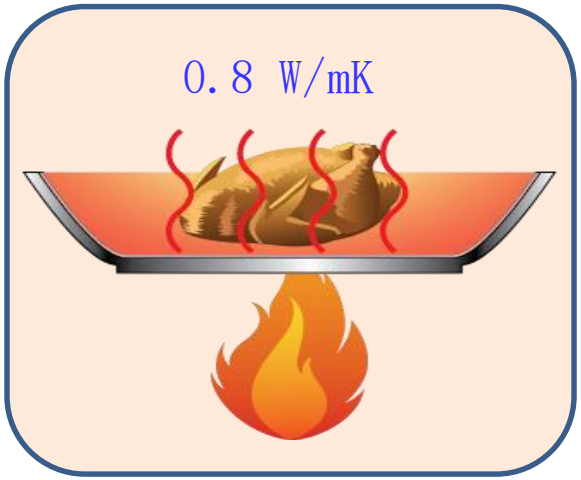
Conduction



Convection



Radiation



Ceramic Coating

PTFE Coating

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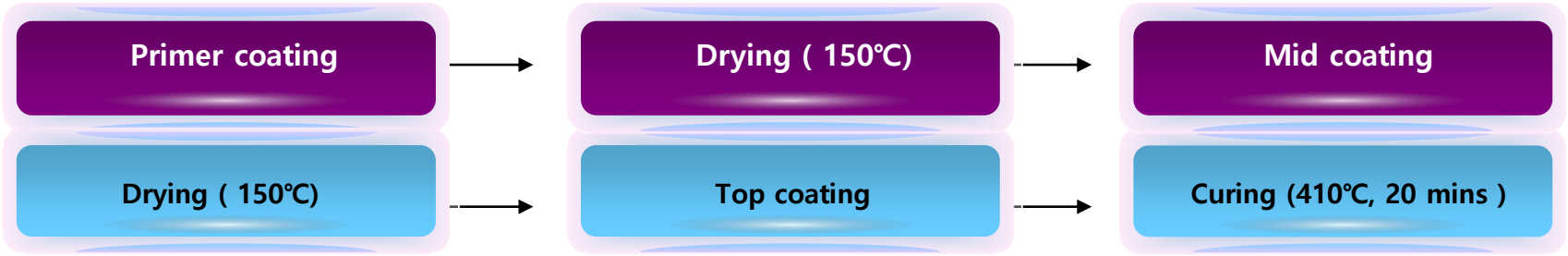
5 Advantages of Ceramic Coating

Process – low CO_2 Emission

Simple Manufacturing Process

[PTFE coating process,_Two/Three layer]



[Ceramic coating process, One/Two layer]

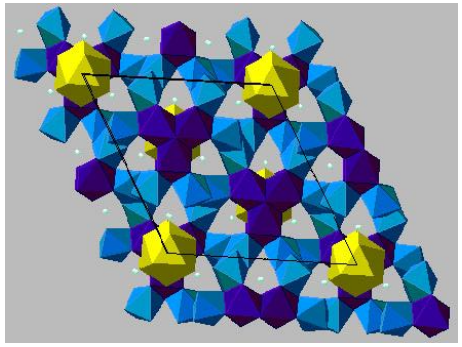
1. Simple process compare with PTFE coating
2. Ceramics coating system can save lots of cost through wet on wet coating system and low temperature curing system.

Functional Ceramic Coating with Additives

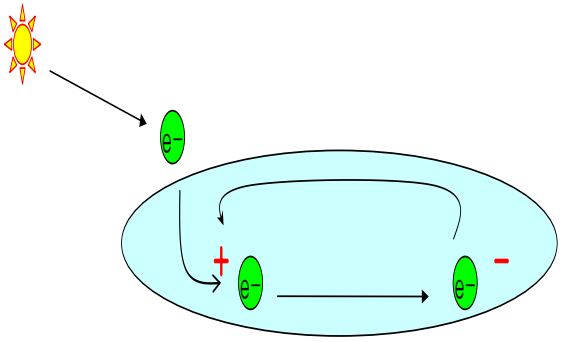
- NEGATIVE ION (Needs to add Negative ion powder)

. Theoretical the ion which has negative charge called as a negative ion, but the negative ion that is good for health means "OH-" ion

. Because of porous structure of ceramic coating, it has much higher negative ion emission rate than any other coating material.



Crystal Structure of Negative Ion Stone



Principle of Negative Ion Emission

※ Principle of Negative Ion Generation

- Electric stone has fixed pole and move electrons from positive pole to negative pole continuously
- The electrons from sun light would be absorbed to positive pole and then the exceed electrons in positive pole move to negative pole.
- The exceed electrons in negative pole be released to the air and then it makes electrolysis of water. Hydrogen ion from electrolysis of water get electrons then become Hydrogen atom and then "OH-" ion would be released

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Functional Ceramic Coating with Additives

- ANTI-BACTERIAL (Needs to add Anti-bacterial additive)

Sample kinds	Initial	After 24hrs	Antibacterial Efficiency(%)
① Blank	2.4×10^4	3.2×10^6	-
② Coated Board	2.4×10^4	10 >	99.9

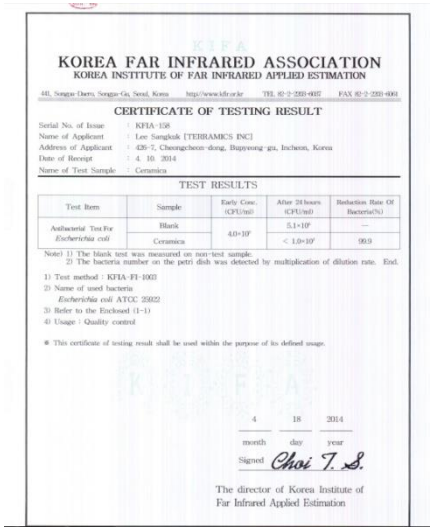
Note :

1) Test condition : Film Attached Method (JIS Z 2801-2000)

   a. The solutions and then inoculate the face of the sample. After the sample is cultivated at 30℃ for 24hrs and dilutions of cultures are divided by pour agar plate method to determine bacteria cell growth inhibition rate

   b. Sample area : 4 * 4 cm

2) Name of Used bacteria : *Escherichia coli ATCC No. 25922*



KOREA FAR INFRARED ASSOCIATION
KOREA INSTITUTE OF FAR INFRARED APPLIED ESTIMATION

CERTIFICATE OF TESTING RESULT

Serial No. of Issue : KFIA-158
Name of Applicant : Lee Sangkuk [TEBRAMICS INC]
Address of Applicant : 426-7, Cheongcheon-dong, Bupyeong-gu, Incheon, Korea
Date of Receipt : 4. 10. 2014
Name of Test Sample : Ceramica

TEST RESULTS

Test Item	Sample	Early Conc. (CFU/ml)	After 24 hours (CFU/ml)	Reduction Rate Of Bacteria(%)
Antibacterial Test For *Escherichia coli*	Blank	4.0×10^4	5.1×10^6	-
	Ceramica		$< 1.0 \times 10^1$	99.9

Note) 1) The blank test was measured on non-test sample.
2) The bacteria number on the petri dish was detected by multiplication of dilution rate. End.

1) Test method : KFIA-FI-1003
2) Name of used bacteria
Escherichia coli ATCC 25922
3) Refer to the Enclosed (1-1)
4) Usage : Quality control

※ This certificate of testing result shall be used within the purpose of its defined usage.

4 month 18 day 2014 year

Signed *Choi T. S.*

The director of Korea Institute of Far Infrared Applied Estimation

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7 Test Method of Non-stick Property

- Reference Test Method

. CMA (Cookware Manufacturer Association) Standard

. Cookware Non-Stick Performance Food Tests (22.2.1 Egg test / 81page)

Scope : This test is applicable for cookare non-stick coatings only. The pass/fail criteria will only be valid for cookware non-stick formulae. This is a test for the cleanability of a product and not the release properties

Test Method :
Wash cookware in hot water at a temperature greater than 140°F containing liquid detergent. Heat the cookware on stovetop so that the surface of the base is between 300 and 350 °F. Cook a room temperature egg broken into the cookware without additional fat or other lubricant until firmly set and then remove the egg with a plastic or nylon spatula. Record whether the test food was removed intact and if the surface wiped clean. The surface is deemed to be wiped cleanif unaided visual eamination after wiping reveals no trace of solid material. A “pass” is recorded if there is no trace of solid material after wiping. “Fail” means traces of solid material remain.

7 Test Method of Non-stick Property

- NEOFLAM Test Method

High Temperature Heating

- Test condition :
  ① Heating at 340±10℃ (maximum 350℃), for 30minutes / Egg Frying at 195±10℃
  ② 1Cycle ⇒ Heating + Egg Frying (10x) + Wash
- Test method :
  ① Initial Test: 10times of Egg frying before High Temperature heating
  ② Repetition Test: 10times of Egg frying after High temperature heating ⇒ 10 cycles at most

Dishwasher

- Test condition :
  ① Standard operating mode of dishwasher (65℃, 90mins), Egg Frying at 195±10℃
  ② 1Cycle ⇒ Standard operating mode of dishwasher(10 times) + Egg Frying (10 times)
- Test method :
  ① Initial Test: 10times of Egg frying before dishwasher
  ② Repetition Test: 10times of Egg frying after dishwasher(10times) ⇒ 10 cycles at most

Measuring temperature
Before non-stick test
(195℃±10℃)

Evaluating the grade
based on Eggs sticked to
the surface

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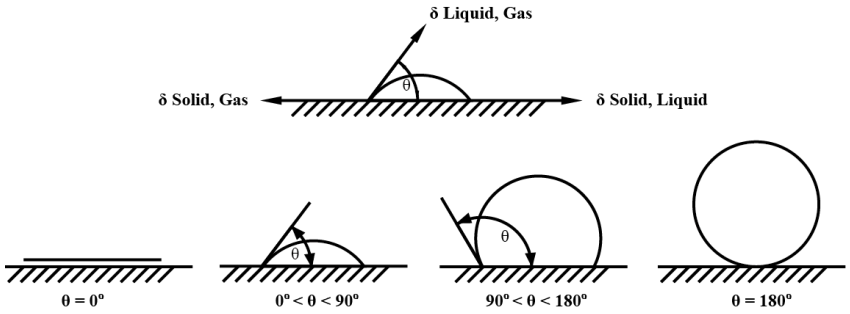
Technological Limitation of Ceramic Coating in Non-stick Property



A liquid drop on solid surface

PTFE Coating < Ceramic Coating

. As a scale of non-stick performance on the coating surface the contact angle of water drop has been used. Methyl chains on the ceramic coating surface shows higher contact angle than "C-F" chains on the PTFE coating and that is the reason why ceramic coating shows much better non-stick performance at the beginning.

. Ceramic coating which is made from natural mineral, oxide material, can't have non-stick property, so it must rely on organic non-stick material. There must be a limit amount to apply organic part in ceramic coating so the consistency of non-stick performance would be poorer than PTFE coating.

Beginning

After many time use

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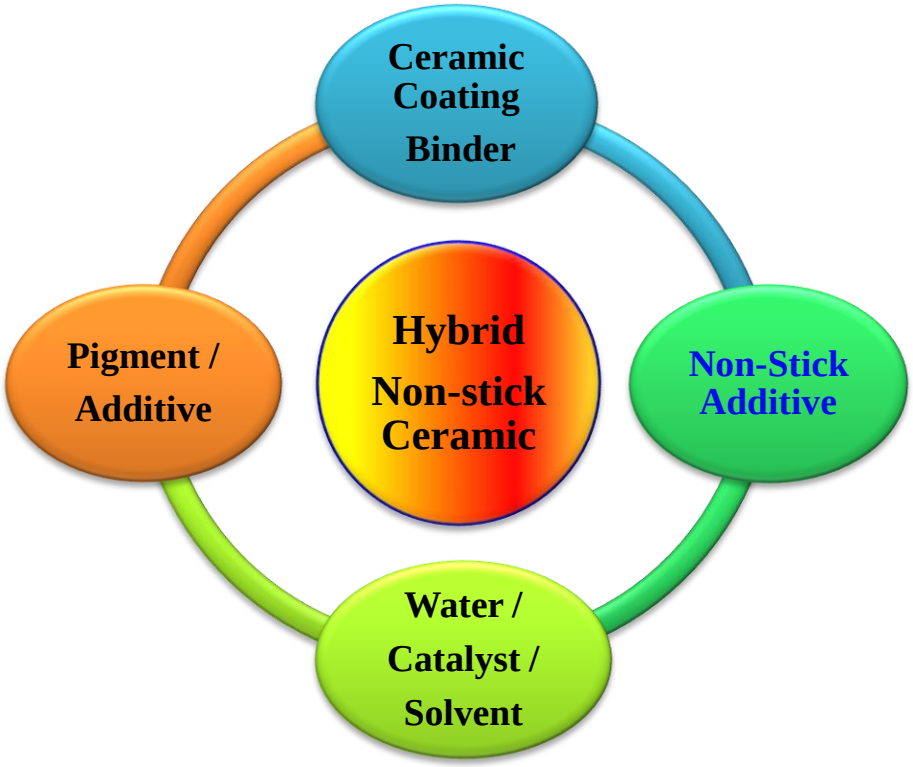
Technological Limitation of Ceramic Coating in Non-stick Property

Since Ceramic Coating has the same molecular structure with natural oxide mineral, it can't have any non-stick property



Component of Ceramic Coating

✓ Since the main molecule of ceramic coating is silica, it is impossible to get a nonstick property itself.

✓ Sol-Gel process can make oxide material from molecular scale so that it has various potential to make hybrid material

✓ Organic non-stick material in top coating solution which can make chemical reaction bond with ceramic coating structure gives non-stick property in ceramic coating.

✓ Because low specific gravity non-stick material may float on the coating surface and the possibility of chemical bond between ceramic coating and non-stick material is very low, ceramic coating 's non-stick property has time limitation.

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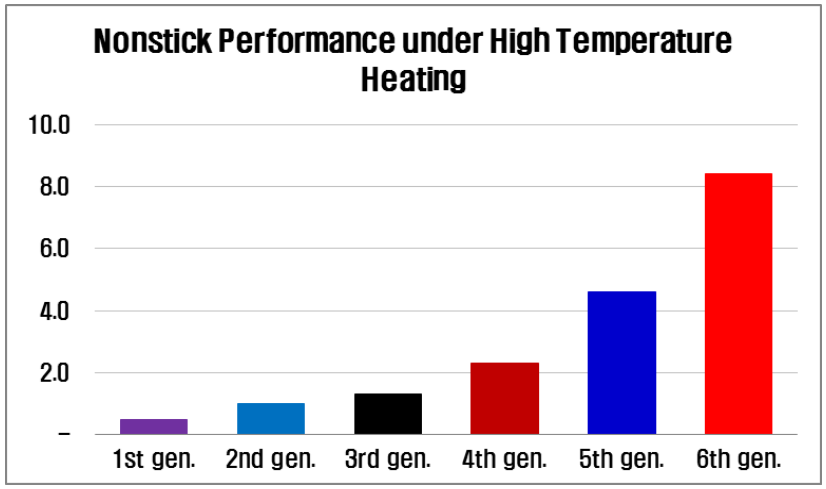
Non-Stick Property Improvement of Neoflam Ceramic coating

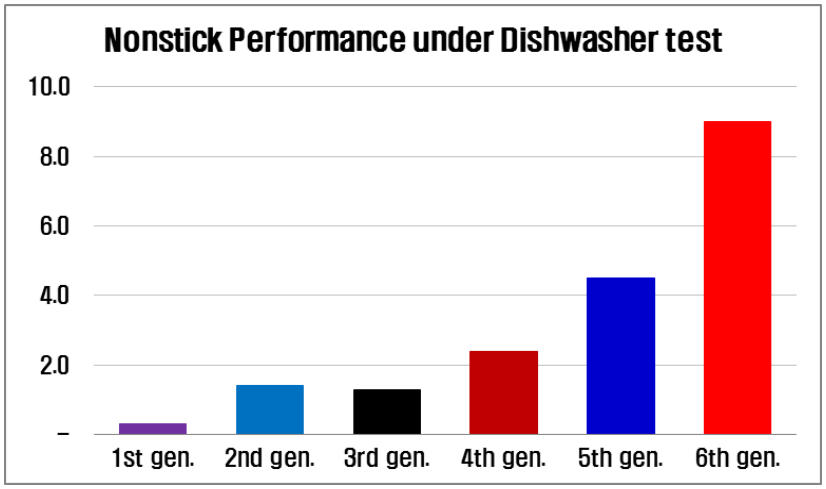
High Temperature Heating / Dishwasher nonstick Test

-COMPARISON ON TEST RESULT

Unit : cycle

Classification	1st gen	2nd gen	3rd gen	4th gen	5th gen	6th gen
High Temperature heating	0.5	1.0	1.3	2.3	4.6	8.4
Dish washer	0.3	1.4	1.3	2.4	4.5	9.0





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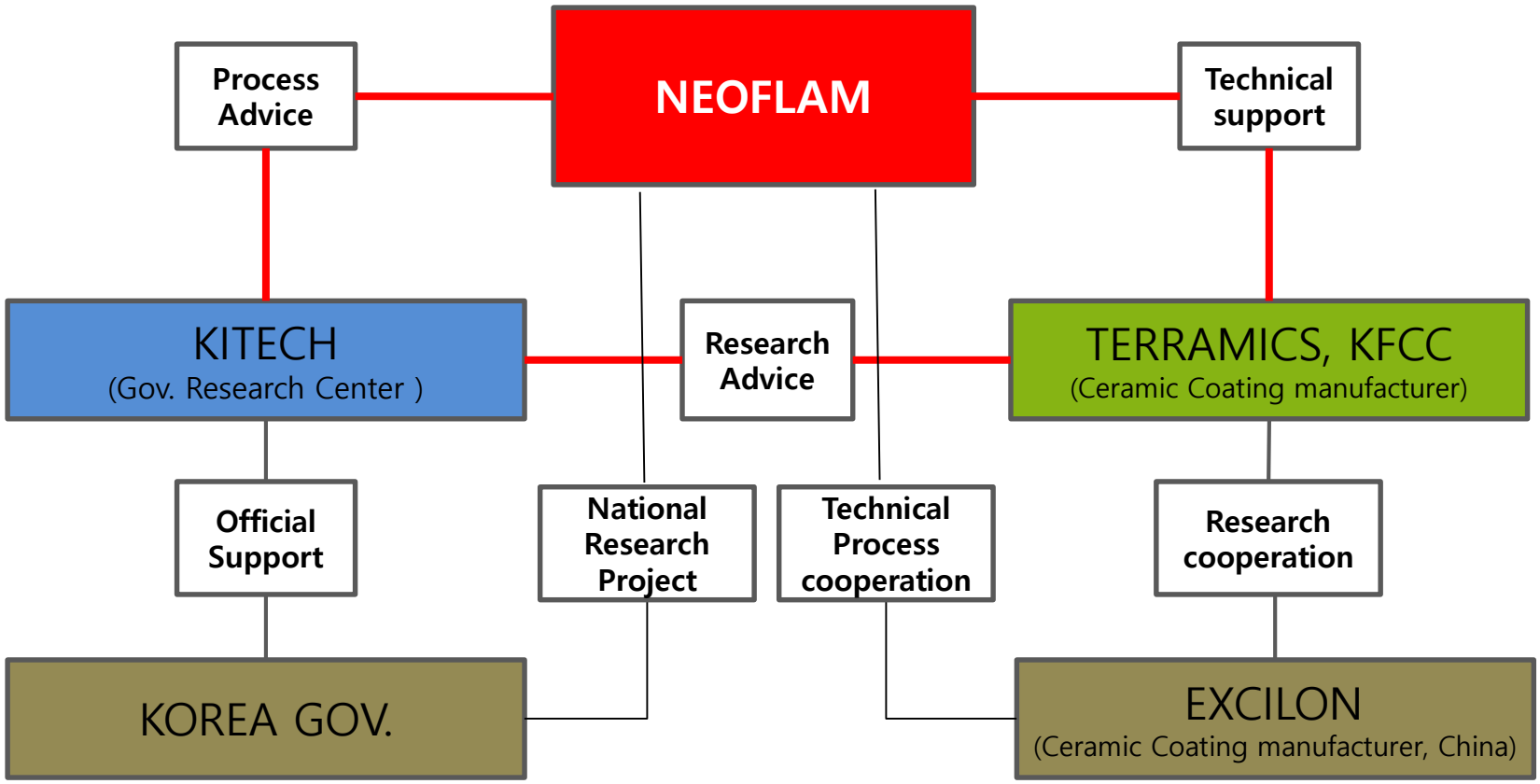
Why Neoflam ?

◎ Research Network



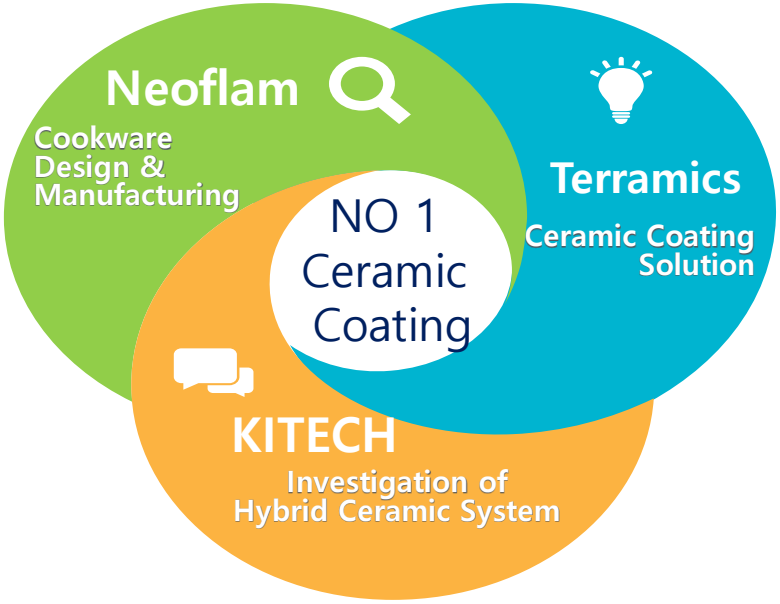
Why Neoflam ?

◎ Government Support

. Gov. R&D Project with NEOFLAM (2016 ~ 2018)

Development of ceramic coated cookware with enhancing crack-free and nonstick function

[The main contents of the development & the configuration of the institutions]



Neoflam

- Multifunctional Ceramic coating process
- Crack-free & Micro-pore control Techniques
- Beautiful product development

Terramics

- Silan networks for Nonstick function
- Economic Sol-Gel Process for Ceramic coating
- Fine-tuning of complicate ceramic system

KITECH

- Controlling of Hydrophobic surface
- High thermostable hybrid ceramic material
- Material design for nonstick ceramic coating

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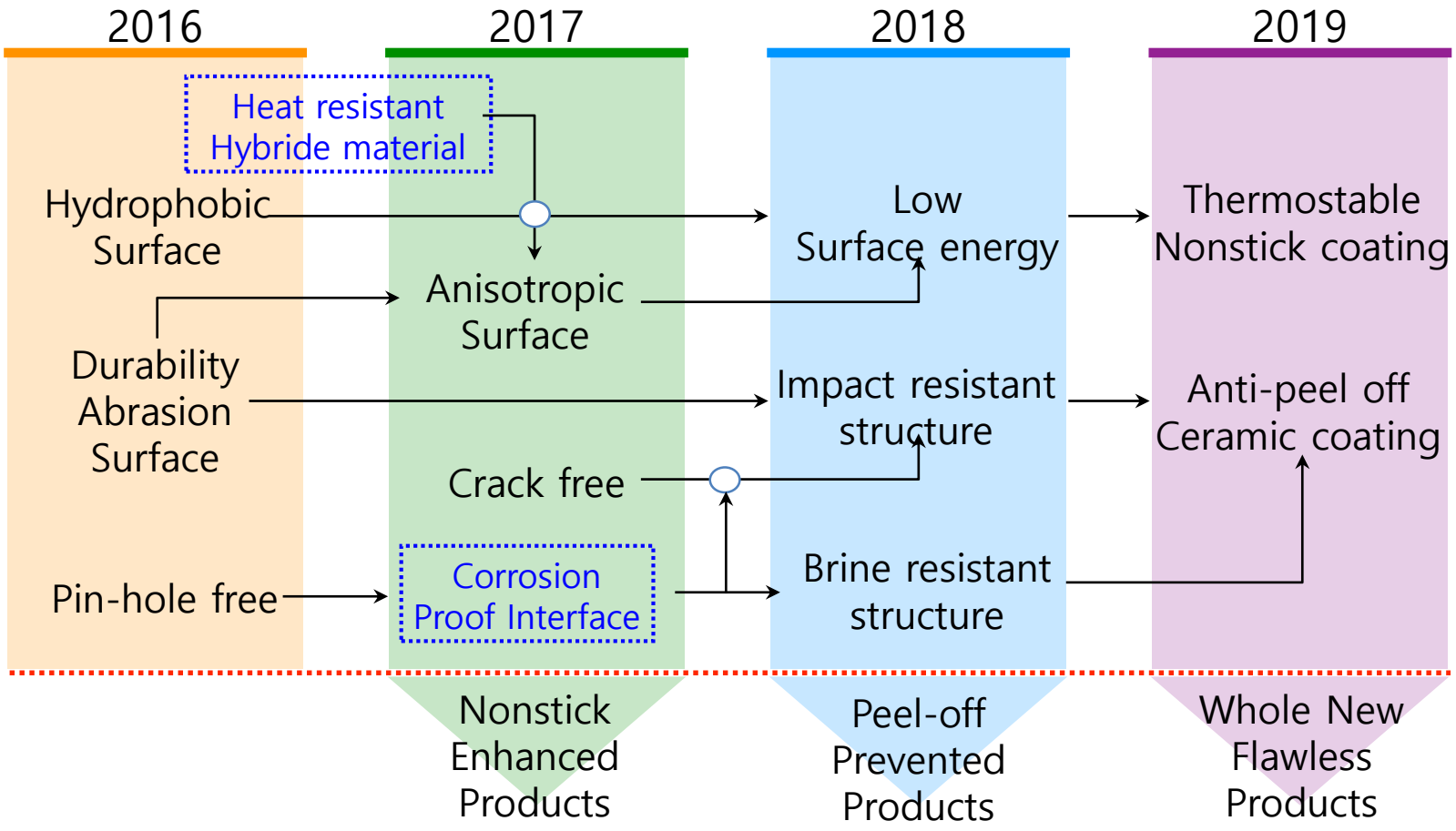
10 Why Neoflam ?



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Why Neoflam ?

◎ Manufacturing Process

. Cookware Manufacturing Process

- ✓ Die Casting : Make cookware shape with Aluminum ingot
- ✓ Fitting : Abrasion process of Die Casted product
- ✓ Sand Blast : Make roughness of cookware workpiece
- ✓ Coating Solution : Make Ceramic coating solution
- ✓ Spray Coating : Coat ceramic solution on cookware workpiece

⇒ You can handle and manage whole above process at one time and place with NEOFLAM

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Why Neoflam ?

◎ Coating Process

Coating Process	What NEOFLAM is different?
Sand Blast	. Surface roughness is very important variable to determine coating quality > Neoflam controls the surface roughness within 1 micrometer
Surface Cleaning	. Dust and Impurity on the workpiece surface can make peel off of ceramic coating > Neoflam set 6step cleaning process [water -> alkaline degreasing -> water -> acidic treatment -> water -> distilled water]
Preheating	. To get a good adhesion of ceramic coating preheating temperature is very important > Neoflam has specialized preheating oven to control . (15m , ~ 150℃)
Spray gun	. Number and quality of spray gun is very important for coating quality > Neoflam uses much more guns than any other competitors (base: 18, top : 15)
Spray Booth	. Dust in spray booth can attach on coating surface then it may cause coating peel off. > Neflam runs dust free clean room which is able to manage temperature
Drying	. Drying step is the most important variable to determine coating surface quality > Neoflam runs F-IR drying system to control evaporation speed
Curing	. Curing temperature and time is key point to determine coating strength and quality > Only neoflam has the curing oven longer than 35 m

Why Neoflam ?

◎ Colors

. Basic Color and Main Components

White	TiO_2 , SiO_2	Black	TiO2 , Cr_2O_3
Red	**CdO** , SiO_2	Orange	**CdO** , SiO_2
Yellow	**CdO** , Sb_2O_3 , SiO_2,	Green	CuO , PbO, Cr_2O_3
Blue	CoO , CuO, MnO	Navy	TiO2, Cr_2O_3
Violet	TiO_2 , Sb_2O_3, SiO_2,,	Pink	Sb_2O_3

- ✓ Ceramic coating needs to use high temperature resistant pigment to make color (up to 400℃)
- ✓ Most of Yellow, Red and Orange pigment contain heavy metal element (Cadmium).
- ✓ Most of Green and Black color pigment contain heavy metal element (Chrominum)

⇒ Only NEOFLAM can make any kind of color without heavy metal element.

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◎ Design

Main Award Career

1. World Class Product of Korea

WORLD CLASS PRODUCT OF KOREA 1

세계일류상품

This award is for the company which occupy world market within 10th (Neoflam is 5th) and expert more than 5 million dollars from Korean govoronment.

Neoflam was selected as a no.1 company in anti-bacterial cutting board and cookware market for 4 years continuously.

2. Design Award

신개념 페탈라이트 쿡웨어 **'모투스'**

특허 받은 분리형 쿡웨어 **'마이팬'**

네오플램의 첫 프리미엄 라인 **'레트로'**

건강함을 입은 칼/칼블럭 **'아베코 칼 & 칼블럭'**

차원이 다른 도자기 내열냄비 **'밸리'**

로맨틱 키친을 위한 혼수 필수품 **'애니'**

현대적인 도자기 내열냄비 **'댄디'**

홈쇼핑 판매 No.1 **'일라'**

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10 Why Neoflam ?

◎ History and Know-how

PTFE Coated Cookware

Toxic Issue of PTFE & PFOS

Only Ceramic Coating
Can Replace PTFE

Replacement of Coating Material

Ceramic Coating

NEOFLAM

Since 2008, Neoflam just has been producing Ceramic coating cookware Product and has specialized manufacturing system and factory in China and Korea for Ceramic Coating.

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THANK YOU FOR YOUR ATTENTION

NEOFLAM®

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