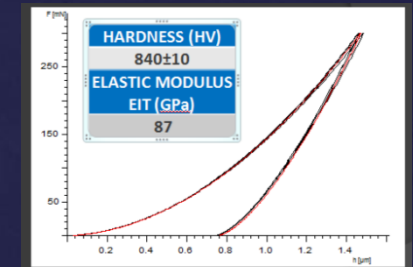
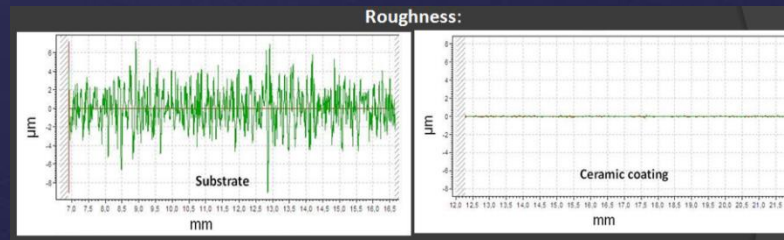


CERAMIC COATING PROPERTIES

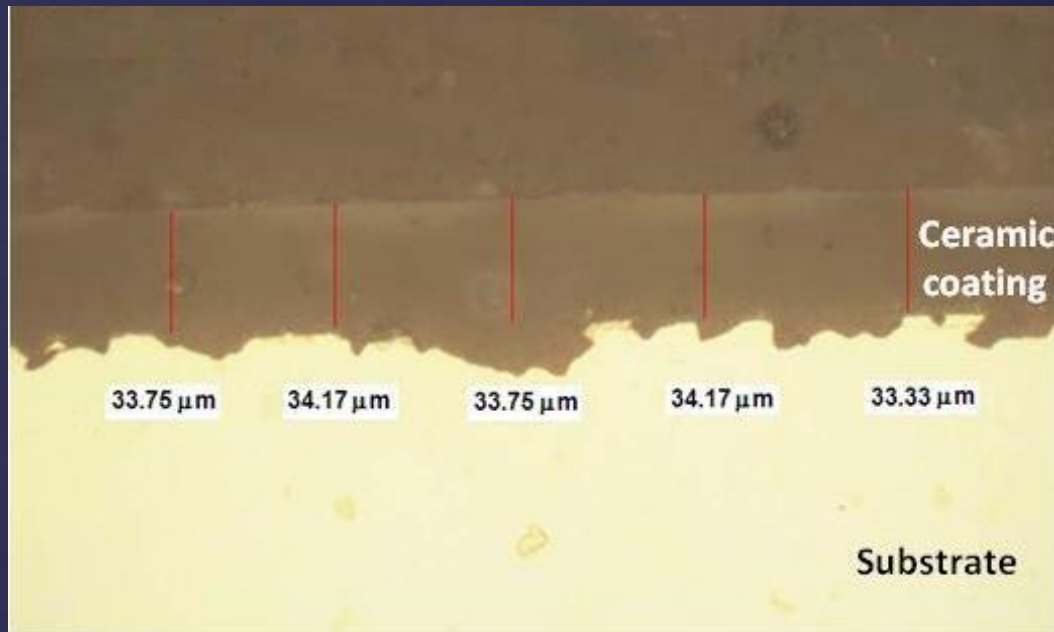


- Non permeable surface
- Aseptic (Inhibits bacterial growth)
- Hygienic (Easy-to-clean)
- High temperature resistance
- High chemical corrosion resistance
- Sun Light resistance (colour stability)
- Environmental corrosion resistance
- High hardness (scratch and abrasion)
- Environmentally Friendly (100% recyclable)



MORPHOLOGICAL

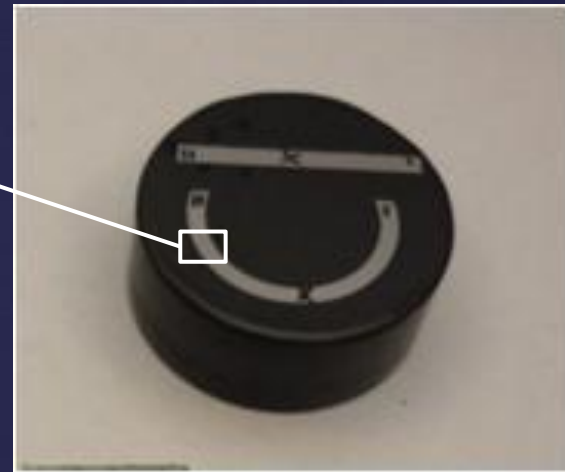
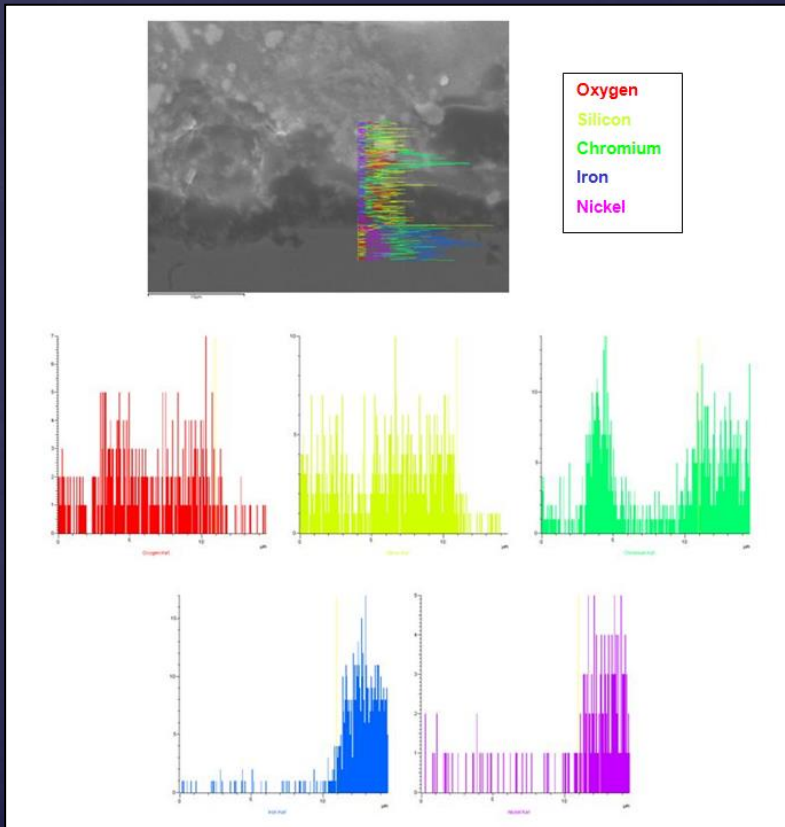
Thickness: **Optical microscopy**



Continuous and homogeneous coating.
Thickness can be adjust modifying rheological
parameters based on final coating properties

MORPHOLOGICAL

Chemical Bonding metal - ceramic : SEM



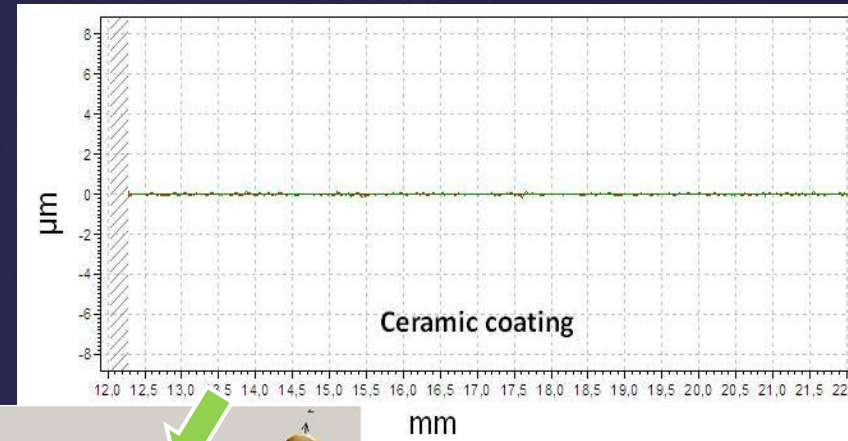
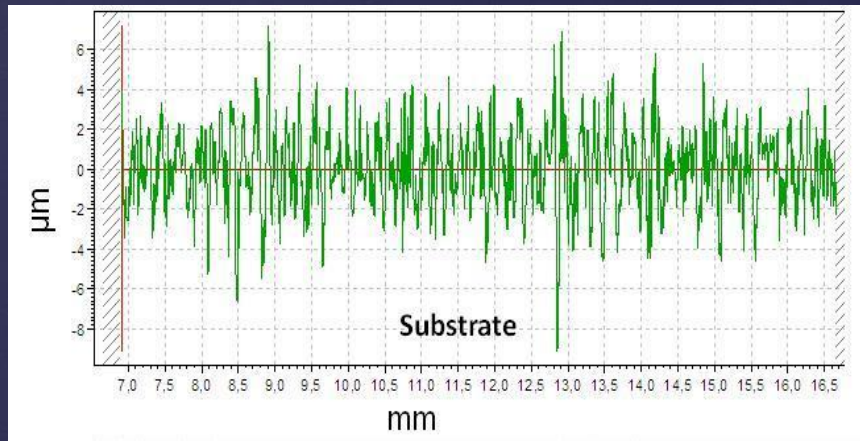
Mapping of SEM-EDX images of ceramic coating sintered in normal conditions in the interface between the substrate and the ceramic coating

MORPHOLOGYCAL

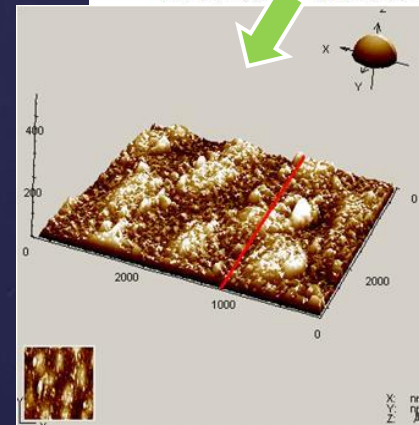
Roughness: Profilometry and AFM

Substrate Roughness
Ceramic Coating Roughness

$Ra \approx 1,5 \mu m$ and $Rz \approx 7,8 \mu m$
 $Ra < 0,04 \mu m$ and $Rz \approx 0,2 \mu m$

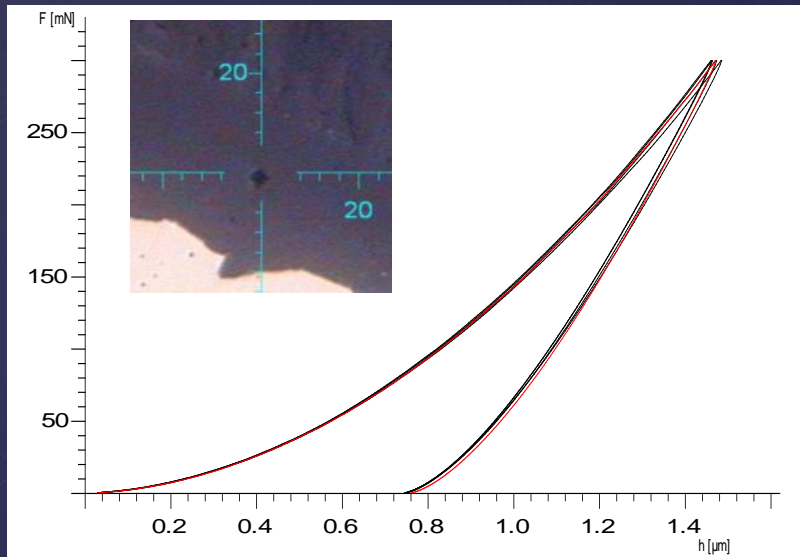


**Important decrease of
roughness, avoiding particles
adhesion and pits**



MECHANICAL

Microhardness



HARDNESS (HV)

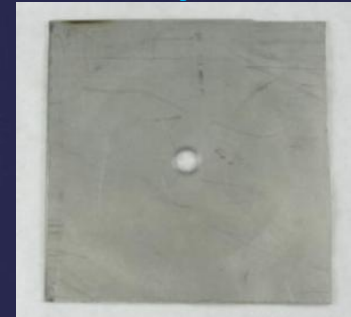
840 ± 10 (65,3 HRC)

ELASTIC MODULUS EIT (GPa)

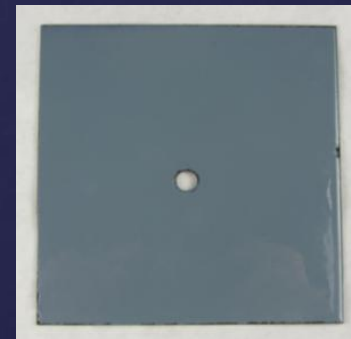
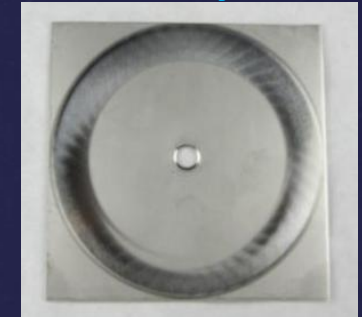
87

Abrasion resistance

0 cycles



10000 cycles



• **Substrate $\Delta w_{10000} = 58 \text{ mg}$**

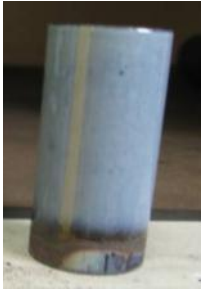
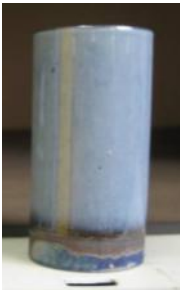





• **Ceramic coating $\Delta w_{10000} = 3 \text{ mg}$**

THERMAL SHOCK

Cycles from 450°C to water cooled 20°C

No delamination - No Cracks



	0 cycles	1 cycle	2 cycles	3 cycles	4 cycles	5 cycles	6 cycles
WATER cooled							

CHEMICAL CORROSION RESISTANCE

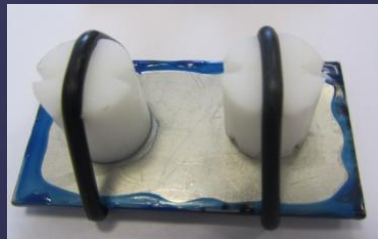
Crevice Corrosion Resistance

ASTM G48A

Method B-Ferric Chloride Crevice

Corrosion Test

Stainless Steel



Ceramic coating








block crevice



Pitting Corrosion Resistance

ASTM G48A

Method A-Ferric Chloride Pitting test:

10% FeCl ₃	Stainless steel	Ceramic coating
0 h (25 °C)		
72 h (50 °C)		
Weight Loss (g/m ²)	>700	≈0 

CHEMICAL CORROSION RESISTANCE

Seawater Corrosion Resistance (Offshore)

Conditions

Solution: 3,5% NaCl at 22 °C

Visual inspection after test

**SURFACE
UNALTERED**






Molten salt Corrosion Resistance

Conditions:

Molten salt composition: $\text{NaNO}_3 + \text{KNO}_3$
(60/40)

46 cycles HEATING (8 hours at 400°C)/Cooling

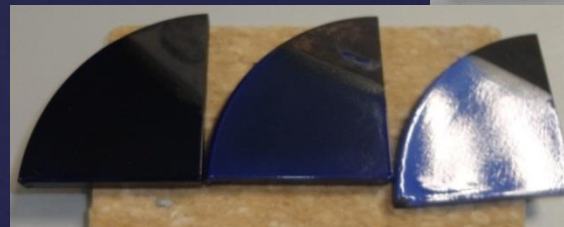
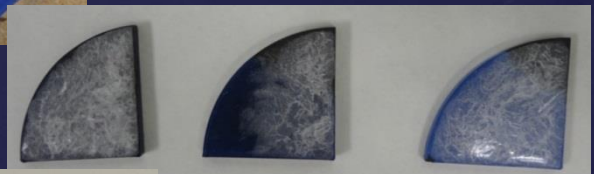
Seawater Corrosion Test

0 h	
1000 h	
16,000 h & GOING	



Initial test

After 46 cycles
/Before cleaning



After 46 cycles /
Surface clean

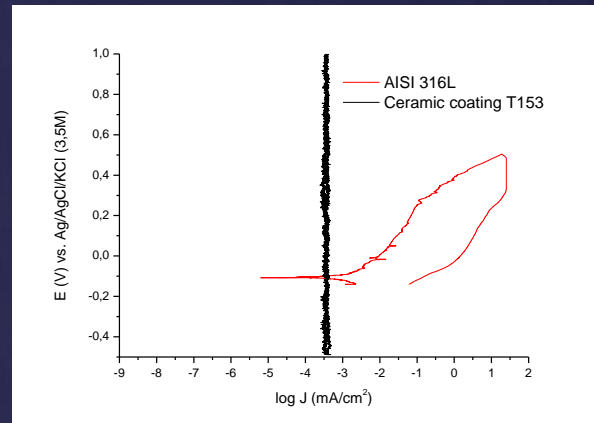
CORROSION RESISTANCE

-Pitting potential measurement:

- JIS G-0577:2005

- Conditions:

- Solution: 5% NaCl, 25 °C
- Counter electrode: Platinum
- Reference electrode: Ag/AgCl
- The tested surface was fully immersed in test solution for 2 h
- The test was conducted by potentiokinetic method from natural electrode potential to 1 mA/cm² of anodic current density
- Potential sweeping velocity: 1mV/s



	E _{corr} (mV vs Ag/AgCl)	Log J _{corr} (mA/cm ²)
	Stainless Steel	-106
Ceramic coating	UNALTERED	

NO CORROSION

OTHER IMPORTANT PROPRIETIES (*)

MECHANICAL

LUBRICITY - Low friction applications

ADHESION - Resistance to damage by impact, torsion, bending or heat shock. **IMPACT**

RESISTANCE - Not fracture due to impact (Depending conditions) **FLEXIBILITY** -

Good flexibility and adhesion when applied to thin metal substrates **STIFFENING** -

Because of its low ductility and intimate bond

THICKNESS - Wide range of thickness

THERMAL

RESISTANCE TO THERMAL OXIDATION/CORROSION - Provide both protection of the metal and ease of cleaning.

THERMAL STABILITY - Ability to withstand intermittent or prolonged heat

THERMAL EXPANSION – Designed to be the same as the substrate.

EMISSION - Power of a surface to release heat by radiation

THERMAL CONDUCTIVITY RANGE $\approx 5-8 \text{ W/mK}$ // Average (reference) $\approx 6 \text{ W/mK}$

ELECTRICAL

DIELECTRIC STRENGTH - Normal is 200 to 500 volts/mil

VOLUME RESISTIVITY

DIELECTRIC CONSTANT - At 400-cycles per second and at room temperature, the dielectric constant is in the range of 6 to 12.

DISSIPATION FACTOR - At 400-cycles per second and room temperature, the dissipation factor is about 1 or 2 %.