IK4 TEKNIKER
Research Alliance

Unai Ruiz de Gopegui Llona

Surface Physics and Technology Unit

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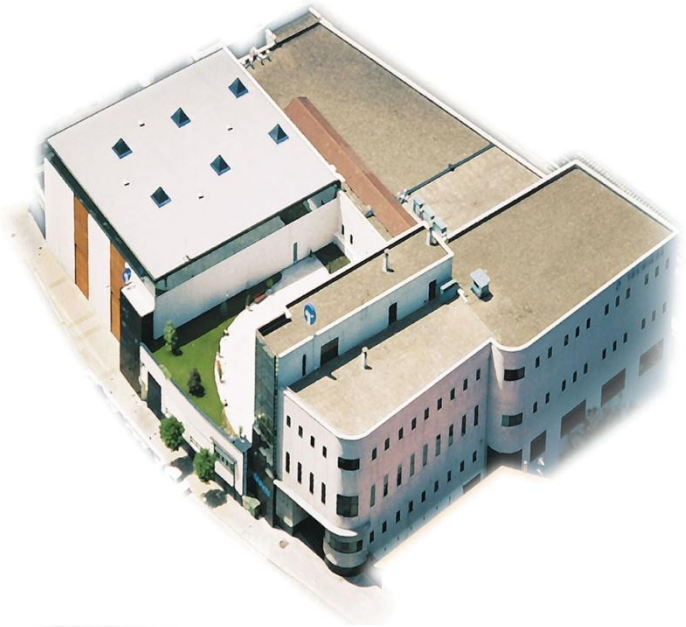
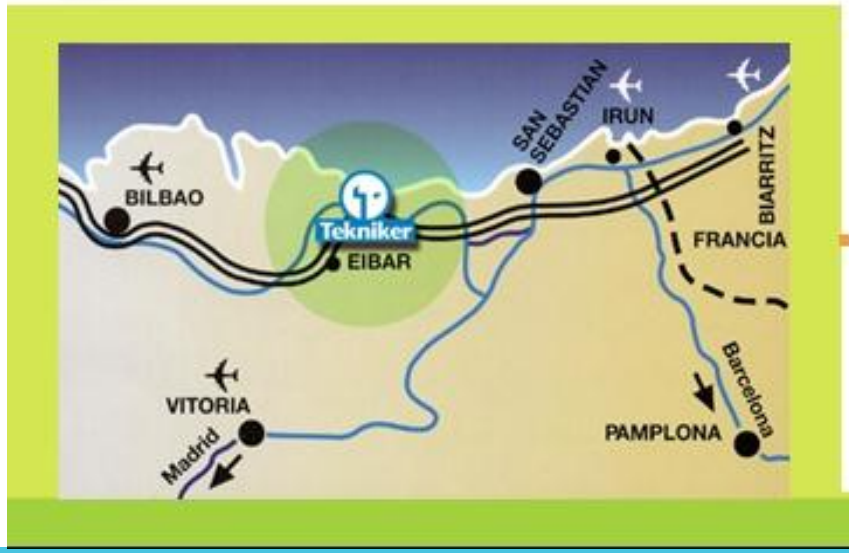
Research Alliance

Where we are





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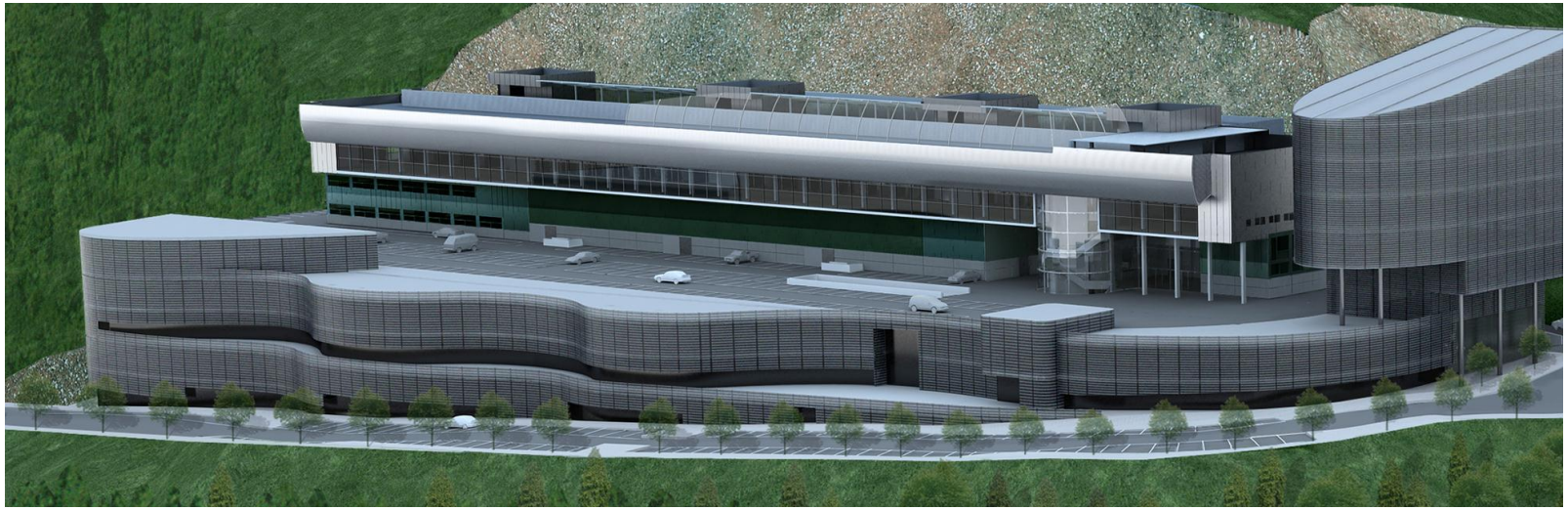
IK4-TEKNIKER is a technology centre legally established as a private non-profit-making foundation whose aim is to increase innovation capabilities of the industrial fabric with a view to improving its competitiveness by generating and applying technology and knowledge

Staff: 258 people
Facilities: 9000 m2 (soon 28000 m2)
Private contract: > 50%



IK4
Research Alliance
AZTERLAN CEIT CIDETEC GAIKER IDEKO
IKERLAN LORTEK TEKNIKER VICOMTECH

Staff: 1,430 people (20% PhD)
Leading 13 of the 90 European projects in which it is involved.
Technology centres: 9
Scientific & Technological Units: 8
Private clients: over 1,500 companies
Private contract: almost 60%. Leaders in Europe
Patents under way: 53

Specialization

Identification and control of systems

Precision engineering

Maintenance and reliability

Intelligent systems

Surfaces

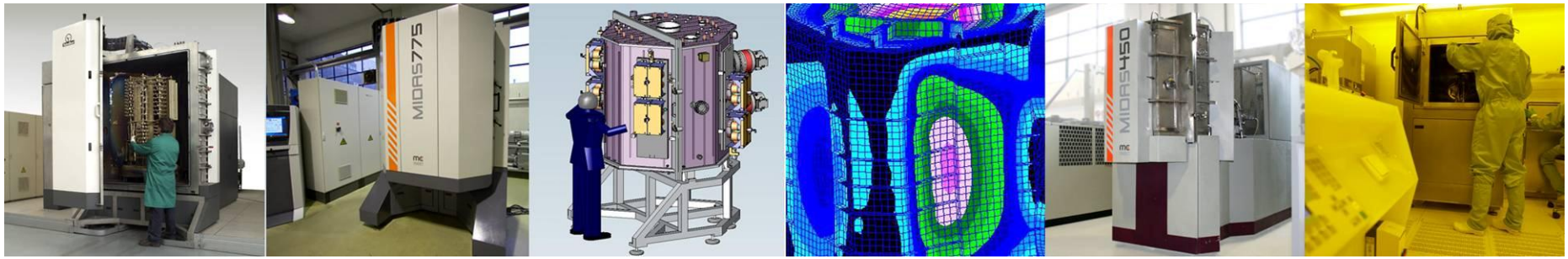
Micro and Nanotechnologies

Electromagnetism and power accelerators

Advanced production technologies (APT)

UNITS:

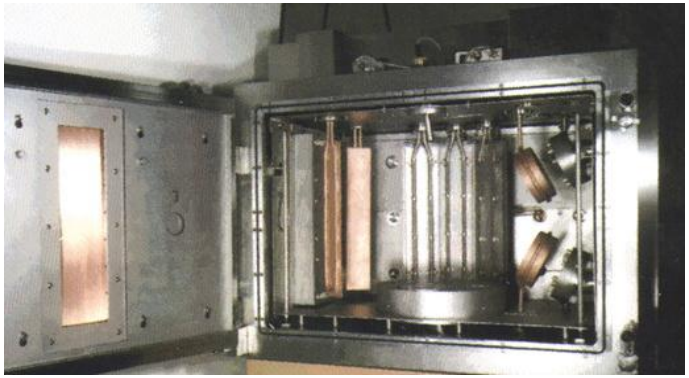
- Micro and Nano Facture (8 people)
- Surface Chemistry (14 people)
- Surface Physics and Technology (13 people)
- Tribology (21 people)
- Ultra-Precission Processes (7 people)



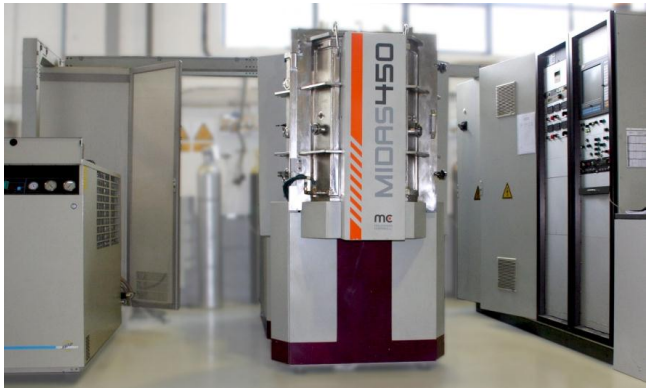
TECHNOLOGY

- Physical Vapor Deposition
- Design and Manufacturing of PVD systems
- Plasma Electro-Oxidation: Mg and Al alloys
- Sol-Gel
- Laser Nd-YAG: texturing and treatment
- Tribological Characterisation: 10-9-104 N
- Nanoimprint Lithography

1990: First PVD system purchased by IK4-TEKNIKER (VACTEC, USA)



1997: first PVD equipment “Made in IK4-TEKNIKER”



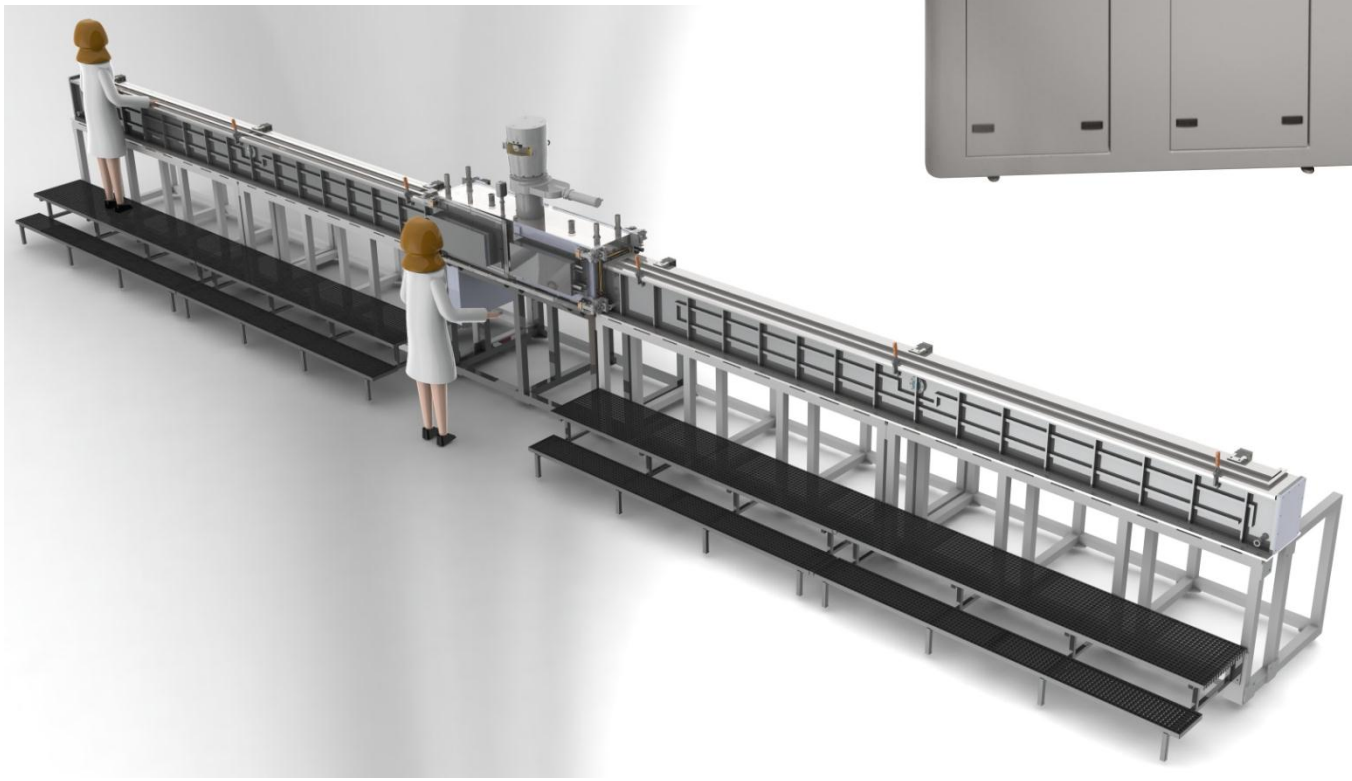
2003: Industrial production of decorative coatings

2012: 8 different PVD systems available in our facilities

PVD Prototypes

90 second cycle 3D decorative coater

4 m long tube coater for thermosolar application



PVD equipment

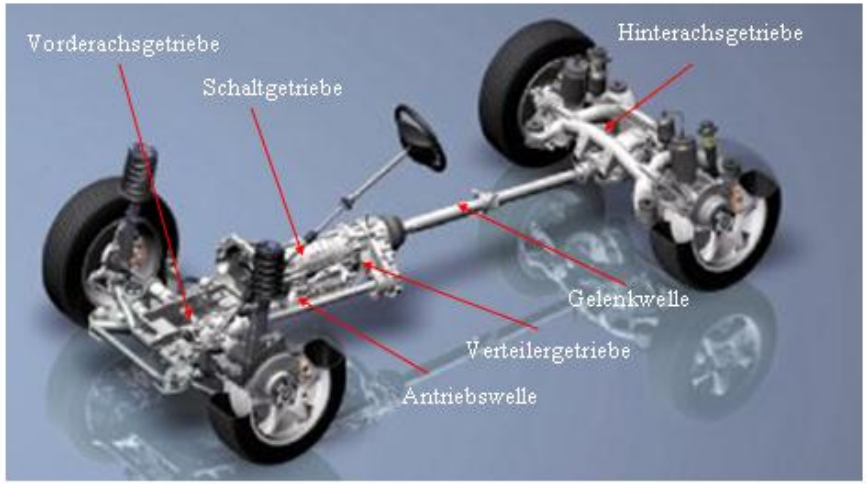
- Arc, thermal evaporation and e-beam with substrate cryocooling
- Magnetron sputtering: DC, Pulsed-DC, RF and HIPP
- From small flat samples up to 750 mm parts
- Soon 4 meters tubes

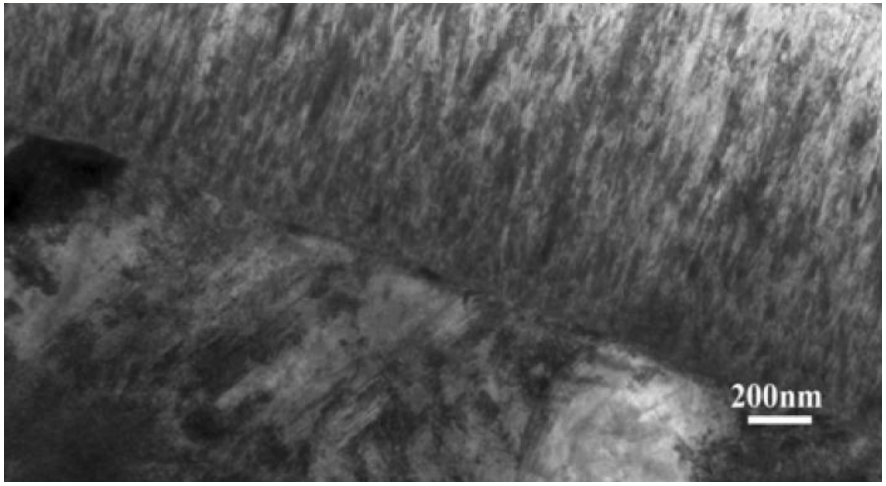
Characterization

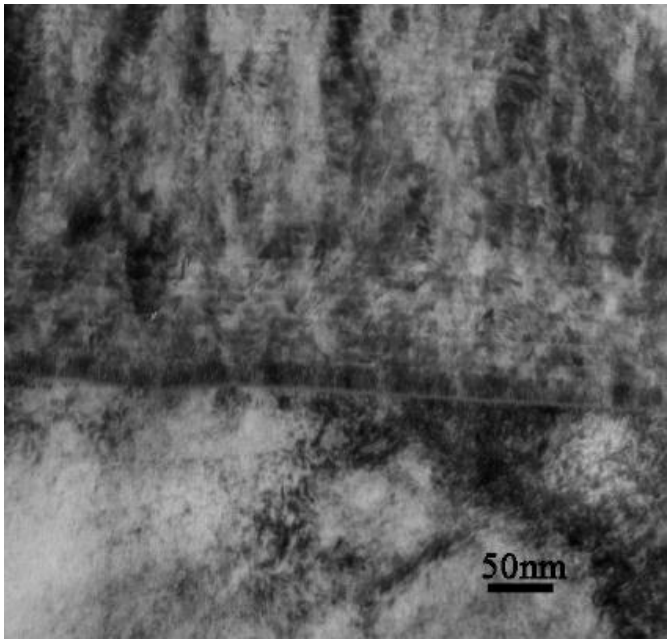
- CSM calotest
- CSM scratch test
- Fischerscope nanoindention
- Transmitance and reflectance spectrometry UV-VIS-IR
- 4 point probe
- GDOES
- SEM + EDS
- AFM: topography and friction (FFM)
- X-Ray Difractometer
- Confocal microscopy: 3D
- Wettability
- Tribometers: Falex, CETR, CSM
- Corrosion and Tribocorrosion
- Software: Film Wizard (optics), MS (molecular dynamics)

Hard and lubricating coatings (tools and mechanical components)

2009: Wear resistant coating for engine and transmission components

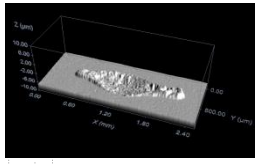


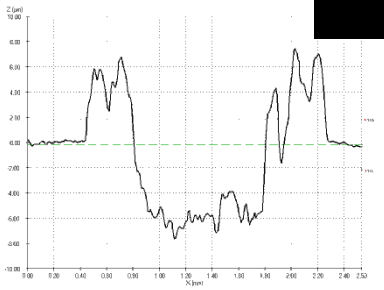




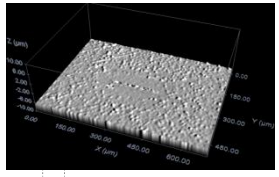
Ti-DLC coatings for knee joint tibial component, fretting and corrosion resistant

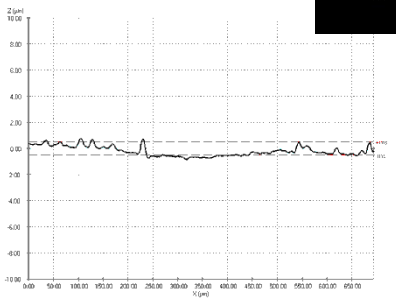
Uncoated Ti6Al4V

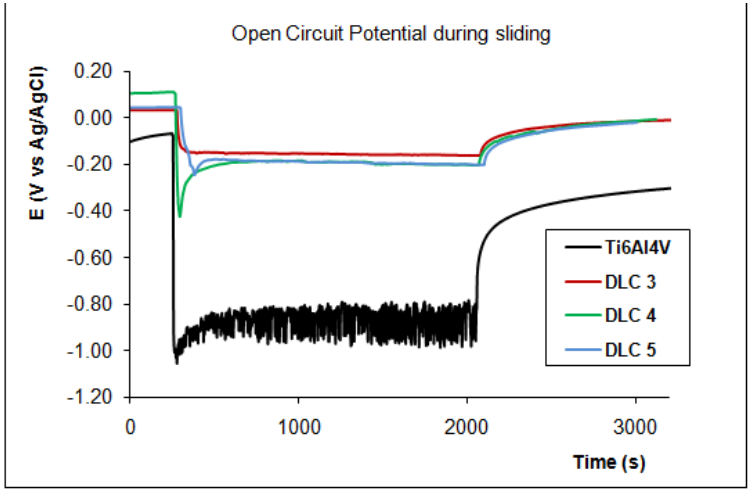


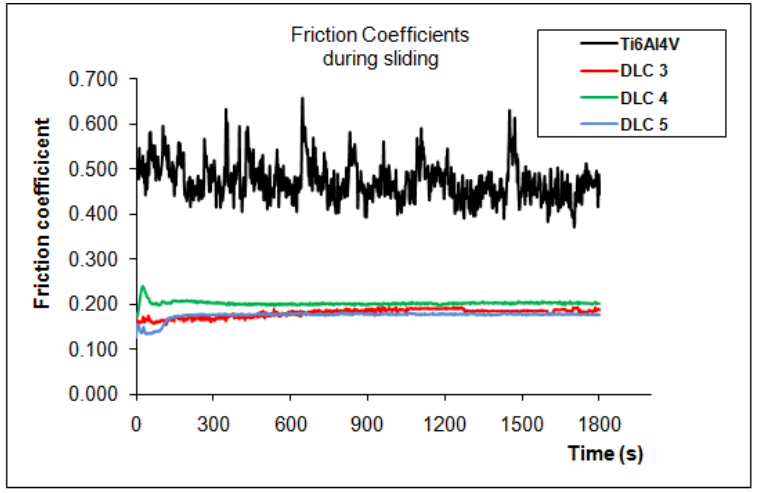


Coated Ti6Al4V



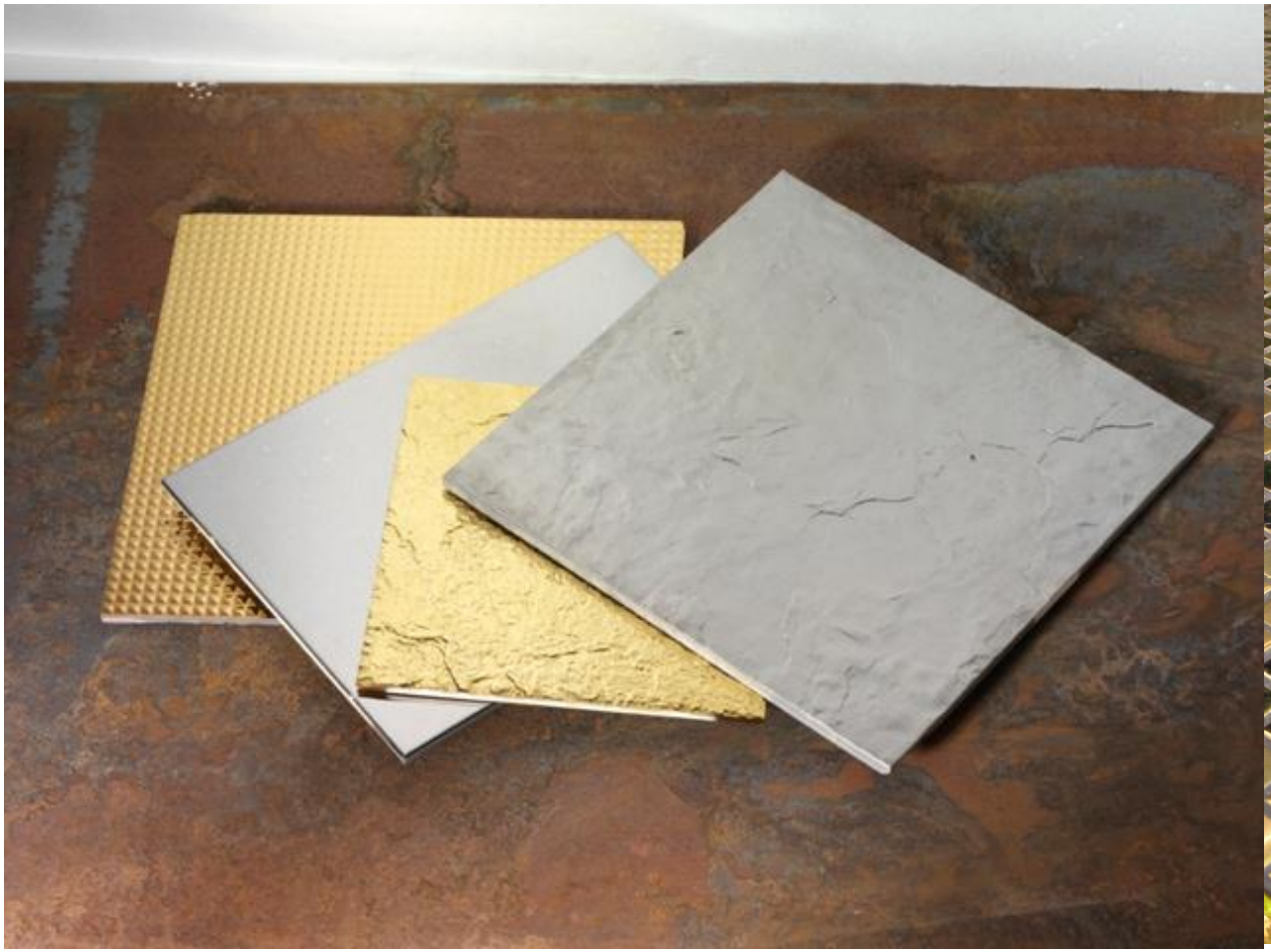


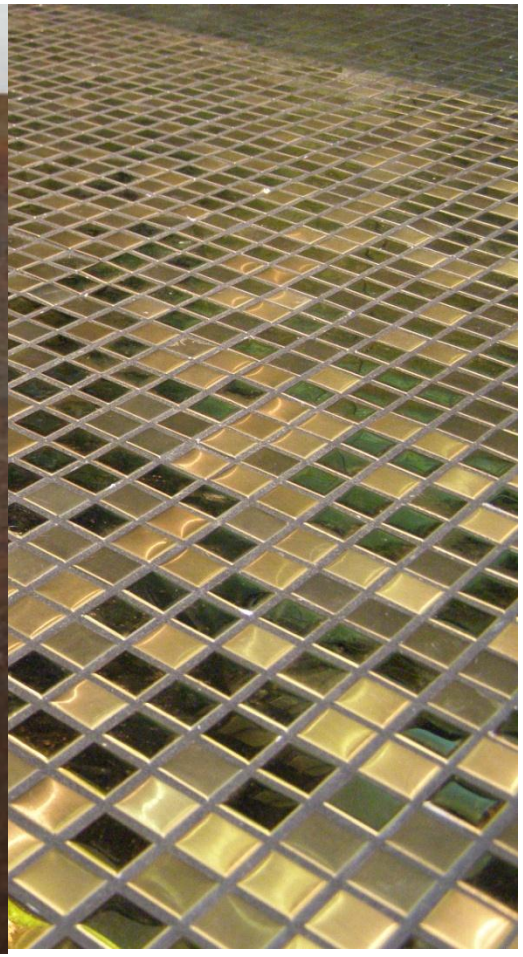




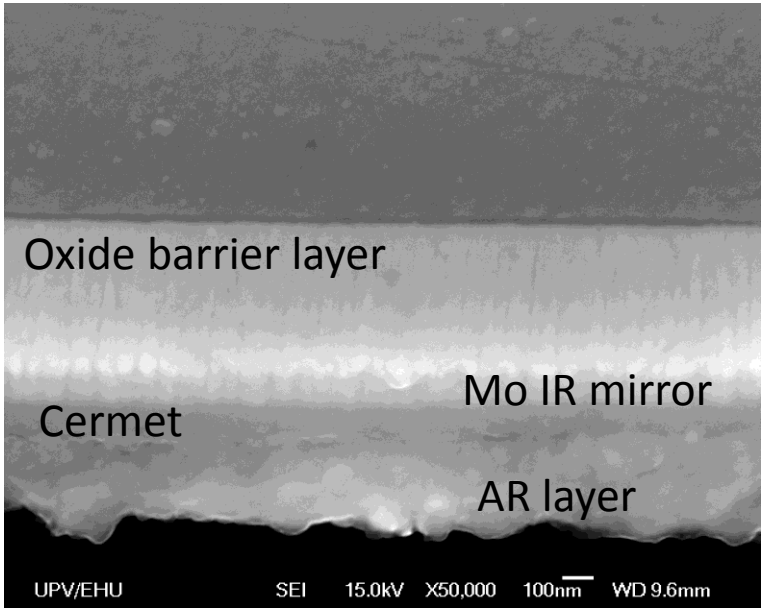
Decorative coatings in metals, plastics and ceramics

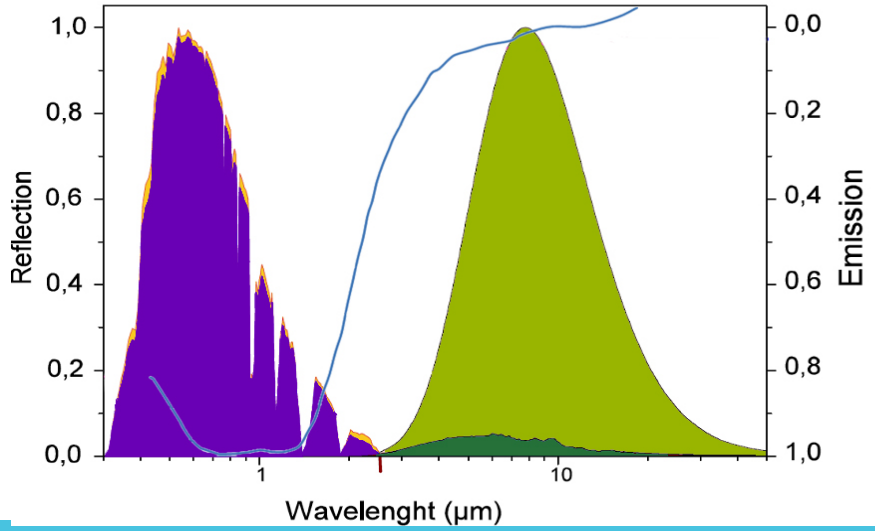
Ceramic tiles (2002: CEVISAMA FAIR - Innovation Award)

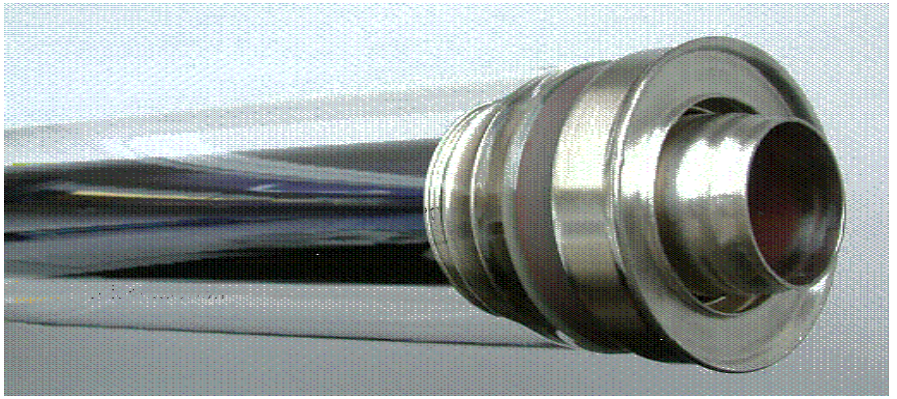




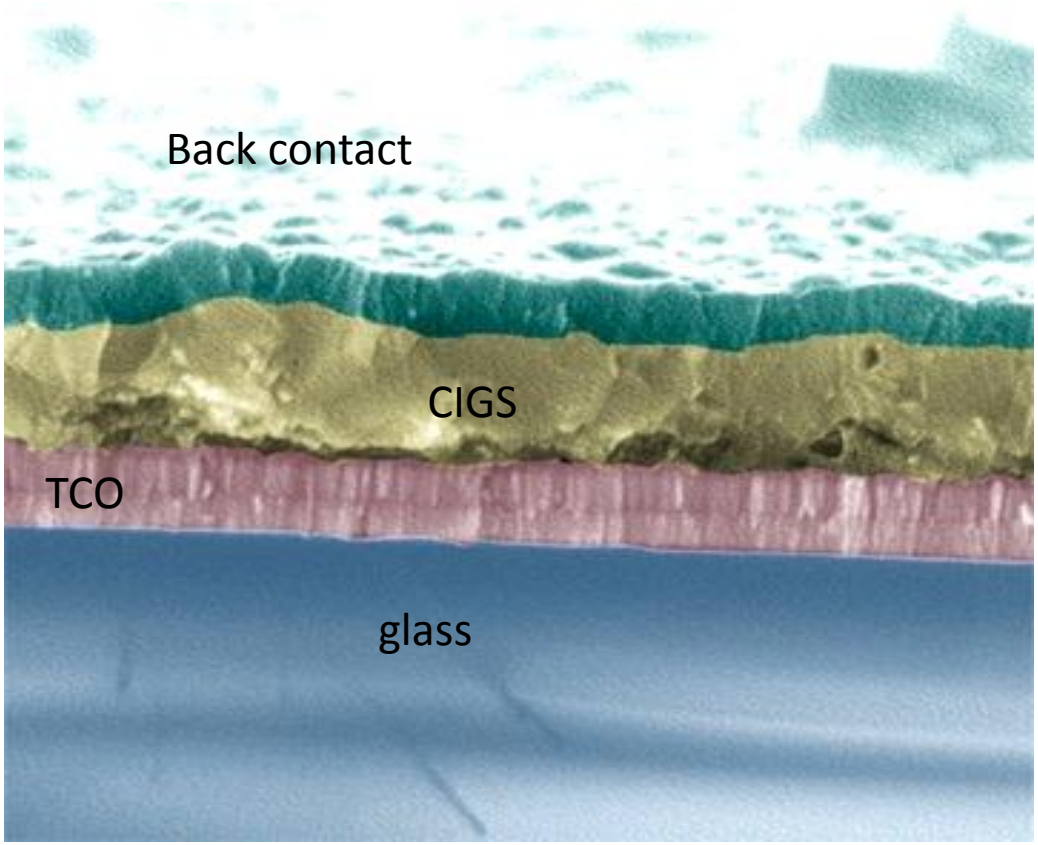
Selective Absorbers





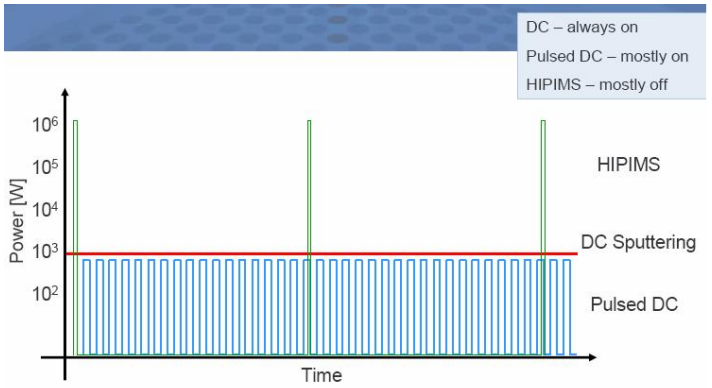


CIGS (Cu-In-Ga-Se) on glass, steel and plastic substrates



HIPP Processes

- Ionization degree > 60% of metallic ions
- No droplets
- Advantages
  - Better adherence
  - No columnar growth
  - More dense coatings. Better corrosion resistance
  - Better thickness homogenity in 3D coatings
  - Less substrate heating
  - Lower friction coefficients and wear



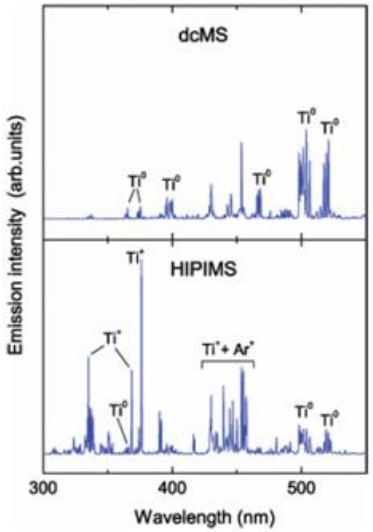
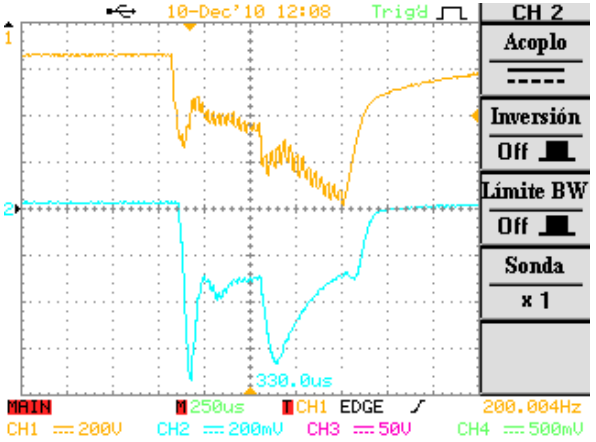


Figure 20. Optical emission spectra from a dcMS discharge and a HIPIMS discharge. Sputtering

- SOLO

Modulated Power Pulse

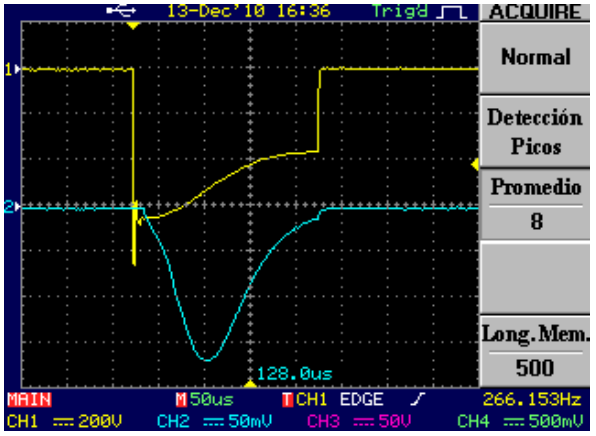
Pmax	330 kW
Vmax	900 V
Imax	550 A



- SINEX

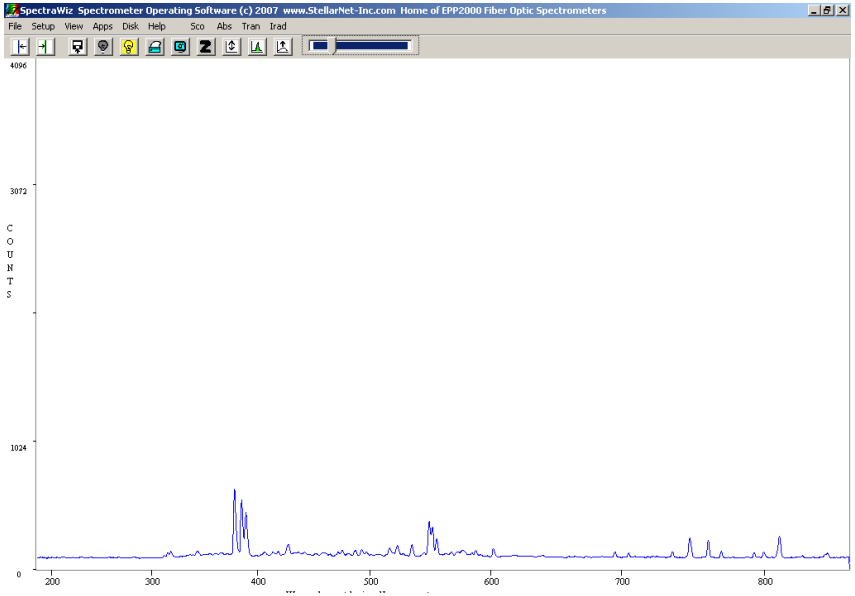
High Power Pulse Magnetron Sputtering

Pmax	6 MW
Vmax	2 kV
Imax	3 kA

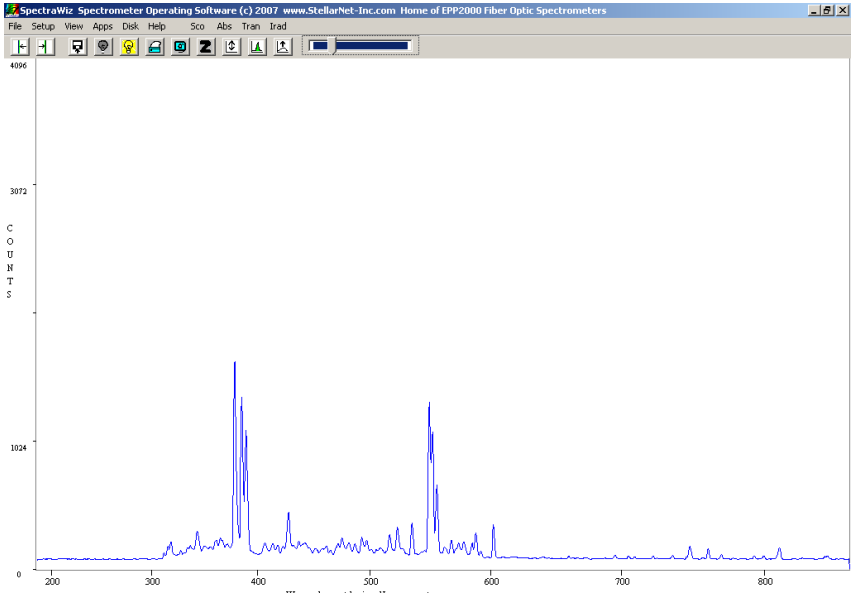


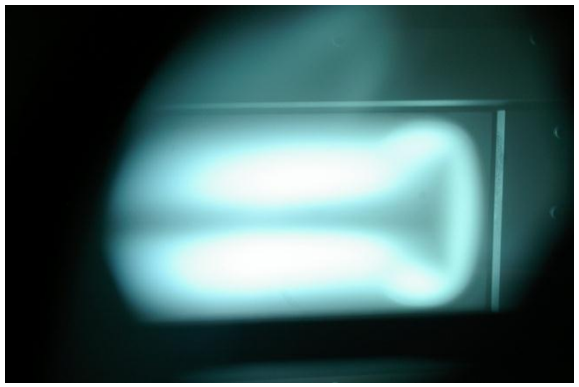
HIPP Processes

Mo Pulsed-DC 4500 W



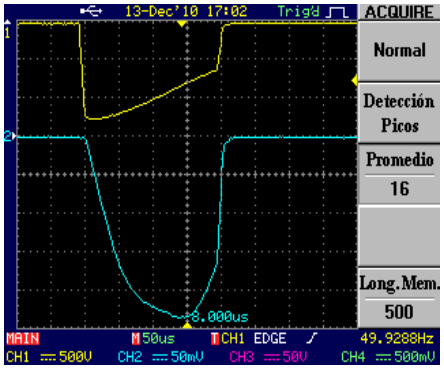
Mo HIPP 4500 W



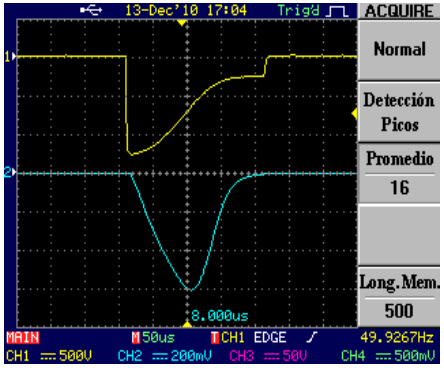


Discharge current vs pressure

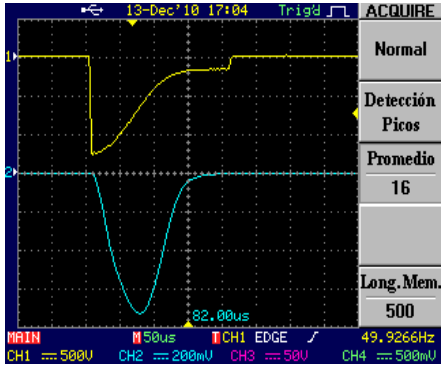
P	6x10-3
Tbreak	150µs
I	110A



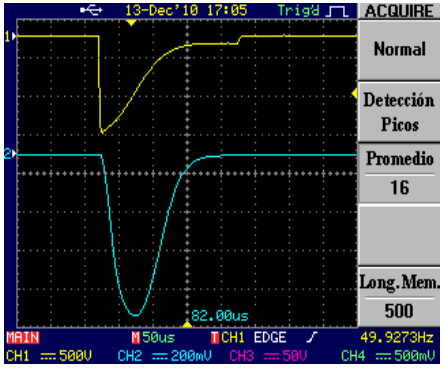
P	8x10-3
Tbreak	100µs
I	280A



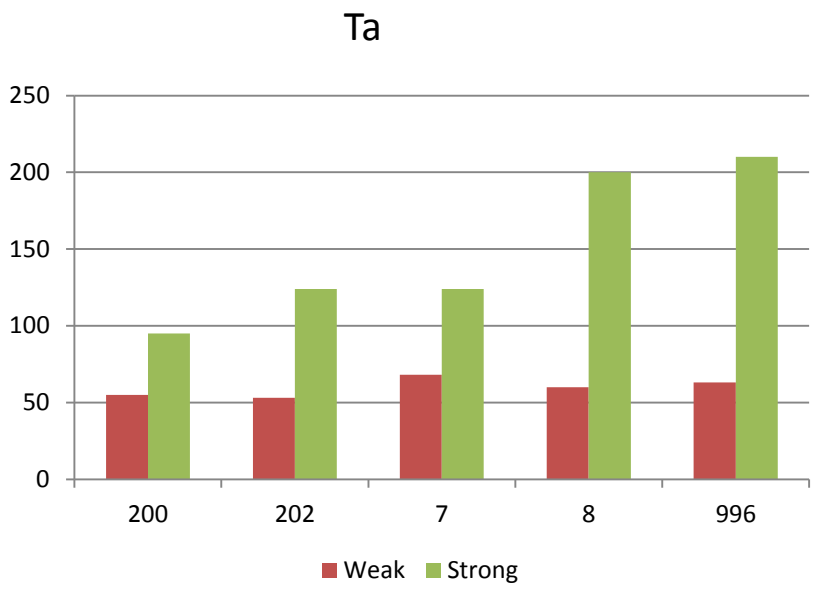
P	10x10-3
Tbreak	75µs
I	375A

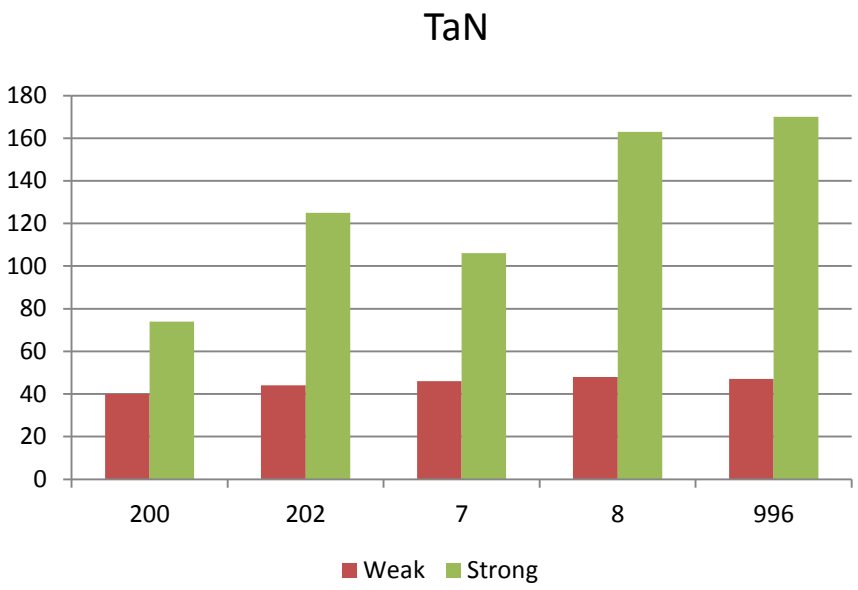


P	13x10-3
Tbreak	50µs
I	410A

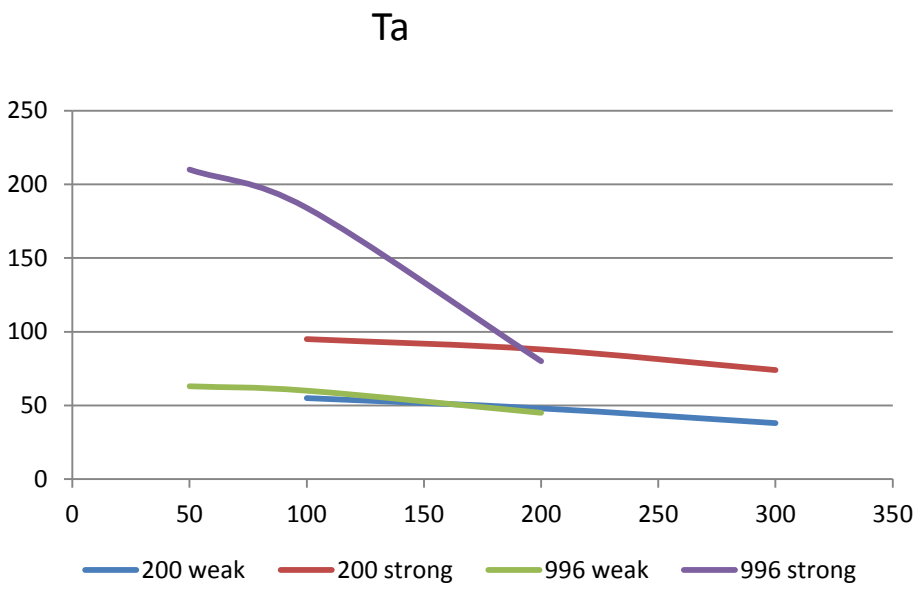


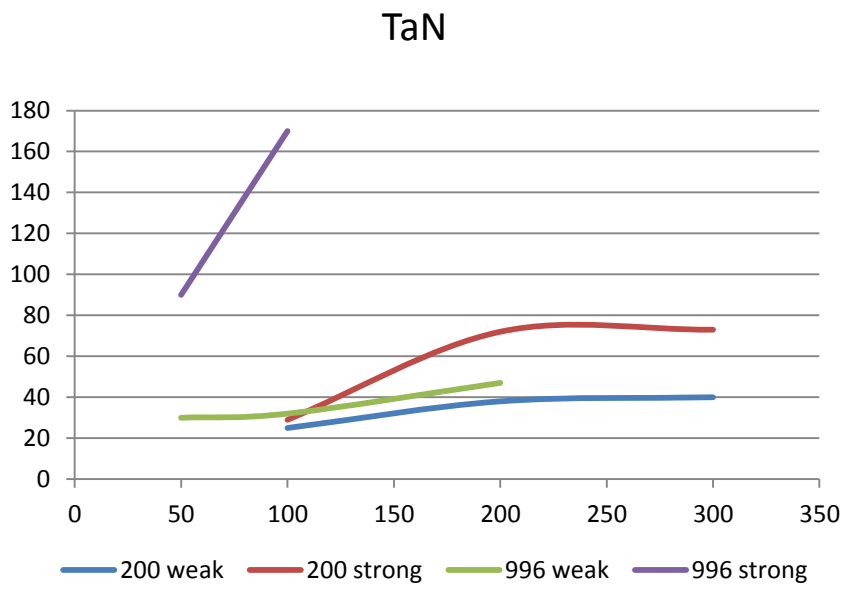
Discharge current vs magnetic field





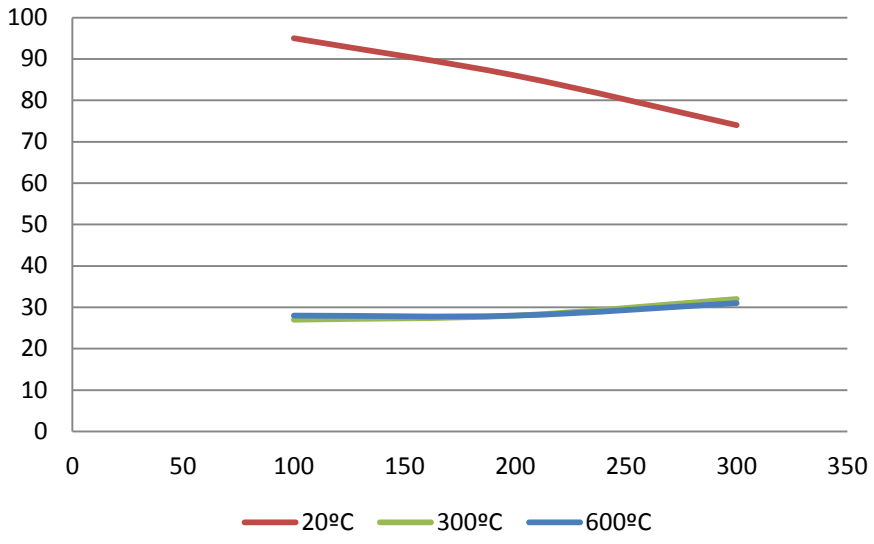
Discharge current vs frecuency



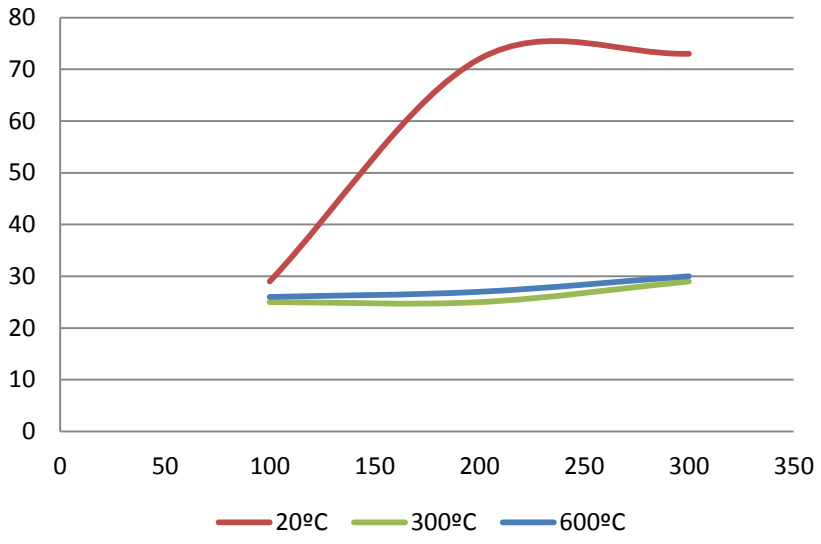


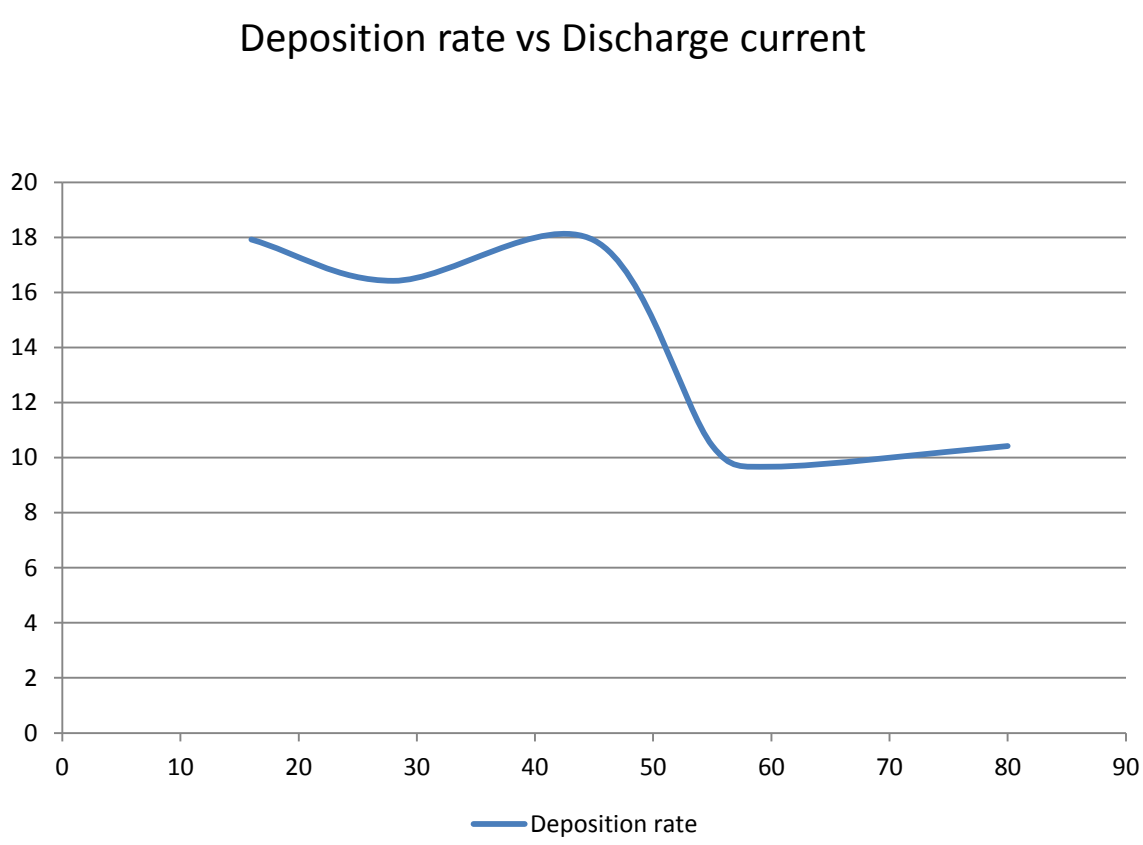
Discharge current vs temperature

Ta



TaN

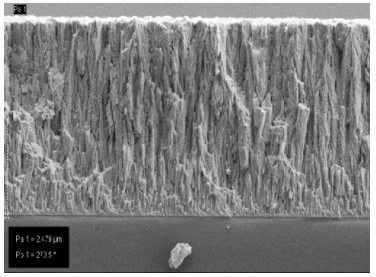


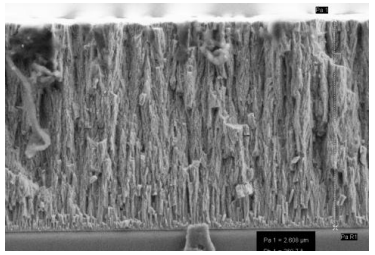

Deposition rate vs Discharge current
20
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
Deposition rate

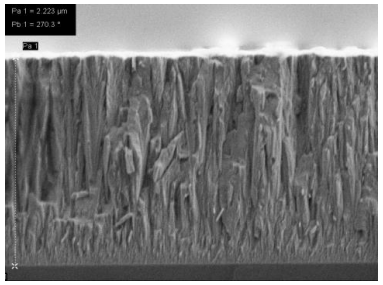
HIPP Processes

	Vpeak (V)	Ipeak (A)	Ppeak (kW)
Pulsed-DC	-770	5.2	4
HIPIMS	-1200	75	90
MPP	-800	100	80

	Thickness (µm)	Deposition rate (nm/min)	Hardness (Gpa)
Pulsed-DC	2.479	20	15.72
HIPIMS	2.594	21	17.76
MPP	2.223	18.5	23.5





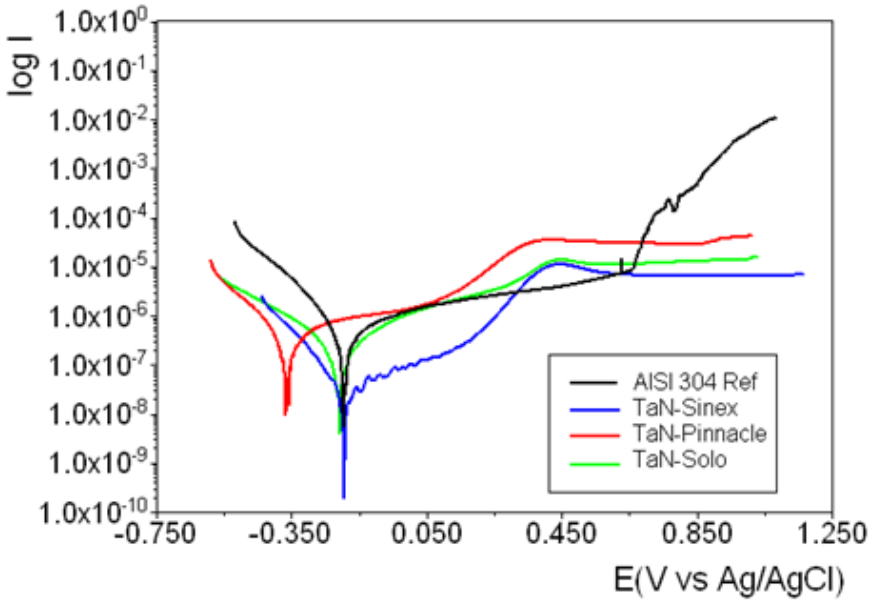


SAME DEPOSITION RATE

HIGHER HARDNESS IN HIPP

- CORROSION TEST

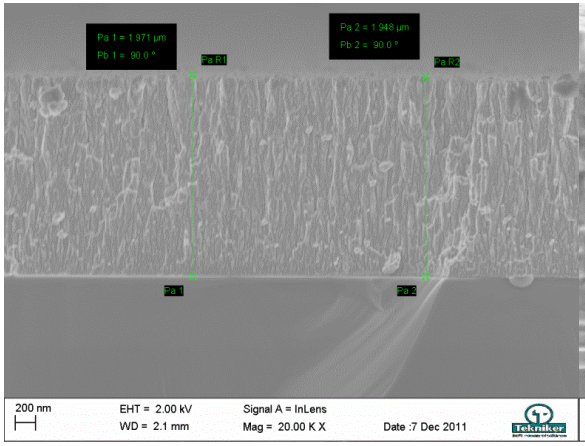
	Ecorr(V)	Icorrx10-6 A	Rp(Kohm)
AISI 304	-0.195	0.63	86.2
Pinnacle	-0.365	0.47	109.3
Solo	-0.208	0.36	205.8
Sinex	-0.194	0.07	987.8



BETTER CORROSION RESISTANCE WITH HIPP PORCESSES

Latest TaN processes

Pulse	Bias (V)	Vpeak (V)	Ipeak (A)	Ppeak (kW)	Hardness (Gpa)	Critical Load (N)
200	50	525	30	15	14	100
996	50	660	58	38	19	86
296	50	520	31	16	16	112
		670	64	43		



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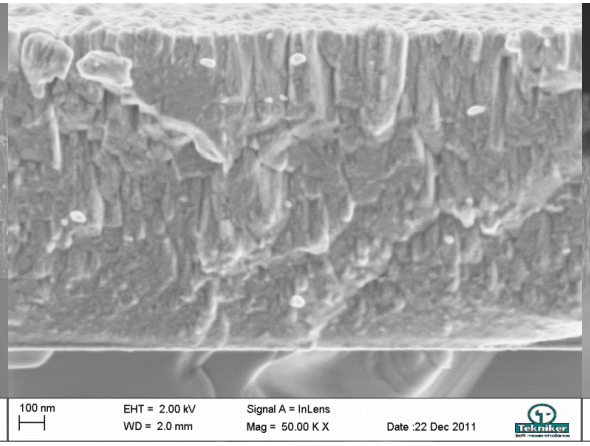

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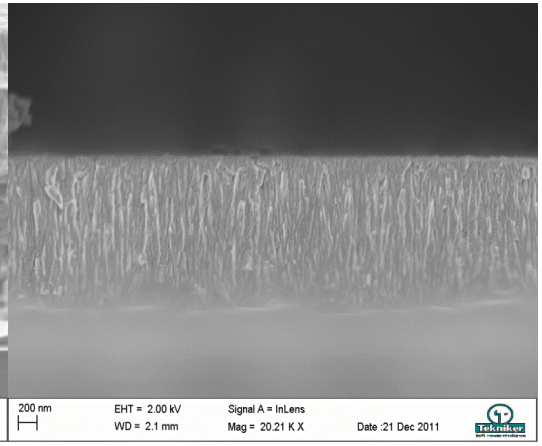
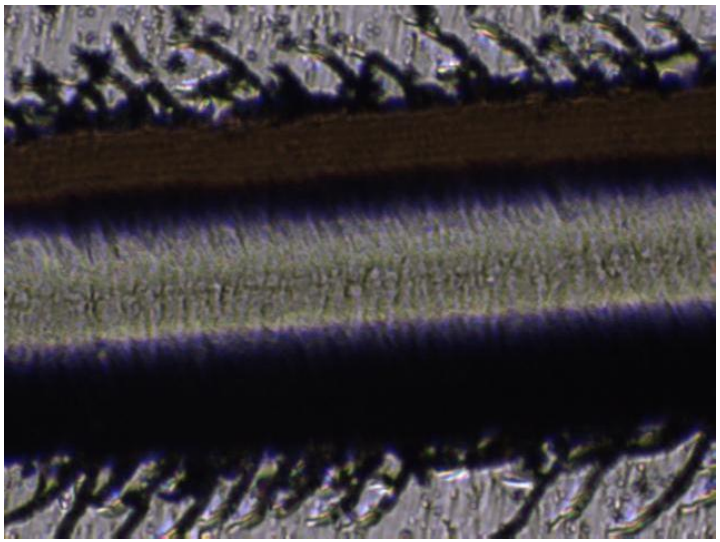


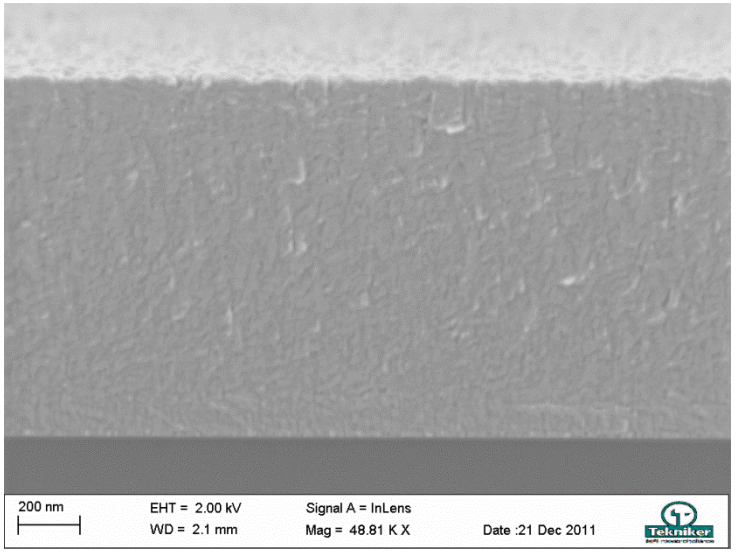
296

Latest TaN processes

Pulse	Bias (V)	Vpeak (V)	Ipeak (A)	Ppeak (kW)	Hardness (Gpa)	Critical Load (N)
996	200	660	60	39	25	122



105 N -- Brittle coating



Totally dense coating

Eskerrik asko

Thank You