





20 years

Advanced

Equipment



24 Millions €

Strong network



285 Experts



200 Projects



THE TECHNOLOGICAL ACCELERATOR OF RESPONSIBLE INNOVATION IN MATERIALS AND PROCESSES





When innovation becomes valuable solutions





For turnkey support from design to industrialization

Our Services







Coating to modified materials



Deposition by magnetron sputtering

Substrate

Target

Voltage (DC, RF, etc.)



- Argon + other gas (N₂, O₂, CH₄...)
- 3 < working pressure < 20 mTorr

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Applications

TiN

Decoration, cutting tools, drill bits, etc.

TiCN

Argon + Reactive gas -

-



Hybrid Coating MeC/CH Chemistry adapted to application



UWC/C:H by a PVD/PECVD hybrid process: W reactive sputtering in Ar/C₂H₂

□ "Green": no solvent
□ Flexible process → compositions



Wilde range of mechanical and tribological properties

Jansson et al. Thin Solid Films, 536 (2013) 1



Hybrid Coating MeC/CH Chemistry adapted to application

□ WC/C:H coatings with various compositions can be synthesized

□ Nanocrystalline WC grains in a hydrogenated carbon matrix



Low friction coefficient, low wear rate combined to moderate hardness

Good alternative to Cr(VI) electroplating

On steel plates



Hybrid Coating MeC/CH Chemistry adapted to application

5 µm Hard Cr by electroplating



« medium [CH] » best properties better or like hard Cr Compromise between mechanical and tribological properties



High entropy alloys Chemistry adapted to application - new development

Classical alloys : 1 or 2 major elements + adding elements to improve some properties

High entropy alloys : Alloys with multi principal elements, \geq 5 equiatomic elements

Highly disordered structure



Theoretical knowledge of bulk alloys from 2004

He & Yang, Front. Mater. 5:42. 2018, 5,42

⇒ New approach with thin films

⇒ New or better surface properties PVD coating from target sputtering Less manufacturing and material cost Green technology

Hardness, wear at high temperature resistance, Corrosion resistance



High entropy alloys Chemistry adapted to application - new development

- 1 µm thin film
- HEA powders or commercial powders
- \Rightarrow quinary FeAIMnCrMo alloy
- Nanohardness : up to 8.5 GPa
- Goal hard Cr : ~ 10 GPa



 \Rightarrow HEA PVD thin films are an interesting alternative





Amorphous alloys Chemistry adapted to application – new development



- ✓ Coating on soft substrate
- ✓ Wear resistance
- ✓ High resistance against corrosion



Ion implantation to modified materials



Why Ion implantation (coating limitation)?







Ion implantation (principles)



Interphase and not interface





Ion implantation (modification)

Hardening effect or nano-screwing

Creation of dislocations

Precipitation of atoms

Decrease in grain size











Improvement of mechanical properties



Ion implantation (bulk metal)



- Increase in surface hardness
- Hardness is dose dependent
- Optimal dose could exist

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- Implantation causes nitrogen precipitation
- Depth of implantation depends on acceleration / dose





Ion implantation (TiAl6V case)



Balls 100 Cr6, 6mm, 25 g, 1cm/s

Increase of the hardness after implantation

Reduction of wear for TiAl6V4





Implantation diffusion (bulk metal)

Implanted ions diffused at 330°C



- Nitrogen implantation in steel
- Greater implantation depth due to species diffusion
- Possibility to address a depth of 5 μ m in diffusion implantation mode
- Pay attention to the surface condition which can change



Implantation diffusion : example of a steel





- Treated thickness up to 5 microns
- Hardness profile up to 850HV on the surface (+150%)
- Following a degressive nitrogen concentration profile.
- Long range" effect up to 12 µm thickness
- Dislocation creation beyond the precipitation thickness

Applications onto coatings







Ion implantation (on electro-Coatings)



Densification and closure of coating pores



Ref

N2 2^E17 ions/cm2



Ion implantation (on PVD Coatings)

Implantation of columnar PVD layers (Molybdenum coating)



- Closure of pores and densification brought by the columnar growth
- Creation of a double structure dense on columnar
- Proven increase in surface hardness





Merci pour votre attention

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