ECOCHROM

A Growth-IMS project

HCAT Meeting
March 15 - 17th , 2005

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Summary

- Objective of the project
- List of Partners and Map
- Some words on Ecochrom programme
- WP(s) progress
- Technical results
- Conclusions

IMS Project

OBJECTIVES : IMS is an international research and development (R&D) program, established to develop the next generation of manufacturing and processing technologies.

MEANS : IMS provides a support structure for conducting R&D projects….

EXPECTED RESULTS :

- can help to improve manufacturing operations,
- enhance international competitiveness,
- lead to technology breakthroughs via market-driven R&D.

More informations on : **www.ims.org**

Objectives of ECOCHROM

To develop an environmentally and economically acceptable process allowing to obtain :

- **harder thick chromium coatings**
- **more resisting to the corrosion than the traditionnal coatings,**

from a new and non toxic electrolytic solution.

ECOCHROM : IMS prog.

ECOCHROM Programme :

- **24 partners**
- **Duration : 42 months (extended to 48)**
- **From April 1st, 2002 to March 31st, 2006**
- **12 Work-Packages**
- **Global IMS Budget : 11 Millions Euros**
- **Divided in 5 different "regions"**
- **Global European Budget : 5.7 millions €**
- **European Commission funding : 2.6 millions €**

Technical Objectives

Electrolyte for chromium plating which allows :

- **Co-deposition**
- **Improvement of corrosion resistance**
- **Improvement of µ-hardness with heat treatment**

Objectives :

- **Developping the process on an industrial scale,**
- **Competitive with dry process…HVOF**

ECOCHROM Partners

"EU" PARTNERS

- Traitements de Surface et Mécanique Protection des Métaux (F)
- Hartchrom AG (CH)
- Ionhawk Oy (Fin)
- Ikan-Kronitek (E)

Industrial platers

- Ecole Nationale Supérieure des Mines de Saint-Etienne (F)
- Institut Traitement Surface (F)
- Cidetec (E)

Fondamental research

- VTT Manufacturing (Fin)
- IVF (S)

Applied Research

- EADS CCR (F)
- Daros Piston Rings AB (S)

End-Users

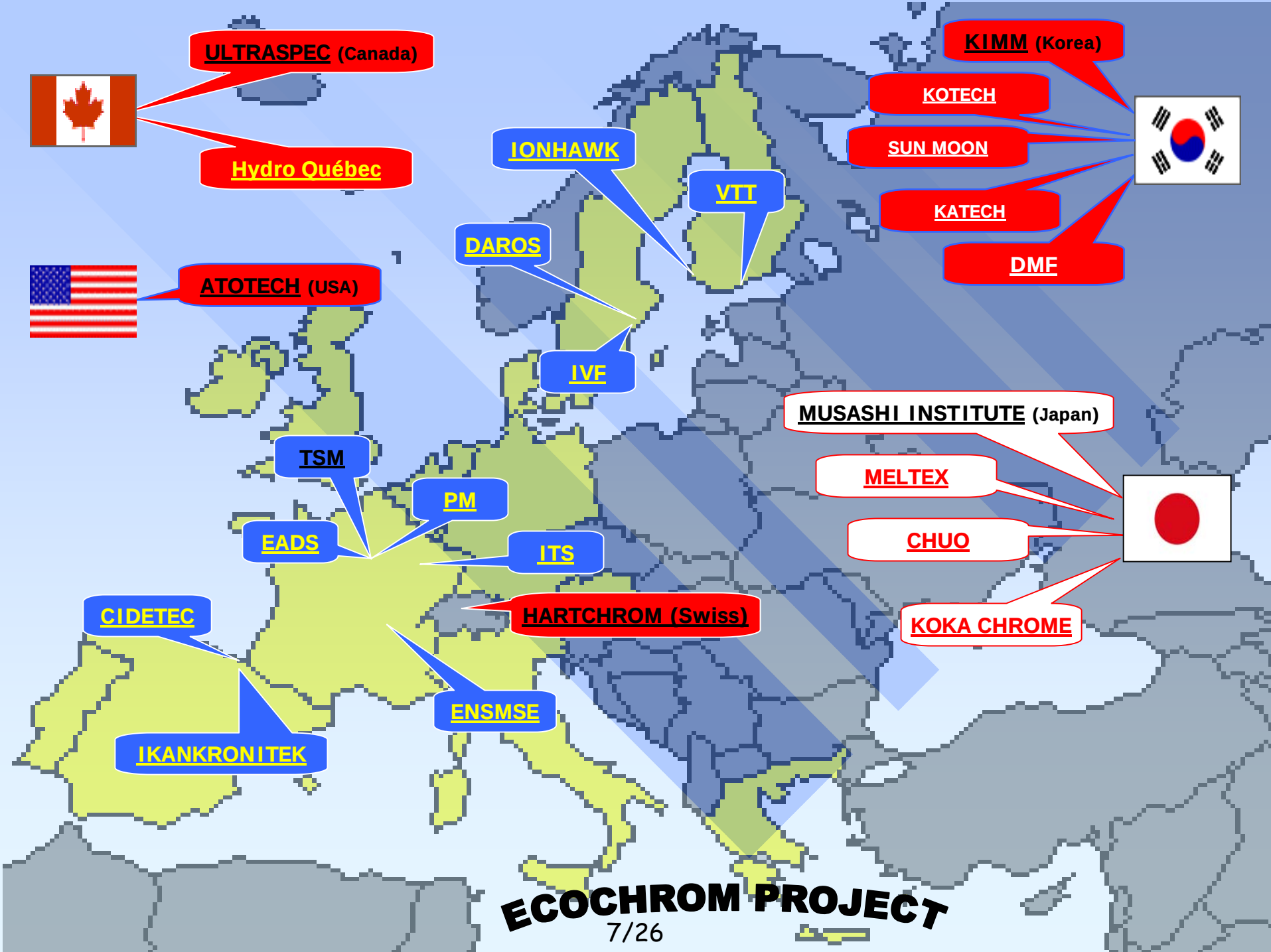
"REGIONAL" PARTNERS

CANADA :
- ULTRASPEC
- Hydro Québec

USA :
- ATOTECH

JAPAN :
- MUSASHI INSTITUTE
- CHUO
- MELTEX
- KOKA CHROME

KOREA :
- KIMM
- KATECH KOTECH
- SUN MOON
- DMF


ULTRASPEC (Canada)
Hydro Québec
ATOTECH (USA)
IONHAWK
VTT
DAROS
IVF
TSM
PM
EADS
ITS
CIDETEC
HARTCHROM (Swiss)
ENSMSE
IKANKRONITEK
KIMM (Korea)
KOTECH
SUN MOON
KATECH
DMF
MUSASHI INSTITUTE (Japan)
MELTEX
CHUO
KOKA CHROME
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7/26

ECOCHROM: WPs

WP(s) Done : (X)

- **X WP 1 : State of the art (bibliography)**
- **X WP 2 : Users and Suppliers requirements : specifications of end-users and suppliers**
- **X WP 3 : Preliminary studies : Cr(VI) and decorative Cr(III) results**
- **X WP 4 : Laboratory development : Development of acceptable processes (following specifications)**

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WP(s) in progress : (O)

OX WP 5 : Optimisation of coatings performances: modification of different parameters

O WP 6 : Validation of laboratory experiments : 50 – 300 l

O WP 7 : Synthesis of the results :

O (Starting) WP 8 : Industrial validation : real components

OX WP 11 : Management

O WP 12 : Link with HCAT programme

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WP 12 : Link with HCAT programme

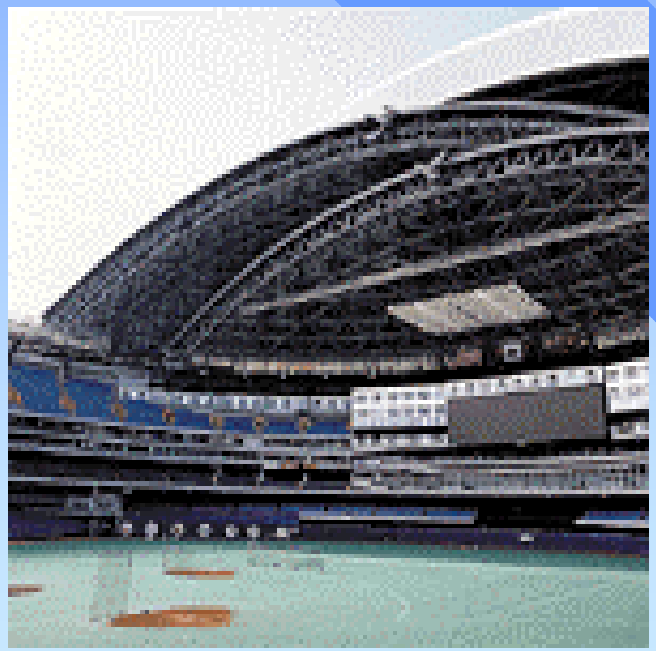
- ***Objective*** **: Perform comparisons between techniques developped in both projects : HVOF and electrochemical deposits**

- ***Work*** **: Characterisation and evaluation of the BAT developped within HCAT and ECOCHROM programme (on samples)**

- ***Purpose*** **: writting a specific synthesis report or guide of potential hard coatings as substitute to Cr(VI)**

HCAT Participation

"Toronto"
September 25-26th, 2002



Skydome

Toronto

HCAT Participation

"Kennedy Space Center - FL"
November 18-20th, 2003

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Not yet begun, next year

WP 9 : Technical and Economical Assessment : validation of innovative Cr(III) solution (technically economically, environmentally).

WP 10 : Users Guide :
report of the work carried out, also a users'guide including recommendation for good utilisation of the processe(s)

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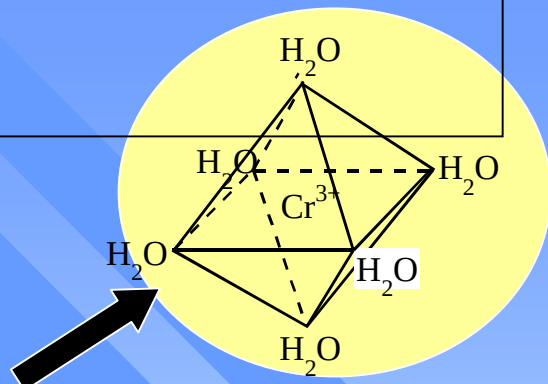

WHY ?

- **High stability of $Cr^{3+}(H_2O)_6$ complex**
- **High reduction potential ($Cr^{3+} \Rightarrow Cr^0$) $\Rightarrow$ $H_2\nearrow \Rightarrow$ pH$\nearrow$**
- **pH$\nearrow$ $\Rightarrow$ formation of non-reducible compounds : olation, oxolation, polymerisation, hydroxides…**
- **Numerous compounds able to be created**

HOW

- **Using trivalent chromium complexed compounds**
- **Using trivalent chromium obtained by reduction**

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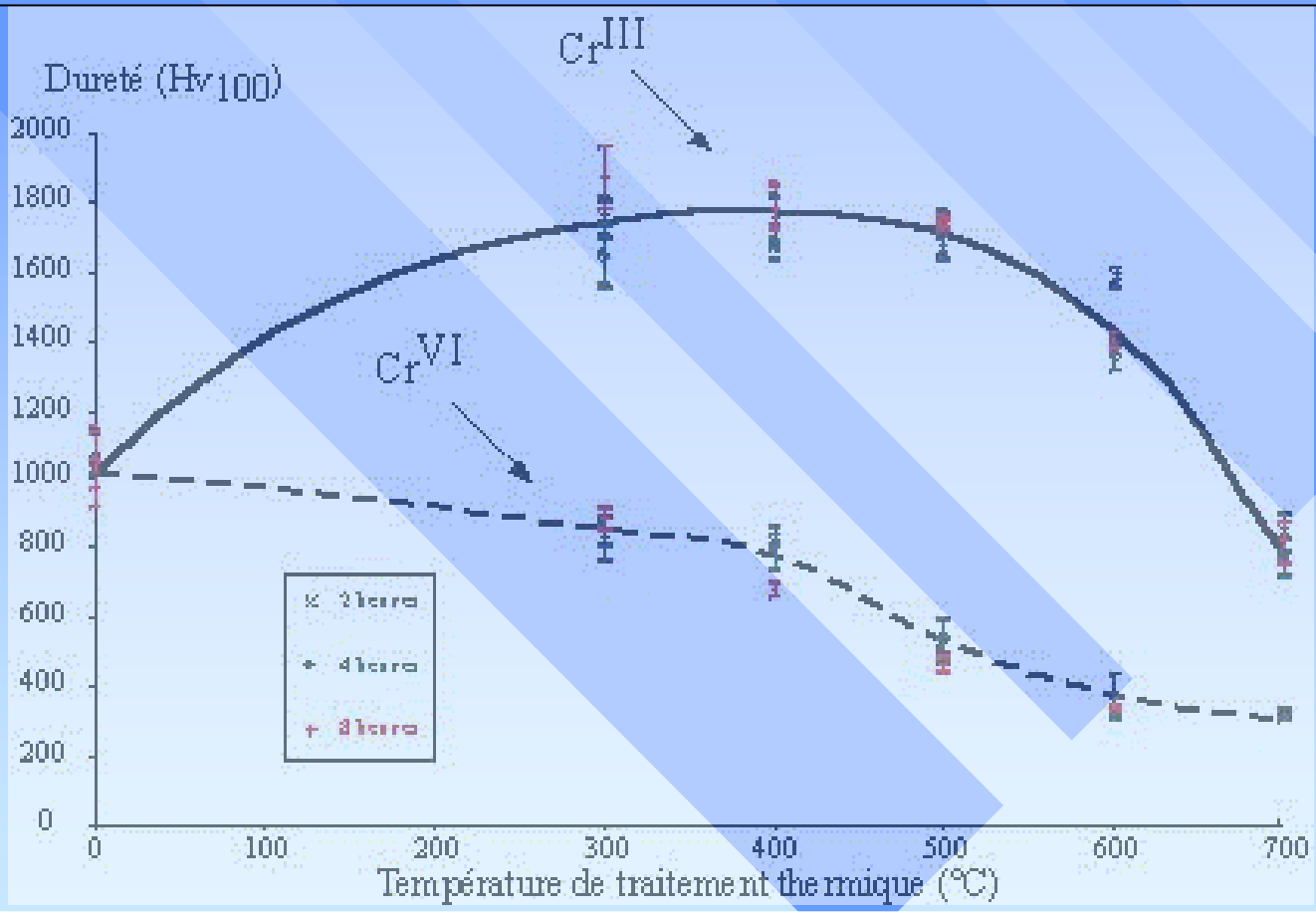
MAIN CHARACTERISTICS of Cr(III)

- (+) : Environmental : regulation
- (+) : Economical : efficiency, effluents,...
- (+) : Decorative aspects interesting
- (-) : Hard Chromium Plating difficult

- (+) : Hardened by heat treatment

Trivalent Chromium



Variation of microhardness as a function of thermal treatment temperature for hexavalent and trivalent Cr Deposit

ECOCHROM :

Processes currently in progress after laboratory development at pilot scale :

- **I - Trivalent Chromium complexed**
- **II - Trivalent chromium obtained by reduction (CrVI)**

Cr(III) complexed

Bath composition:

- Chromium chloride: 300g/L,
- Boric acid: 30g/L,
- Glycine: 50g/L,
- Ammonium chloride: 130g/L,
- Aluminium chloride : 50 g/L
- pH : 0.5 - 1

Plating conditions:

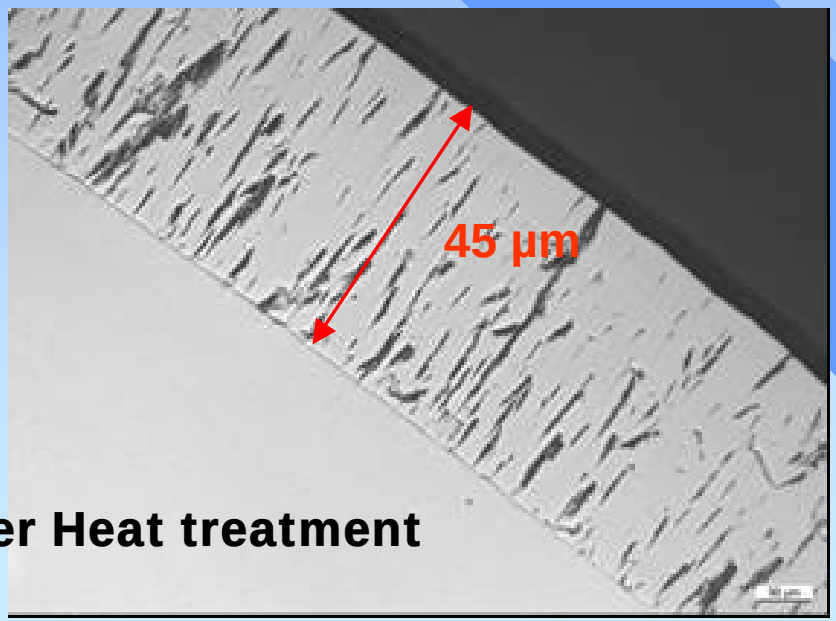
- Bath temperature: 30-50 °C
- Current density: 30-40A/dm^2 (mainly 40A/dm^2)
- Anode: Ti(Pt), Ti(Ir_2O_3), C

Cr(III) complexed

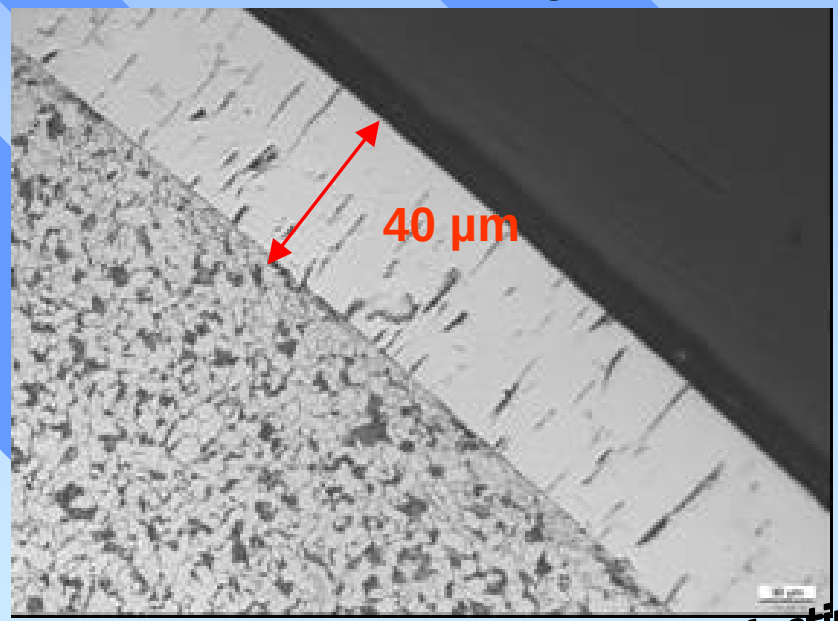
Rate of deposition : 1µm/mn 45 A/dm²

Microhardness : 700 to 800 HV_{100g}

1500 to 1800 HV_{100g}



After Heat treatment



Cr(III) complexed

TESTS in PROGRESS at different SCALE :

50 Litres and 200 Litres :

Different partners from Europe and Japan

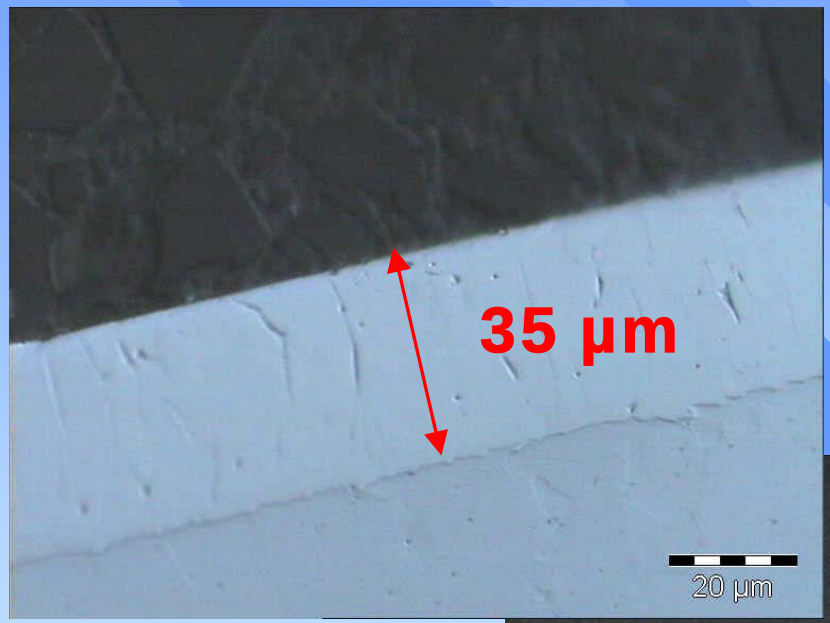
- **Confirmation of laboratory results**
- **Parts to be tested in real applications**

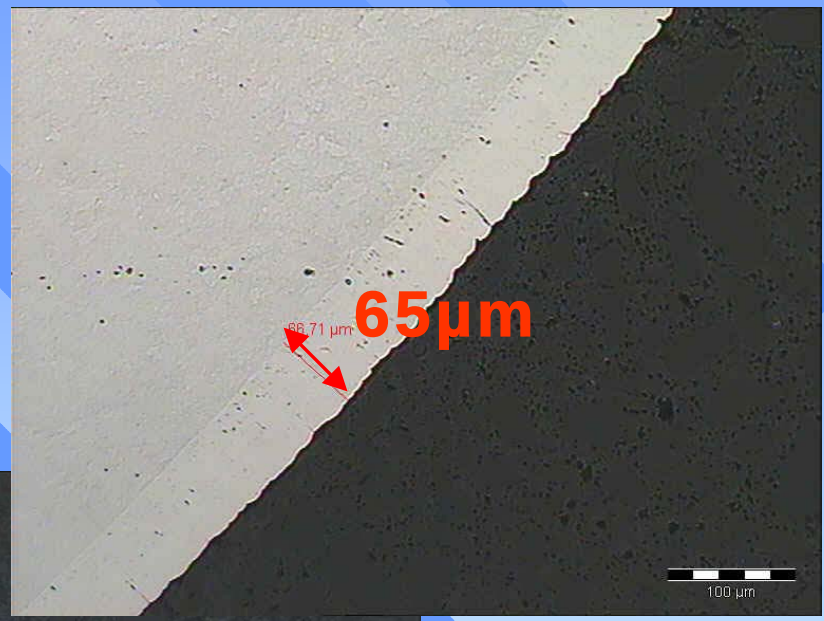
Cr(III) reduced

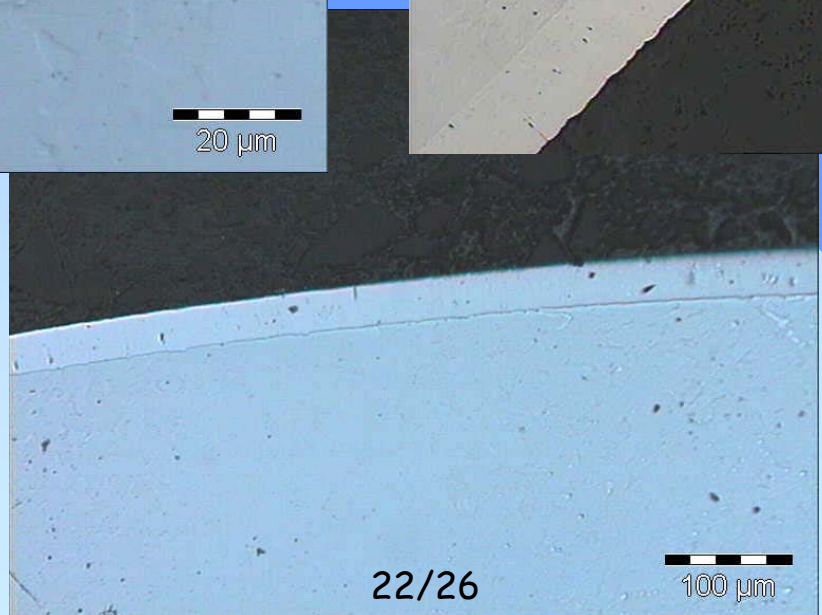
- AQUEOUS SOLUTION : CrO_3 reduction - 💥 danger ! !
- PROCESS CHARACTERISTICS :
  - 50-70 g/l (Cr(III)), Chloride medium < 1 ppm
  - Conductive salt : NH_4Cl, Buffer : H_3BO_3,
  - Wetting agent
  - Anodes Ti (Pt) or Ceramics

    80 A/dm², 50°C, 3µm/mn
- DEPOSIT CHARACTERISTICS :
  - Thickness about 50 to 100 µm
  - Microhardness : 1000HV/100g
  - Cracks through the deposit

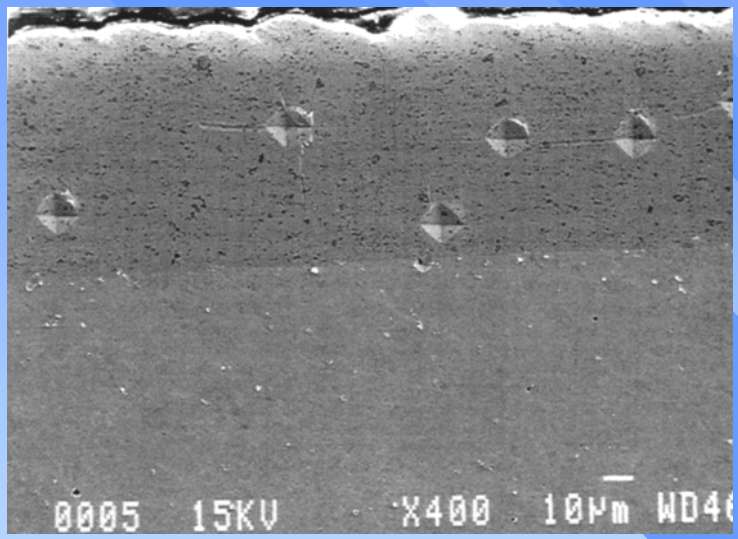
Cr(III) reduced

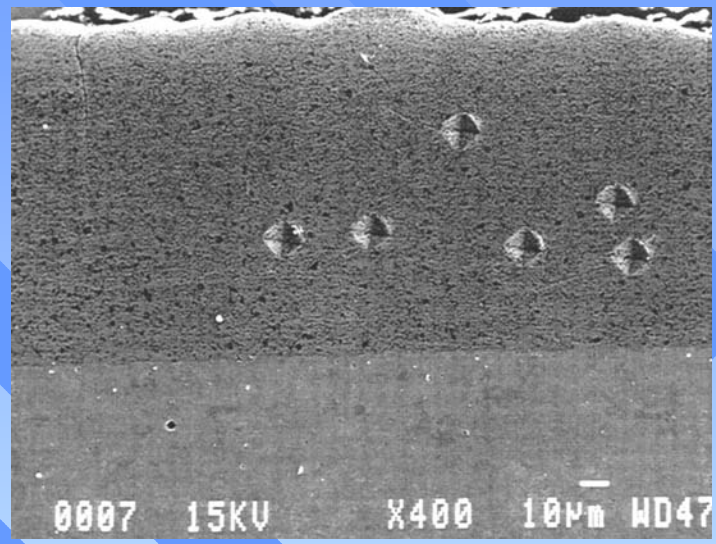


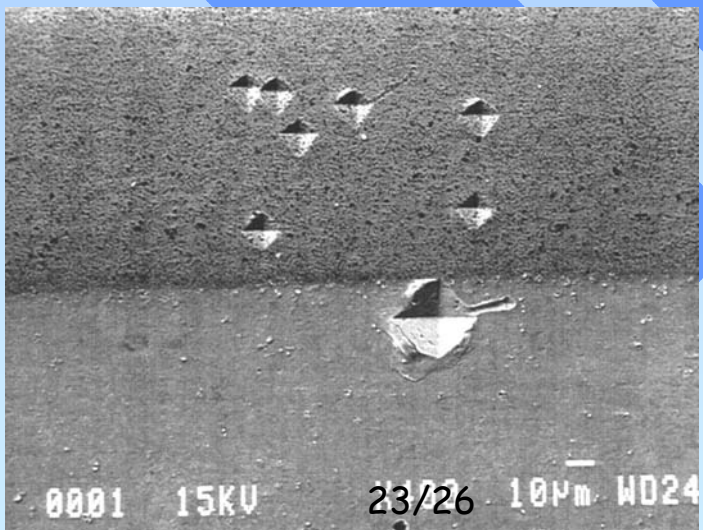




Cr(III) reduced







Cr(III) reduced

TESTS in PROGRESS at pilot SCALE :

50 Litres

Different partners from Europe

- **Confirmation of laboratory results**
- **Parts to be tested in real applications**
- **Replenishment efficient (no by-products)**

Conclusions

RESULTS:

- **2 processes in development**

WORKS DONE :

- **Replenishment and life time of bath : OK**
- **Tests on small real parts (pilot scale): 50 – 200 liters**

WHAT TO DO NEXT

Tests on 500 to 1000 L tanks with real parts (next year).

Thank you for your attention !...

And Thank you to the HCAT team for their support and for their efficient welcome !