MULTIDISCIPLINARY TECHNOLOGIES FOR HEXAVALENT CHROMIUM REPLACEMENT IN SURFACE TREATMENT







PASSIVATION / CONVERSION LAYER

hybrid inorganic/organic coatings by sol gel processes





Hydrolysis /condensation of Si, Zr or Ti-based precursors (in water or alcohol)

Coating application (dip, spray, roll coat)

Formation of a 3D-network (thermal or UV curing)

Corrosion protection

Efficient barrier effect with low thickness (few μ m)

Protection of aluminium alloys Aluminium Sol gel

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CASS Test 48h Protection of galvanized steel



Cathodic polarization curves in NaCl 0.1M Sol gel formulation can be combined with corrosion inhibitors or nanocontainers to provide active corrosion protection

Pre-treatment : adherence promoter for paint



Without silane



Organosilane without curing



Organosilane curing at 180°C

Cathodic delamination test on scratched powder coated HDG



FUNCTIONALIZED NANOCLAYS AS CORROSION INHIBITOR NANOCONTAINERS self-healing pigments for coatings ·



Incorporation of corrosion inhibitors in nanocontainers : provide « self-healing » of the metal in the presence of an artificial defect or ingress of aggressive species

- Fast or slow diffusion of inhibitive species to the metal
- Different types of release trigger (pH, ionic strength, etc.)

Focus on the use of nanoclays

- Platelet shape : increases barrier properties
- Ion exchange capability : incorporation of cationic or anionic corrosion inhibitors
- Cheap material easily functionalized



Double layer hydroxide (anionic)

Suspensions of 5wt% of nanocontainers in NaCl solutions with different ionic strengths



Incorporation in organic coatings

Reference



30 minutes



4 hours



4 hours

Water-based polyurethane on Al 5005 : **Boiling water resistance**



Epoxy resin on Al 5005: EIS (barrier properties) and evaluation of delamination scratched coatings (immersion in NaCl 0.5M)





HARD CHROMIUM different technologies depending on the material requirements or applications

WC : CH hard coating by PVD (physical vapor deposition)



- Magnetic field (B) superposed to electrical field (E)
- 10-1 < pressure < 1 Pa
- Ar + reactive gas





- Hardness decreases when X(C2H2) increases
- X(C2H2)=15 %, best compromise between mechanical and tribological properties
- Better mechanical properties than reference : 5µm hard Cr (from CrVI)

Ni alloys as alternatives for hard chromium electrodeposition

Nickel Tungsten : combination of mechanical and corrosion protection thanks to the co-deposition of tunsten and formation of a passive tungsten oxide layer

Nickel Chromium (CrIII) : combination of chromium with other elements to ductilise the coating and reduce the cracks (main issue with CrIII electrodeposition)





Multilayers

- One bath but modulating application parameters
- Alternating US conditions
- Creating interfaces allowlimiting crack propagation





PLASTIC METALLIZATION

alternative « dry » processes for surface preparation, activation and metal coating application





CrVI alternative platform products, processes and characterization facilities to support « green » transition

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