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&

ArcelorMittal

Developpements des technologies sous vide pour le traitement au défilé de produits plats

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1981- 1991: HFP Bandstahl GmbH, Germany

Aluminum strip coater, fully continuous air-to-air operation

strip parameters :

width 635mm, thickness 0.2-1.0, speed line 30-120m/min

PVD technologies for metal strip has been introduced in industry from the 1980 years :

- 1981-1991, Germany, HFP Bandstahl GmbH, aluminium strip coater
- 1981-1990, Japan, Nisshin Steel, zinc strip coater
- 1990-1996, Japan, Kobe Steel, Al, Ti, Cu, Cr strip coater
- 1993-2000, China, JHSSC, Cu and Ti strip coater

- 1994 - , Germany, ALANOD, light reflectors coater on Al strip
- 2000 - , USA, OVONICS, solar cell coater on Stainless Steel strip
- 2005 - , Belgium, ARCEO, ArcelorMittal, steel products for industry

…. What was the base of the failure in industry during the 1980 years and success 10 years later?

Main reasons of the difficulties to introduce the technologies in metal industry in 1980:

✓ hard competition with other established technologies : hot-dipping, electroplating, cladding

✓ maintenance of the vacuum equipments, low metal coating efficiency

✓ no sufficient engineering competence regarding innovative tasks

Few reasons of success to manufacture products on metal strip now:

✓ Innovative products

✓ High process control system to maintain a high product quality

✓ Flexibility of the line given by the installation of different vacuum technologies

ALANOD - Germany

High performance optical coating on anodized Al substrate

- 1994, AlBA1, annual capacity 4 million squaremeter
  - Number of coating 4
- 1998, AlBA 2, annual capacity 5 million squaremeter
  - Number of coating 5
- 2003, AlBA3, annual capacity 5 million squaremeter
  - Number of coating 5

H. Küster VacMess 2005 - Germany

Energy Conversion Device (ECD Ovonics)

Continuous roll-to-roll manufacturing of thin film amorphous silicon alloy multi-junction solar cells on Stainless Steel strip

- 2000, Auburn Hill 1,
  - capacity 28 MW – 0,4 million m^2/year
- 2006, Auburn Hill 2,
  - capacity 30 MW
- 2008, Auburn Hill 3,
  - project 60MW

Dr. M. Izu VacMess 2005

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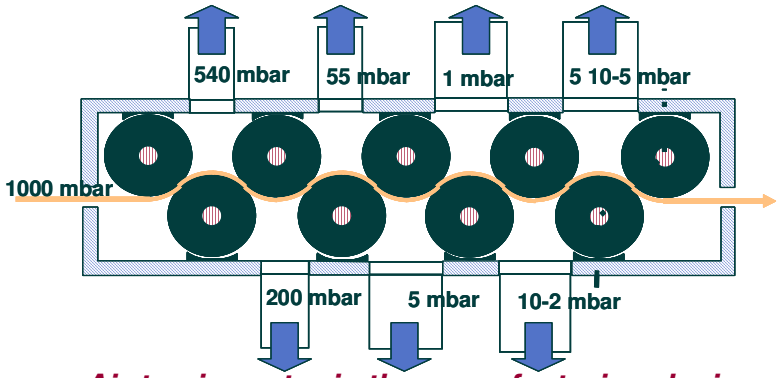
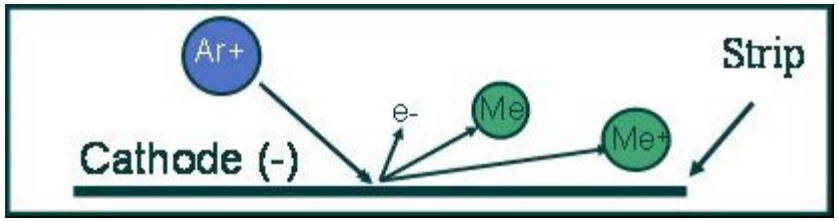
PVD Technology for metal strip

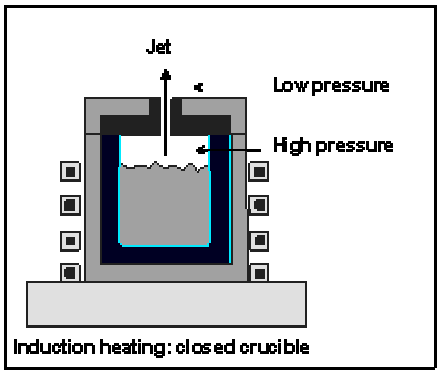
"Physical Vapour Deposition (PVD)" processes constitute a family of vacuum techniques for coatings and surface treatments. The different steps are the creation of a metallic or non metallic vapour (by sputtering or evaporation), transportation under vacuum of atoms (with or without plasma assisted) and condensation on a substrate.



Air to air coater is the manufacturing design of process line for deposition on metal strip coating.

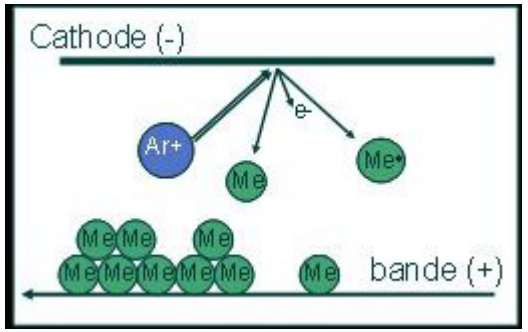


Ion bombardment by Sputter Etching device to clean the metallic surface is essential to get a good coating adhesion.



Patent CRM Belgium

… and micrometric coating of metal or alloy by "Jet Vapour Deposition".



Deposition of nanolayer to functionalize metal strip can be achieved by Sputtering Deposition …

Rotative cylindrical Magnetron

AC and DC sputtering

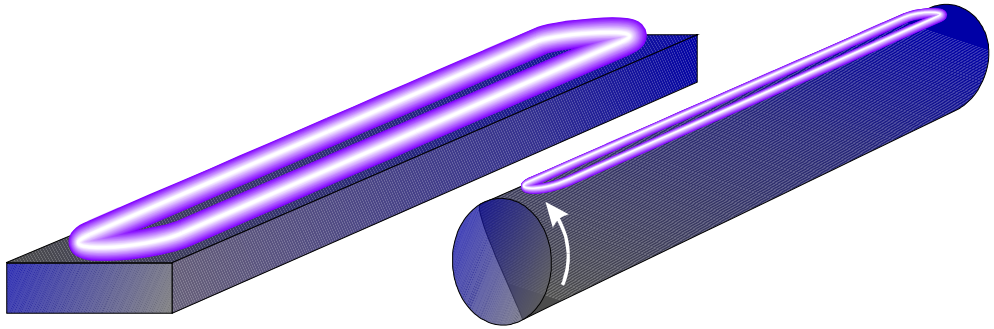
Advantage of Circular magnetron target

High power density
(20W/mm of racetrack circumference)

High deposition rate
(75nm by m/min for TiO_2)

High target material utilization
(70~ 85%)

Reduction in arcing and defect generation in reactive sputterring



Planar or Circular Magnetron Target

ARCEO – Roll-to-roll PVD line for steel

ArcelorMittal picture – ECCA Bruxelles nov 2004

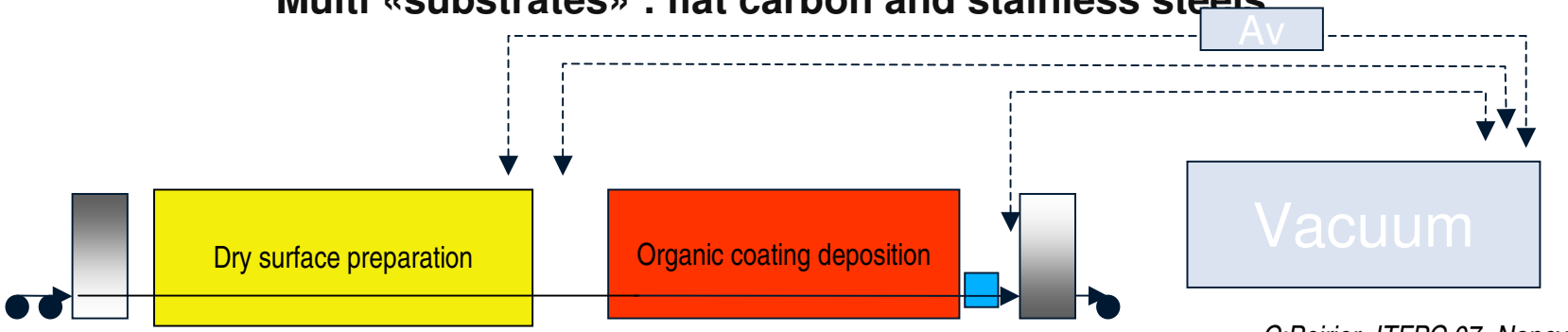
ARCEO – Roll-to-roll PVD line for steel

- **Identity :** **a new production line of Arcelor Operationnal Unit Center Europe ,Cold Plant of Liège**
- **Location :** **Ramet , Liège**
- **Production :** **Industrial Line (from October 2005)**

A wide dimensionnal range :
Width : 700 to 1500 mm

Multi «Products/Markets» ability

Multi «substrates» : flat carbon and stainless steels



C:Poirier- ITFPC 07- Nancy

PVD Products / Markets

Arceo Products

- **Esthetic Surfaces**
  (Decorative aspects)

- **Reflectors**
  (Lignt Management Surfaces)

- **Easy cleaning/ anti staining**
  (Active surfaces)

- **Adhesion Provider**
  (Step to organic coatings reengineering, process learning curve)

- **High corrosion performance coating**
  (D. Chaleix presentation)

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