The New PVD HI3-Technology: Latest Developments and Potential for Coining Dies.

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Oerlikon
The New Segment Surface Solutions

Segment Manmade Fibers
Segment Drive Systems
Segment Vacuum
Segment Surface Solutions
Segment Advanced Technologies

Oerlikon Balzers + Sulzer Metco
Two pioneers under one roof

Sulzer Metaplas GmbH
Oerlikon Metaplas GmbH
The merger of Balzers and Metco will form a global technology leader in surface solutions

**Surface Solutions Segment**

- **THICK LAYER COATING**
  - Thermal Spray
- **THIN FILM COATING**
  - PVD
  - PECVD (PACVD)
- **NITRIDING**
  - Plasma Nitriding

**Transaction summary**

- Signing Jan. 30, 2014
- Closing June 2, 2014
- Enterprise value of CHF 1 bn
- Forms the Surface Solutions Segment
- Surface Solutions to become largest Segment of Oerlikon Group
- Represents the latest step in Oerlikon’s transformation process
- Positions the Group for long term profitable growth
PVD Technology

PVD coatings
- have a high surface hardness
- increase wear protection
- have high chemical resistance, a low tendency to stick and weld
- have an excellent layer adhesion.

PVD coatings on coining dies are used for many years now around the world.

PVD coatings substantially increase the lifetime of dies and quality of coins.
PVD Technologies offered today

Innovative APA Arc Technology
- High target utilisation
- Low target cost
- High deposition rate
- High Ionization rate (up to 100%)
- Excellent coating adhesion

Magnetron Sputter Technology
- Wide range of materials
- Low deposition rate
- Low Ionization rate (30-40%)
- Medium coating adhesion
- Smooth coatings

HiPIMS Sputtering Technology
- Wide range of materials
- Low deposition rate
- High Ionization rate (up to 90%)
- Very good coating adhesion
- Very smooth coatings
A New Innovative PVD Technology

High Ionization 3 (triple)
The Combination of three high ionization processes has been developed.

Oerlikon Metaplas has developed and combined 3 technologies with high ionization:

- **AEGD**: high ionized plasma etching process
- **APA Arc**: high ionized arc coating process
- **HIPIMS**: high ionized sputter coating process
High Ionization in PVD Processes

A high ionization during the coating process is important because:

- it is necessary for dense and very smooth coatings
- better phase and composition control is possible
- less defects within the coating are produced
- a high coating adhesion can be achieved

This provides an excellent tool to design coatings with required improved properties
A New Innovative PVD Technology

HI3 Technology

- For the first time, process and material combinations can be applied, that offer completely new opportunities for high performance PVD coatings.
- Combined strengths of 3 processes in one PVD system
- Innovative approach to the next generation of PVD coatings for various applications
- **HI3 Technology** allows to achieve layer architectures that could not be realized previously by standard technologies.
A New Innovative PVD Technology

Arc specific materials:

(Me1Me2Me3X)
- CrX
- TiX
- AlTiX
- AlCrX
- AlTiCrX
- .......... 

Magnetron materials:
Si, VX, B₄C ...

top layers on APA Arc coating

doping/ nanolayers

- APA Arc module
- HiPIMS module
- Anode of AEGD etching module
First **HI3 Coatings** have been developed:
1. APA Arc $AlTiN + HiPIMS AlTiSiXN$

First cutting tests showed potential in cutting of stainless steel. However, we are looking for more tailored coatings not only for cutting tools.
First HI3 Coatings have been developed:
2. APA Arc AlTiN + HiPIMS VXN

H = 2297 +/-109, E(0.3) = 419 GPa

H = 2824 +/-131, E(0.3) = 408 GPa

Hardness 2775 +/-40, E(0.3) = 345 GPa

First promising results for taps, stamping and small forming tools. However, we are looking for more tailored coatings also for other tools.
First **HI3 Coatings** have been developed:

3. APA Arc **AlTiN** + HiPIMS **SiBCN**

SiB based coatings have the highest scientific published oxidation resistance. The alloying with SiB results in a grain refinement of the AlTiN.

**SiBNC**: amorphous
- micro hardness: 20 GPa
- E-Modulus: 250 GPa

**AlTiN/SiBNC**: fine columnar
- micro hardness: 28 GPa
- E-Modulus: 350 GPa

**AlTiN**: columnar
- micro hardness: 27 GPa
- E-Modulus: 300 GPa
Summary

- **HI3 Technology** combines the strengths of 3 processes in one PVD system: excellent adhesion, high deposition rate, smooth coatings, economic production

- Innovative approach to the next generation of PVD coatings for various applications.

- First developed **HI3 coatings** show promising results for a wide range of application.

- With **HI3 Technology** coatings for coining dies can be tailored
  - by a wide range of materials
  - by micro alloying
  - by doping
  - by design of layer architecture

- **HI3 Technology** has great potential for improvement according to the needs of coining applications: for **circulation coining dies** and for **proof coining dies**.

- You are welcome to start testing and improving with us to the best suitable coating for your coining application.
17 Oerlikon Metaplas PVD coating systems have been installed at mints worldwide:

- Royal Canadian Mint
- Shanghai Mint, China
- Royal Thai Mint, Thailand
- Venezuela Mint
- Ukraine Mint
- Chengdu Mint, China
- Casa de Moneda, Mexico
- Shenyang Mint, China
- Mint of Finland
- Nanjing Mint, China
- Noida Mint, India
- Ukraine Mint
Thank you.