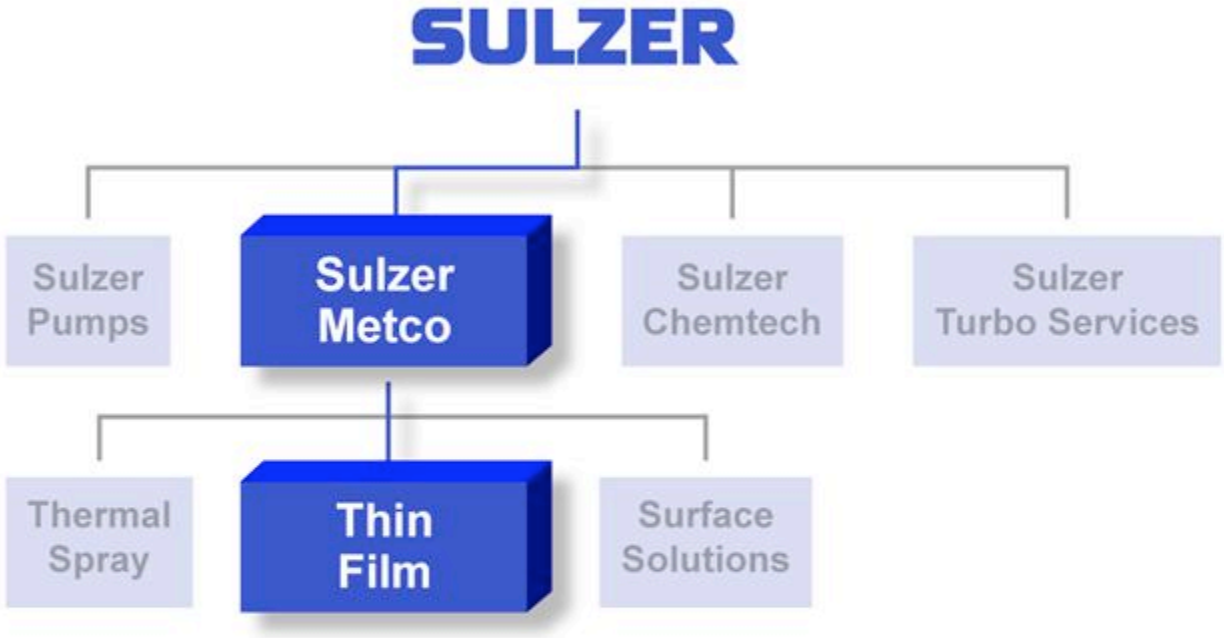
Welcome to Sulzer Metaplas GmbH!

Company Presentation Sulzer Metaplas GmbH, September 2008

Corporate structure

- founded in 1834
- stock-quoted company (Switzerland)
- 2007: 3.5 billion CHF
- 11,600 employees worldwide



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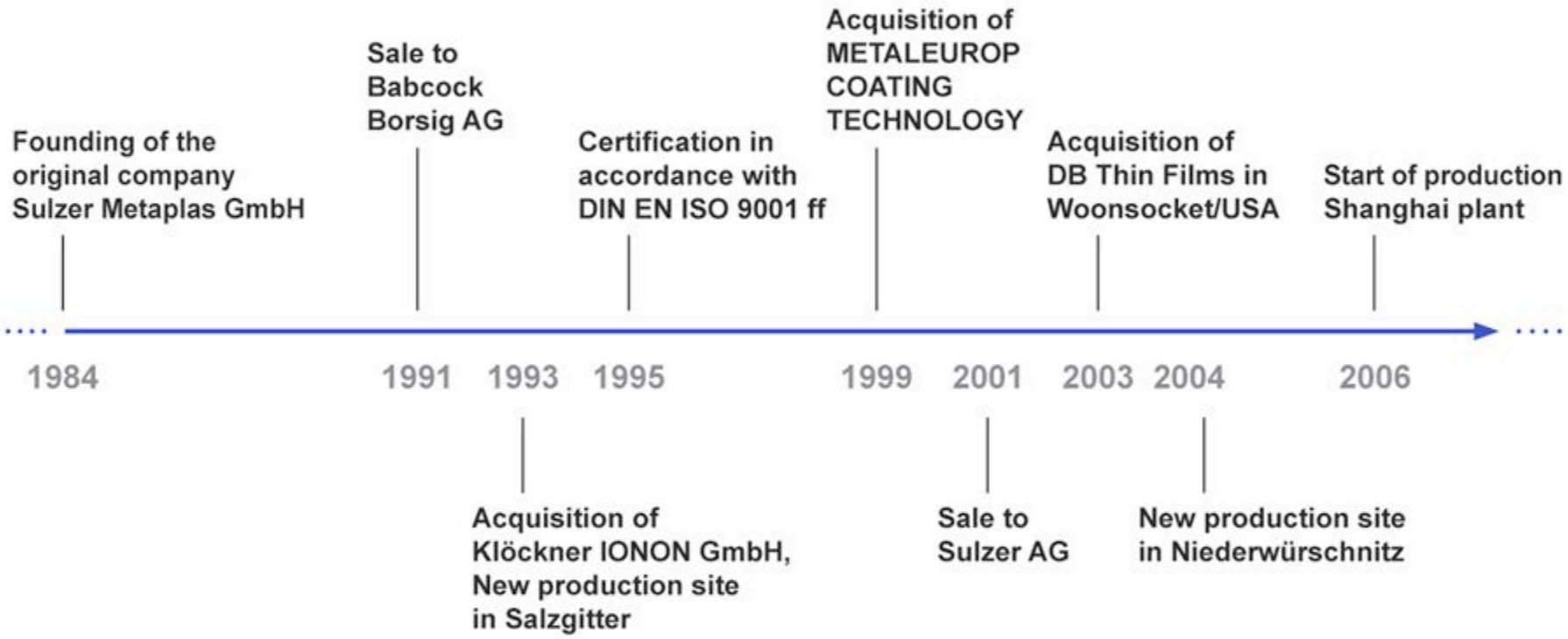
History

SULZER
Sulzer Metco



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Locations

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Germany

Bergisch Gladbach
Headquarters:
- PVD coating
- Heat treatment
- Systems

Salzgitter
- Heat treatment

Hohenlockstedt
- PVD coating

Niederwürschnitz
- Heat treatment

Altbach
- PVD coating
- Heat treatment

USA

Woonsocket
- PVD coating

China

Shanghai
- PVD coating
- Heat treatment

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Industries

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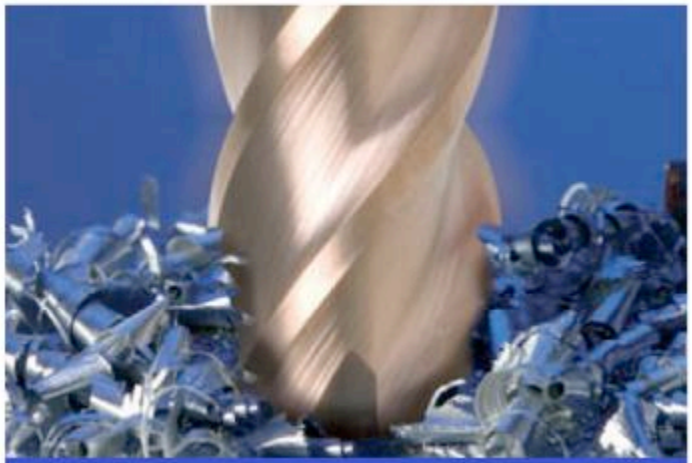
Automotive and Automotive Supplier



Machine Tools

Mechanical Engineering

Plastics Industries

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Overview

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Plasma Heat Treatment

Plasma Combination Treatment

PVD

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Plasma heat treatment - benefits

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- High surface hardness
- Improved resistance against wear, corrosion, and fatigue
- Repeatable nitride structure
- Activation of high-alloyed steels
- High accuracy grade, low distortion
- Reduced adhesion
- Environmentally friendly
- Application in nearly all industrial areas in serial and single-part processing

Plasma heat treatment – system examples

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Systems

- Bell, pit and horizontal furnaces, designed in the form of stand-alone, tandem and multiple unit systems, make up our basic concept.
- Completed systems:
  - up to 30 tons batch weight
  - up to 22,000 mm batch length
  - up to 4,000 mm batch diameter
- Standard system sizes (usable volume)

dia. 600 x 1,000	dia. 800 x 1,200	dia. 800 x 1,500	dia. 1,000 x 1,500	dia. 1,200 x 2,000	dia. 1,200 x 2,500

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Plasma combination treatment - benefits

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- Enhanced surface hardness
- Significantly improved wear protection
- Excellent corrosion resistance, even in applications with biodiesel or in marine atmospheres
- Outstanding abrasion and sliding properties
- Improved fatigue resistance
- High process effectiveness
- Environmentally friendly

Plasma heat treatment – system examples

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Systems

- Bell, pit and horizontal furnaces, designed in the form of stand-alone, tandem and multiple unit systems, make up our basic concept.
- Completed systems:
  - up to 30 tons batch weight
  - up to 10,000 mm batch length
  - up to 4,000 mm batch diameter
- Standard system sizes (usable volume)

dia. 600 x 1,000	dia. 800 x 1,200	dia. 800 x 1,500	dia. 1,000 x 1,500	dia. 1,200 x 2,000	dia. 1,200 x 2,500

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PVD - benefits

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- Excellent adaptation of layer thickness and surface properties
- Outstanding layer adhesion even with low coating temperatures
- High production performance, suitable for serial production with strong cost effectiveness
- High flexibility due to versatile system configurations for many different component shapes, sizes and quantities
- Strong wear protection and low friction properties
- Low adhesive and heat-sealing characteristics

PVD – system examples

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Systems

- Our range includes complete system families, ranging from the mini-compact version for research and laboratory purposes up to large systems and special installations suitable for coating of series products and large components.
- Completed systems:
  - up to 2,700 kg batch weight
  - up to 4,000 mm batch length
  - up to 1,600 mm batch diameter
- Standard system sizes (usable volume)

dia. 300 x 300	dia. 400 x 500	dia. 600 x 700	dia. 1,200 x 1,100

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Plastics

- Blow moulds
  (e.g. spiral mandrel distributor)
- Extrusion tools
  (e.g. extruder screws, calibration tools)
- Injection die moulding tools
  (e.g. screws)
- Forming tools

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Machine tools

Cutting:

- Drilling tools
- Milling tools
- Threading tools
- Broaching tools
- Hobs
- Inserts

Forming:

- Pressing tools
- Bending tools
- Cupping or drawing tools
- Forging tools
- Blanking dies
- Stamping dies
- Coining tools

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Automotive

- Drive train components
- Hydraulic components
- Bearing parts
- Engine components
  (e.g. crankshafts, camshafts)
- Chassis components (e.g. ball pins)

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Special solutions

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- Springs
- Hydraulic components
- Aerospace technology
- Mechanical engineering
- Medical technology
- Offshore technology
- Wind energy technology
- Decorative applications
- Turbines

Coating services

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- Pick-up and delivery service
- State-of-the-art plant technology
- Experienced, qualified personnel
- Short reaction time through 24-hour operation
- Continuous improvement of surface quality
- Computer-assisted order processing

Systems

- Engineering and system sales worldwide
- Wide range of systems for applications ranging from R&D machines to systems for serial production
- Modular system concepts for maximum flexibility

Shop-in-shop

- Innovative shop-in-shop solutions at the respective customer location
- Full integration into the customers' production and logistics chain
- Know-how bundled at the customer location saving costs and increasing flexibility
- Short reaction time in response to changed process requirements

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Service

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- Consulting, training and qualification
- Research and development in own Technology Center: customer-specific application development
- Turn-key projects: installation of turn-key production units
- After-sales service and support (including spare parts)

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The Third International Seminar on Modern Cutting & Measuring Engineering

November 7-9, 2008

Shenzhen, PR China

About a trend-setting PVD technology platform to meet the increasing demands of Chinese cutting tool manufacturers

满足中国切削刀具制造商不断变化需求的PVD技术平台

G.Erkens, J.Alami, J.Vetter, J.Müller

The Secret of Staying Ahead

Surface modifications providing solutions 先进的表面处理技术

surface-modification	Operational demands			
	Adhesion	Abrasion	Fatigue	Corrosion
Carburizing	+	+	++	0
Nitriding	++	+	+++	+
Nitriding + Oxidation	++	+	++	+++
Borizing	++	+++	0	0
PVD	+++	++	0	0
PACVD	+++	++	0	0
Nitriding + PVD	+++	++	+++	+
Nitriding + PACVD	+++	++	+++	+

Comments:
0 no influence
+/++ small or medium improvement
+++ significant improvement

Optimization of coating properties necessitates the use of a combination of coating technologies.

采用组合涂层技术来优化涂层性能

Driving high technology 高科技的驱动者
Introduction 摘要

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- Introduction
- 简介
- new generation of evaporators
- 新一代蒸发源
- results of plasma activation
- 等离子活化的功能
- micro alloyed coatings
- 微合金涂层
- Trends:发展趋势
  - texture tailored coatings
    涂层织构
  - hybrid technology
    混合技术
  - duplex technology
    组合技术

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Novel APA technology 新型APA蒸发源技术

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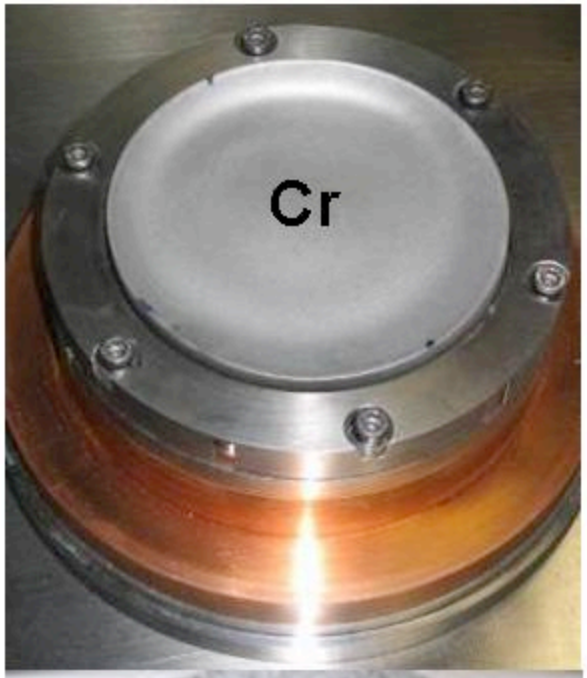
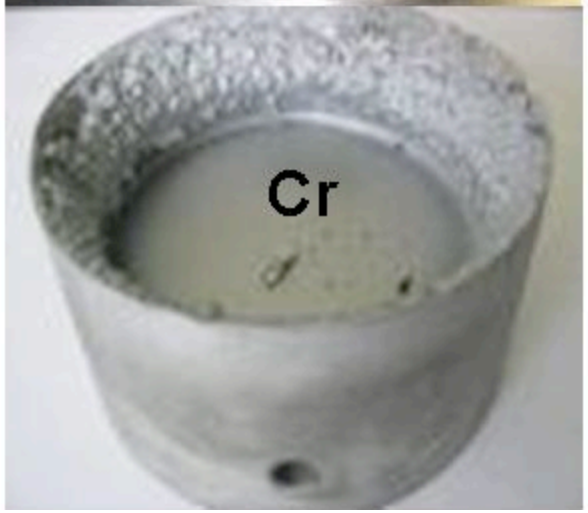
APA
Advanced Plasma Assisted
5000Ah
and can still be used for another 5000Ah



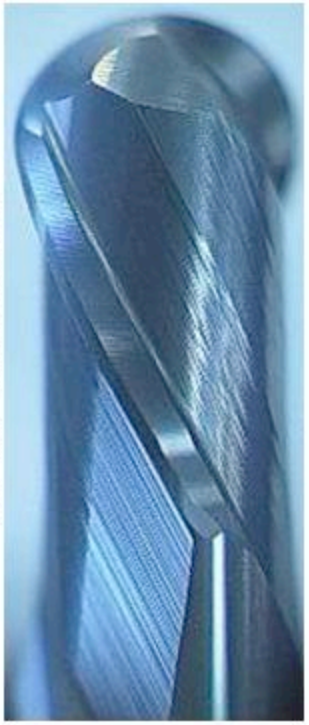
S63N
2500Ah
end of lifetime occurring tunnel effect
穿隧现象



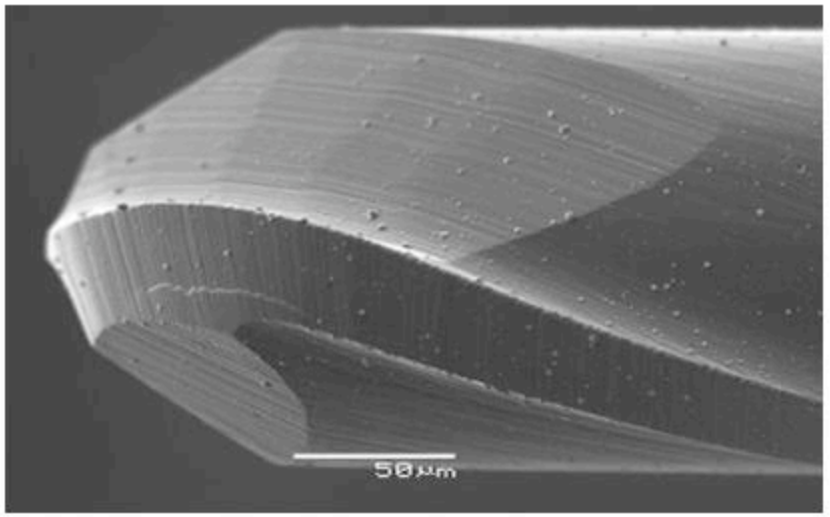
M_{force}: ma(Al,Cr)N-system (as deposited)

standard evaporator
传统蒸发源

plasma activated APA evaporator
等离子活化蒸发源



perfect results on micro tools



The technology platform
技术平台
modular and flexible
模块式及柔性
one platform…various opportunities…many solutions !!!
一个平台…不同机会……多种方案

Driving high technology 高科技的驱动者
The answer to multiple demands 对多需求的响应

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Adjustable capacity to meet development or production needs

Multiple turntable options

Multiple evaporator/cathode options

Adaptable to a wide variety of applications configured with AIP and/or MSIP, DC, pulsed DC, HPPMS or PACVD

Hard Coating Processes 硬质膜工艺

AlTiN, AlTiXN, AlTiSiXN, TiN, TiXN, TiCN, AlCrN, AlCrXN, CrN, CrON, CrSiXN,AlTiN/NbN,... multilayers, nanolayers, nano-composites, **micro alloyed coatings**, insulating nitrides, various types of oxides, hard/soft compounds, in-situ lubricating films and many more

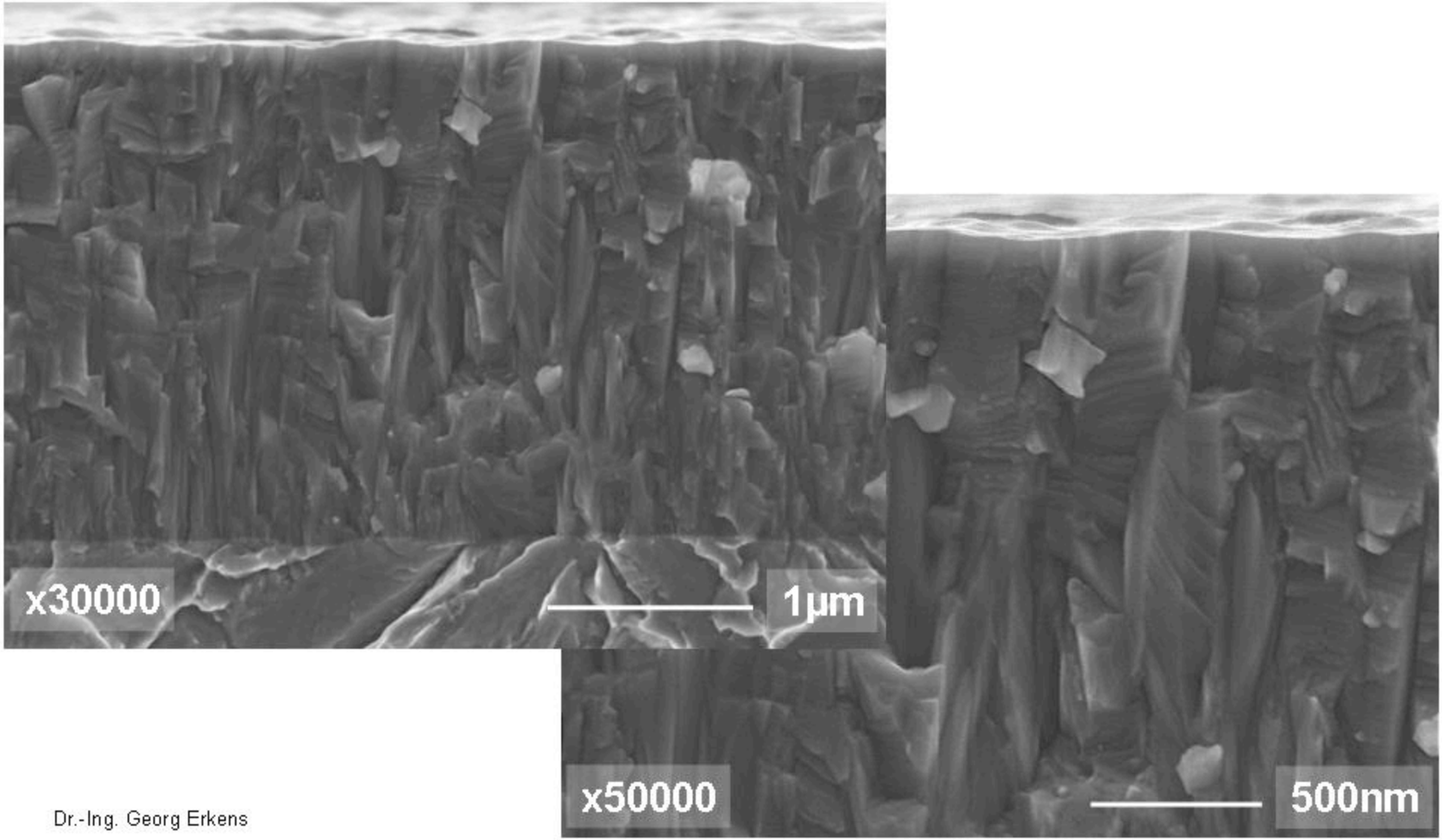
Component Coating Processes 零件涂层工艺

a-C:H, a-C, a-C:H:Me, CrN, CrON, CrAlN, CrALON & Others

Hybrid Processes 混合工艺

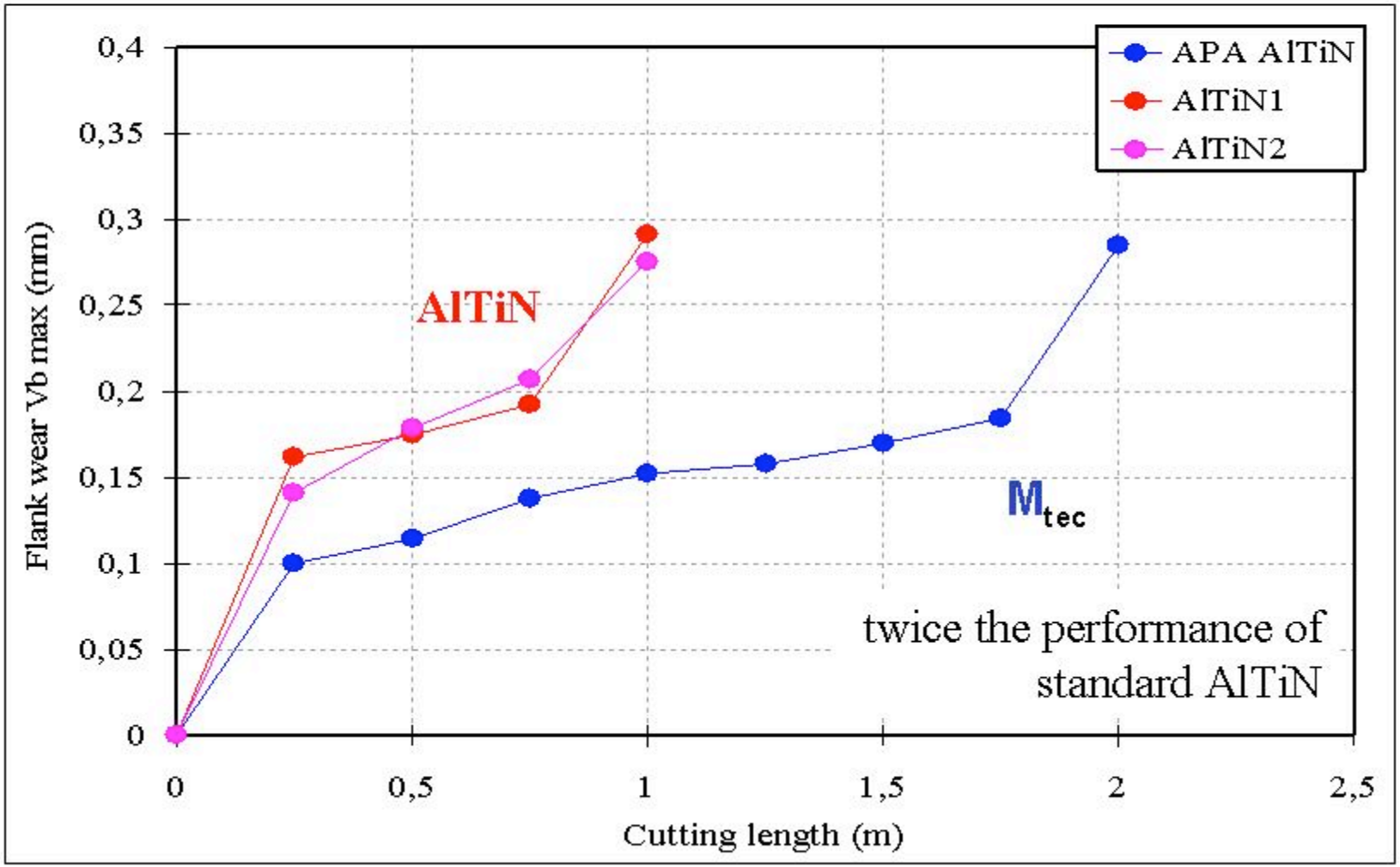
AIP & MSIP, HPPMS combined with PACVD, duplex

M_{tec} from the METAPLAS machining Series 切削加工系列

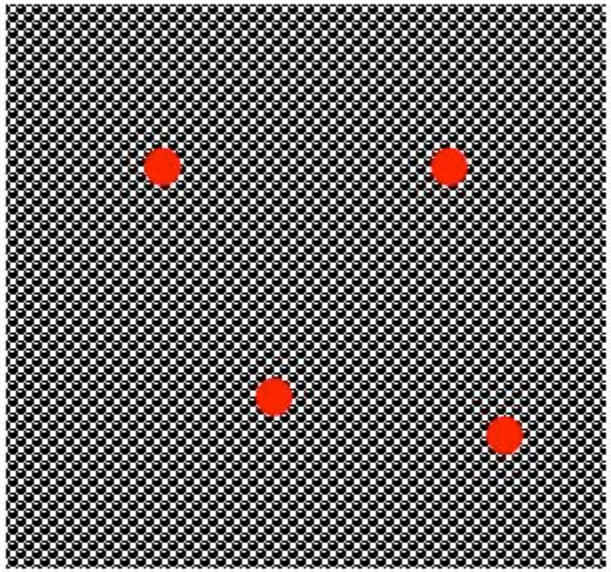


Cutting test results: rough milling 应用案例:粗铣削

material: tool steel with 40 HRC
dry, v=120m/min, fz=0.1mm/tooth



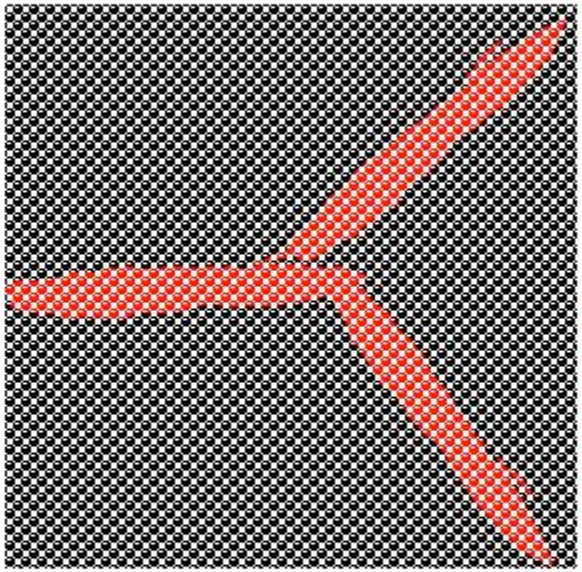
Nano-composite states: alloying – phases
纳米组份:合金-相



doped coatings

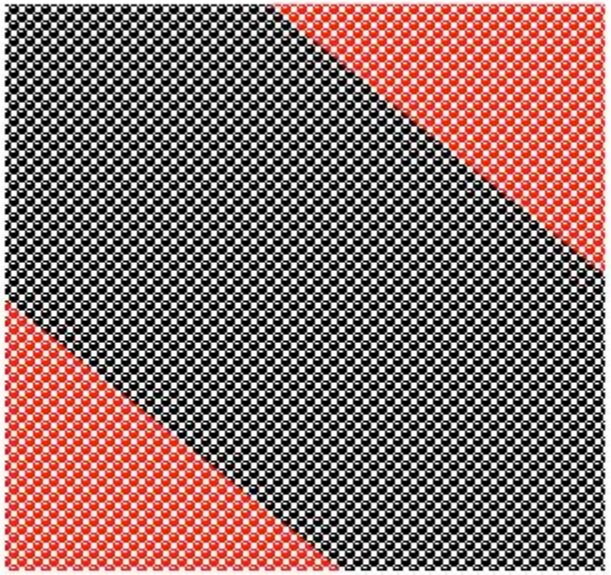
AlTiN plus some atoms e.g. Si

"micro alloyed"



grain boundary segregation 晶界偏析

e.g. AlTiNC/C accumulating C at the grain boundaries



two or more phases

hcp AlN + fcc AlTiN
hcp $(CrTi)_2N$ + fcc TiCrN starting at 17 at% Cr

The changed electron structure leads to
电子结构的变化可导致:

- increased electrical resistivity 电阻性能
- improved phase stability 相稳定性
- reduced thermal conductivity 热导性能
- increased oxidation resistance 抗氧化性能
- increased formation of oxides 氧化物形成
- improved fatigue resistance 抗疲劳性能
- increased yield, compressive and shear strength
屈服、压缩及剪切强度
- the stochastic incorporation of a significant amount of larger elements (0.1-3at%) will influence the atomic crack propagation e.g. $R_x > R_{Cr} > R_{Si} > R_B$
随机组合的大尺寸元素(0.1-3at%) 将影响原子的裂纹延展表现

Micro alloyed coatings: How does it work?

A significant amount of 0.1 – 3at% of an additional element

1) The element is incorporated into the crystal leading to higher stability, higher oxidation resistance, etc.

2) The element is accumulated at the grain boundaries leading to an amorphisation and thus forcing the formation of a nano-composite.

3) Influencing the nucleation towards smaller grain sizes and thus forming nano-crystalline structures, e.g. nano-columns.

Driving high technology 高科技的驱动者
coating optimization by "micro alloying" 微合金涂层

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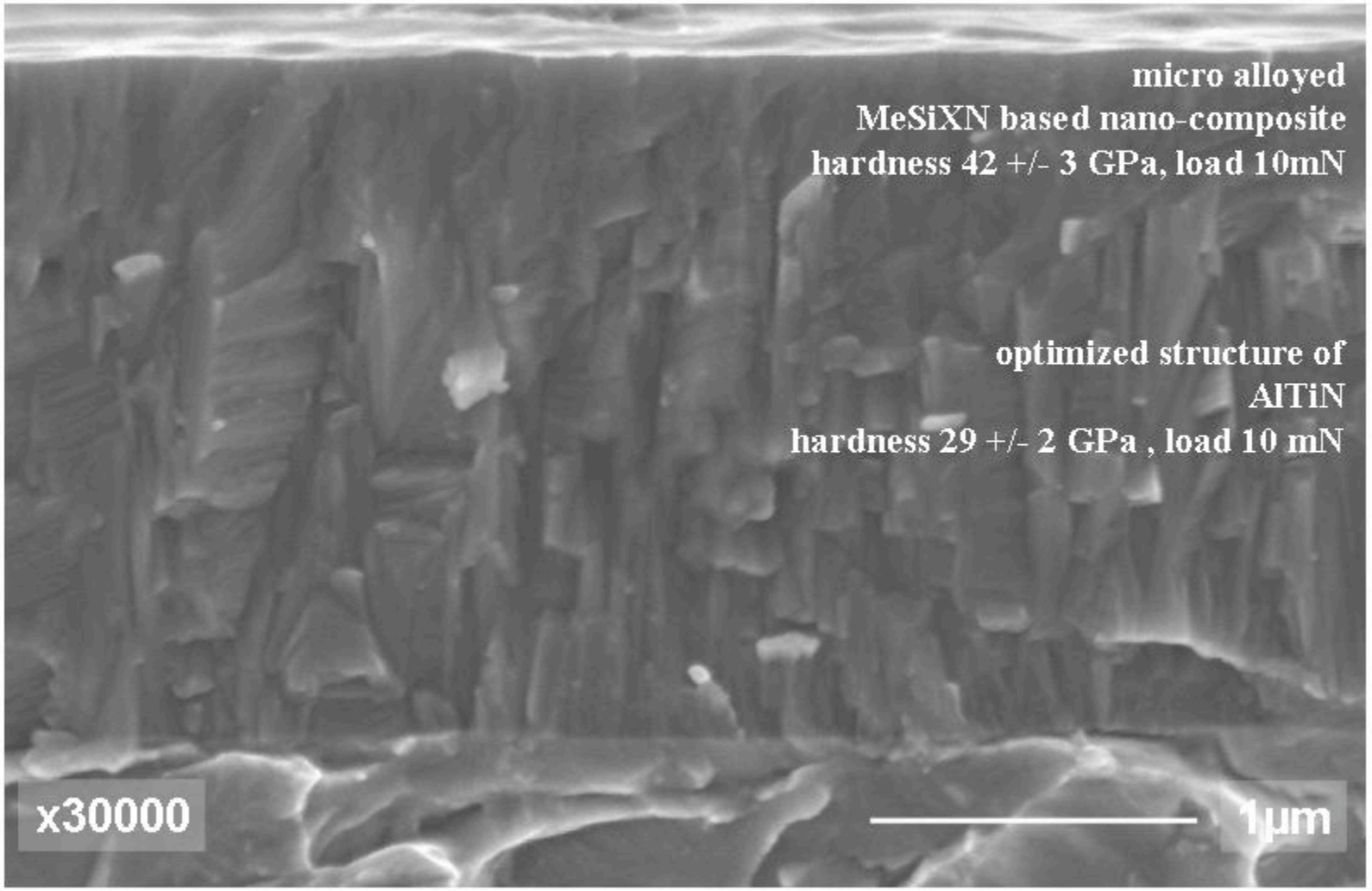
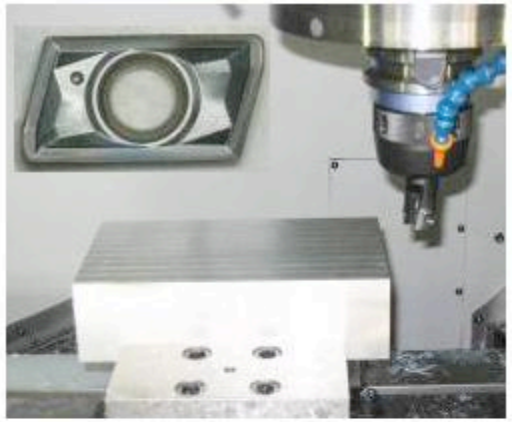
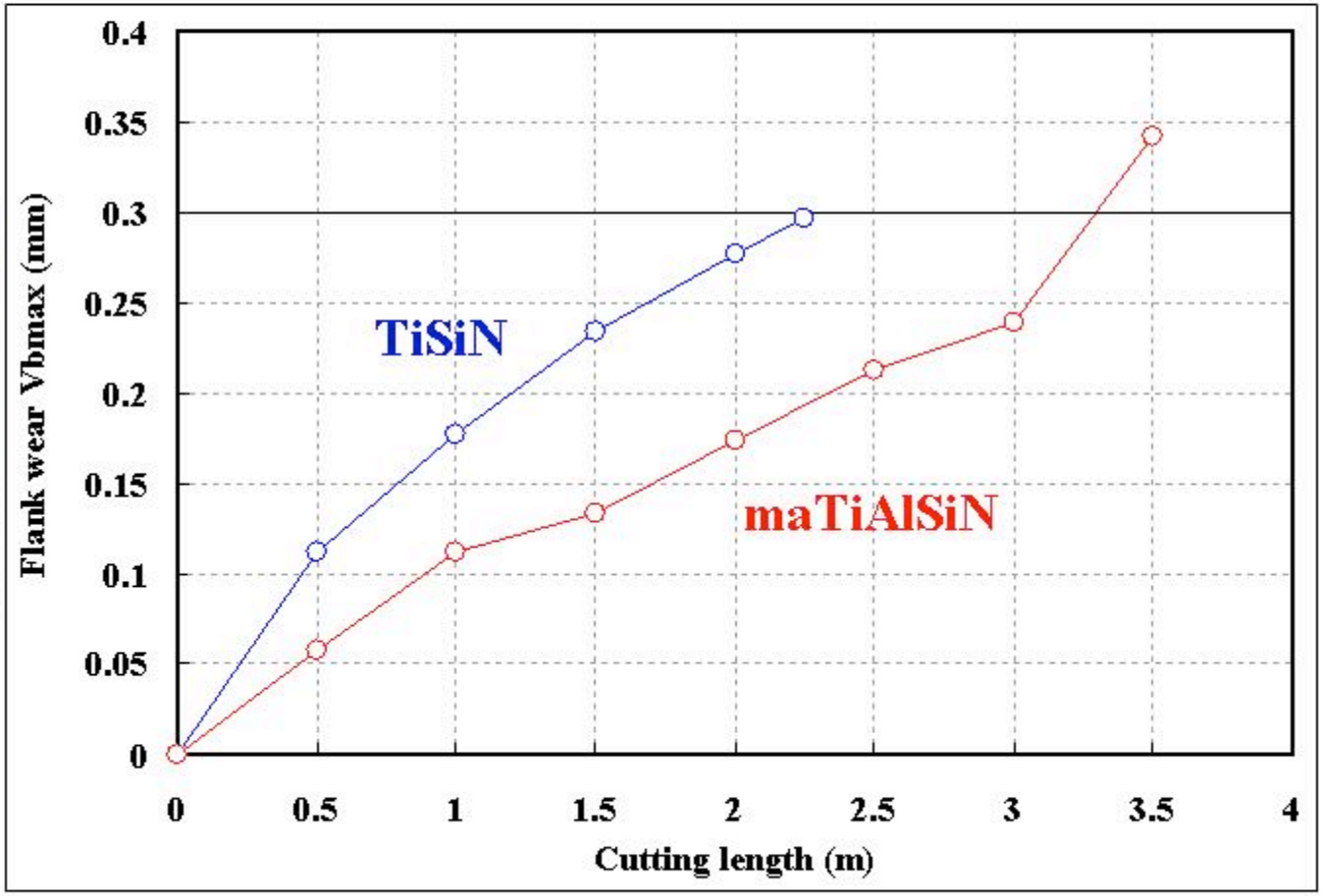
M_{power} from the METAPLAS machining Series 切削加工系列



material: X210Cr12, 200 HB annealed
dry
v=150m/min, fz=0.15mm/tooth, ap x ae = 3 x 10mm





Driving high technology 高科技的驱动者
coating optimization by "micro alloying" 微合金涂层

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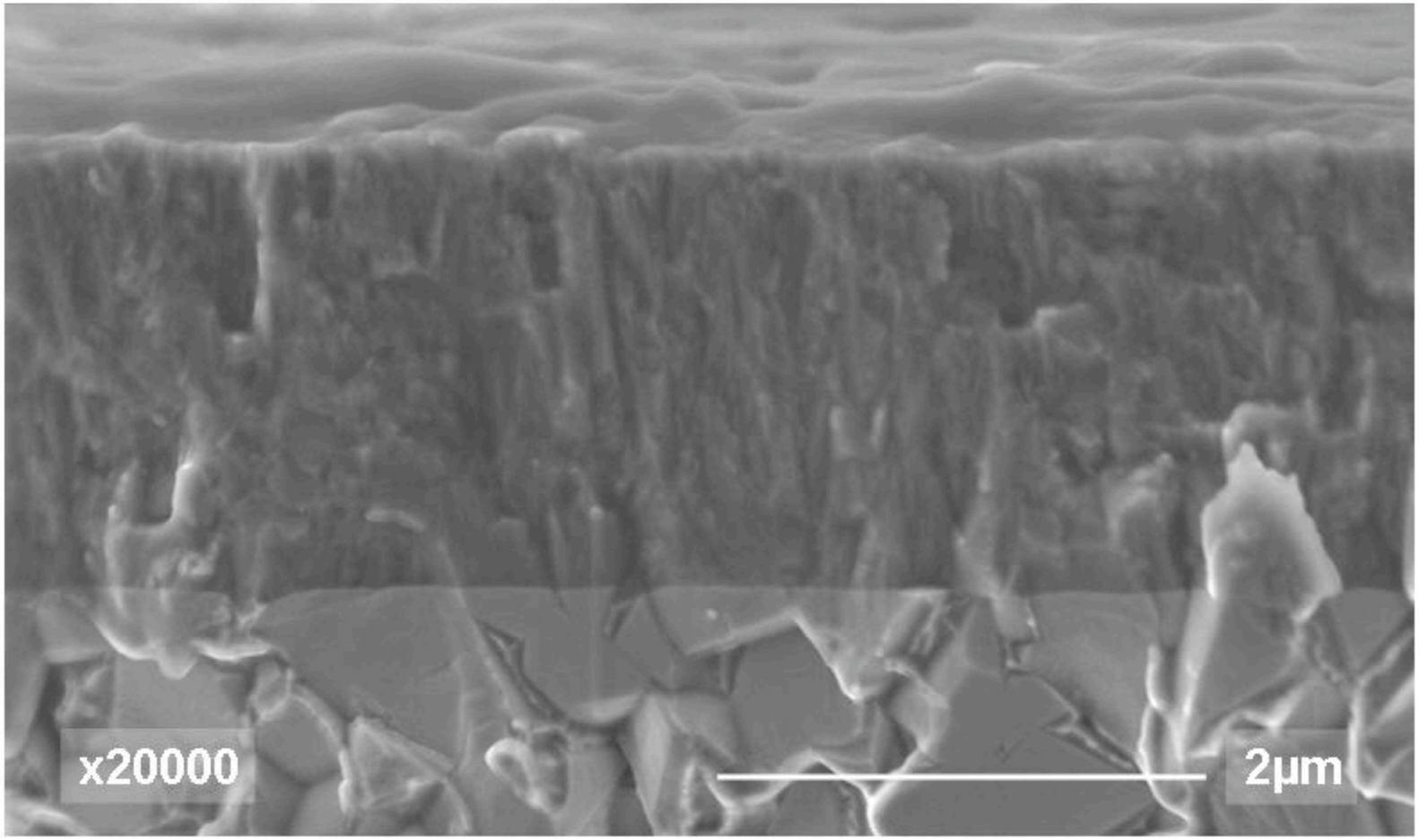
M_{force} from the METAPLAS machining Series 削加工系列



Driving high technology 高科技的驱动者

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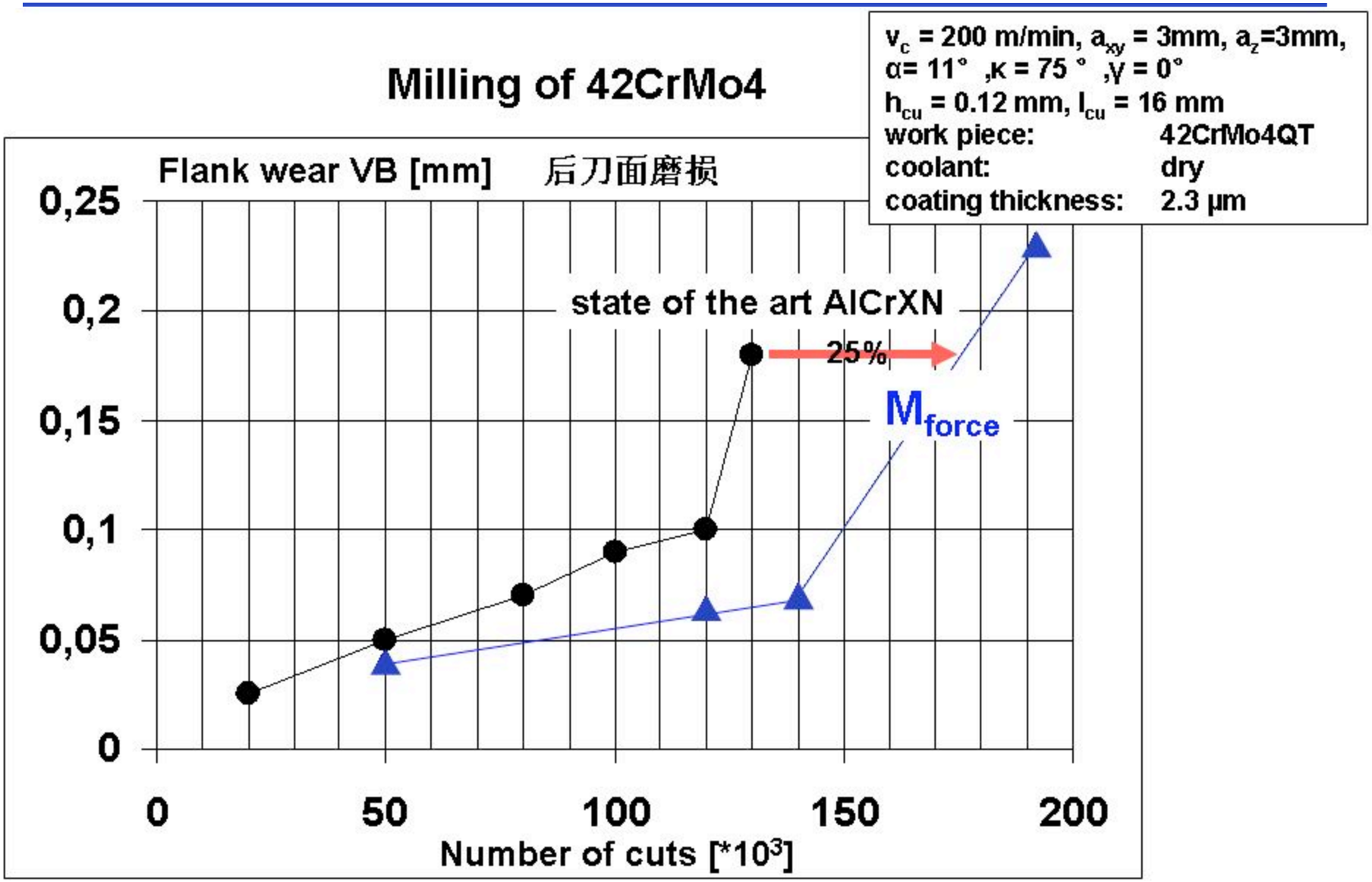
M_{force}: ma(Al,Cr)N base coating



Trend in driving high technology: 发展趋势
AIP-MSIP hybrid process technology 混合工艺技术

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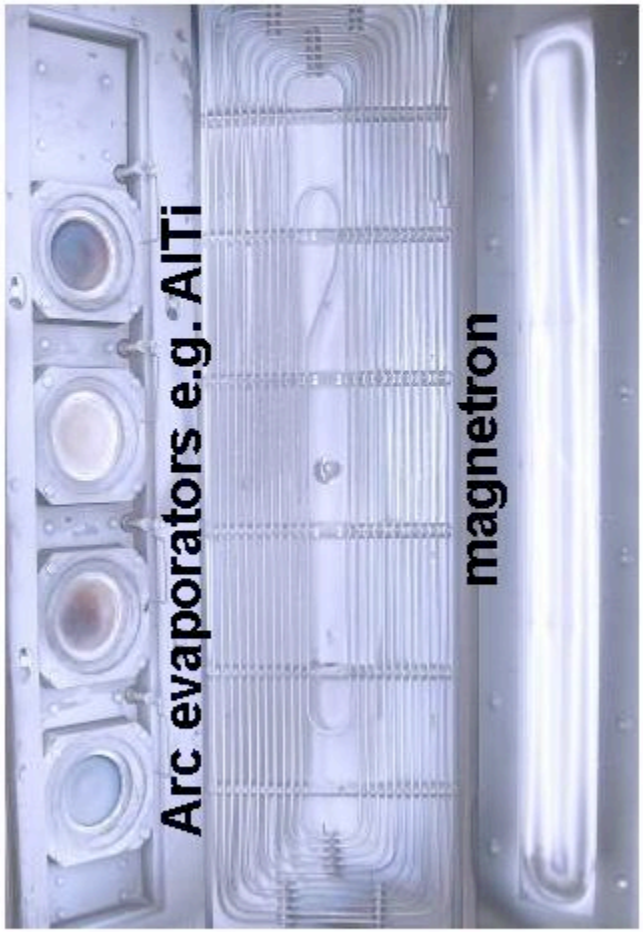
micro alloying: AlTiSiXN



Driving High Technology 高科技的驱动者
Hybrid processes (AIP & MSIP) 混合工艺

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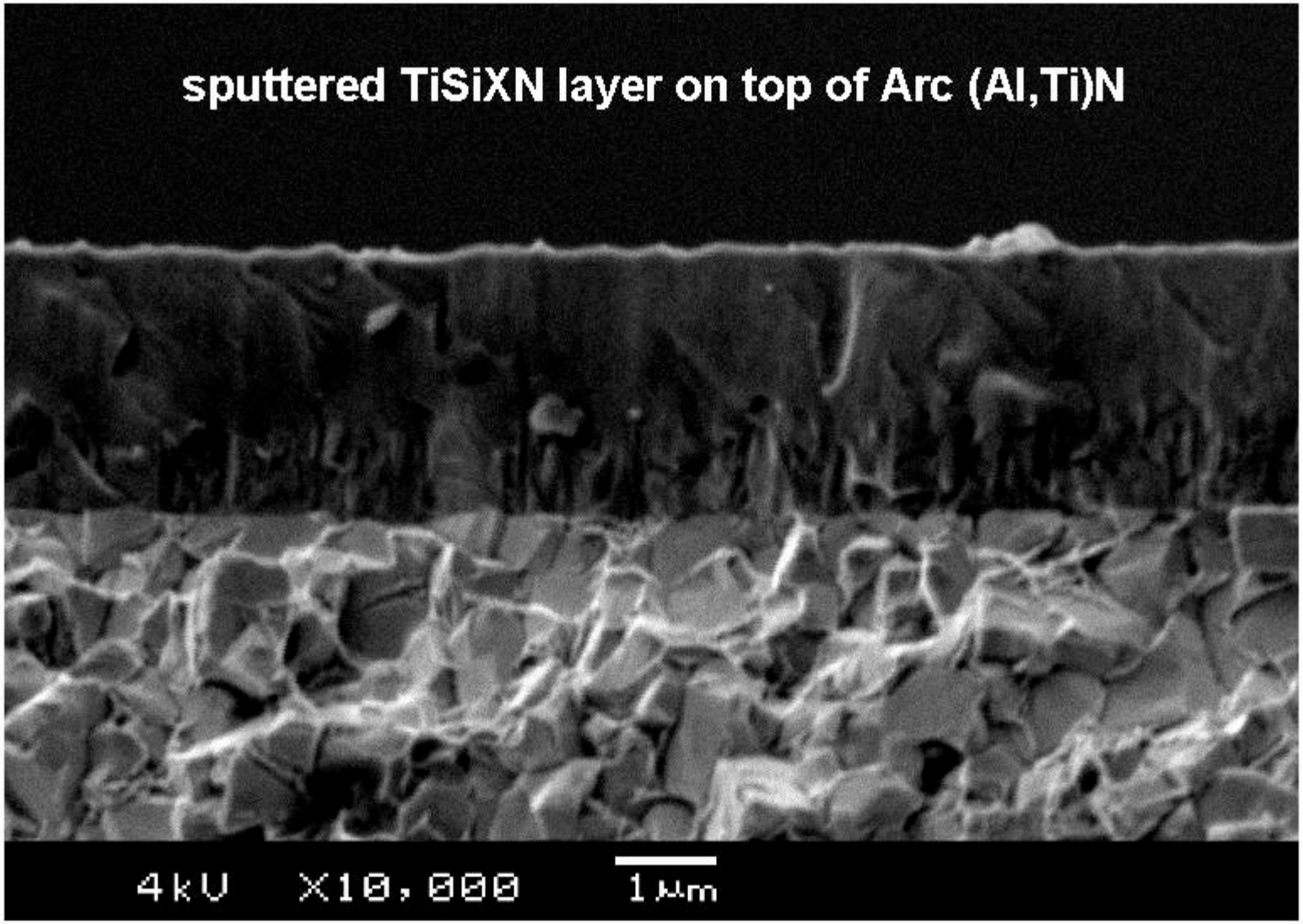

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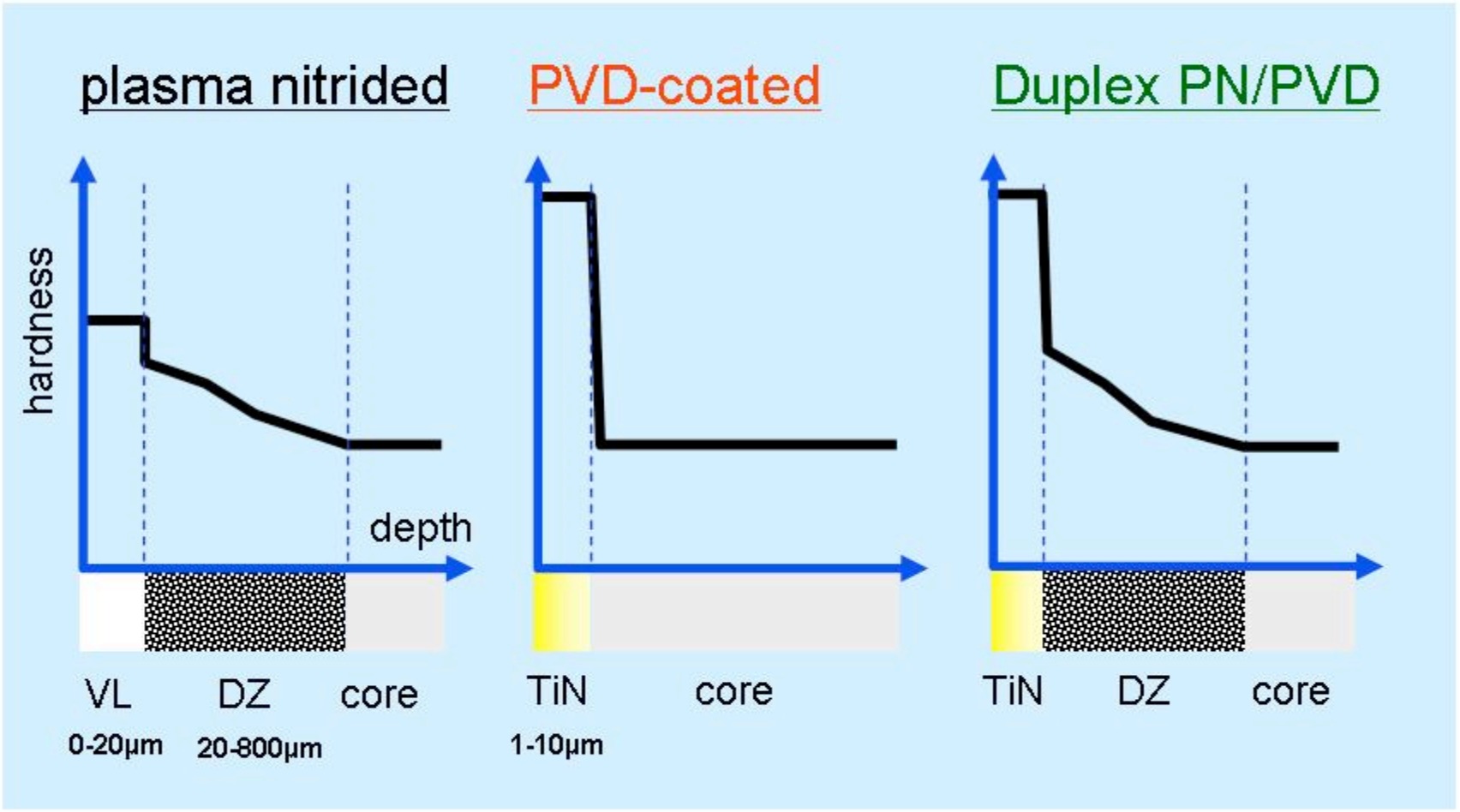
Combined treatment for tools and components
用于刀具和零件的组合处理工艺

Hardness profil of different processes



typical unit for plasma nitriding

pressure 50 – 500 Pa

N_2, H_2, CO_2

glow discharge ↻ ions

mechanical treatment
polishing

typical unit for PVD

Driving high technology 高科技的驱动者

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Innovative 2 step 1 cycle treatment 革新性的2:1组合处理

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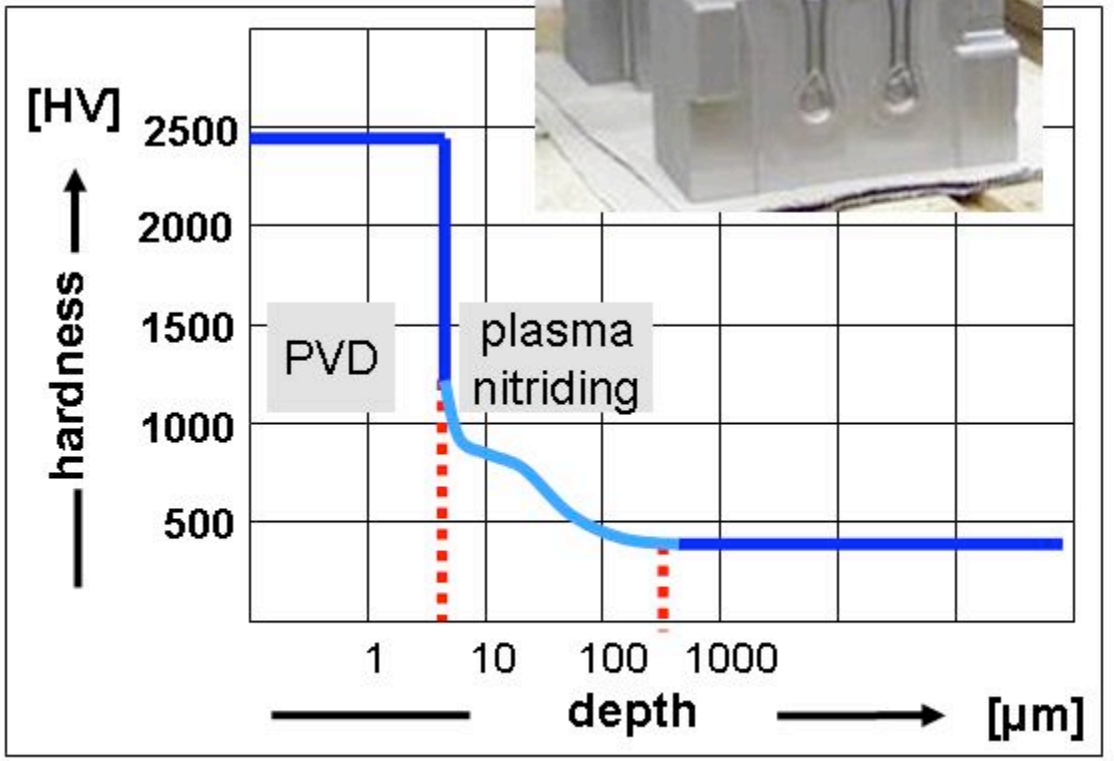
Advantages of 2 step 1 cycle process 2:1组合处理的优势

reduction of proces steps
reduction of energy consumption
reduction of process time

short time PN (10 to 240min)
PN layer supporting the PVD coating

graded hardness transition
graded stress transition
high wear resistance
increased fatigue strength
improved corrosion protection

only one unit necessary



Driving high technology 高科技的驱动者

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Duplex treatment for various type of tools
不同类型刀具的组合处理

PN + CrN treated forging die
increase in lifetime: > 2

Forging Die

hot working steels
1.2314, 1.2343, 1.2365

cored wire

rule of thumb:
tensile strength < 1.500 N/mm²
► PN + CrN or CrCN

tensile strength > 1.500 N/mm²
► CrCN coating

Driving high technology 高科技的驱动者
Duplex treatment for various type of components
不同零件的组合处理

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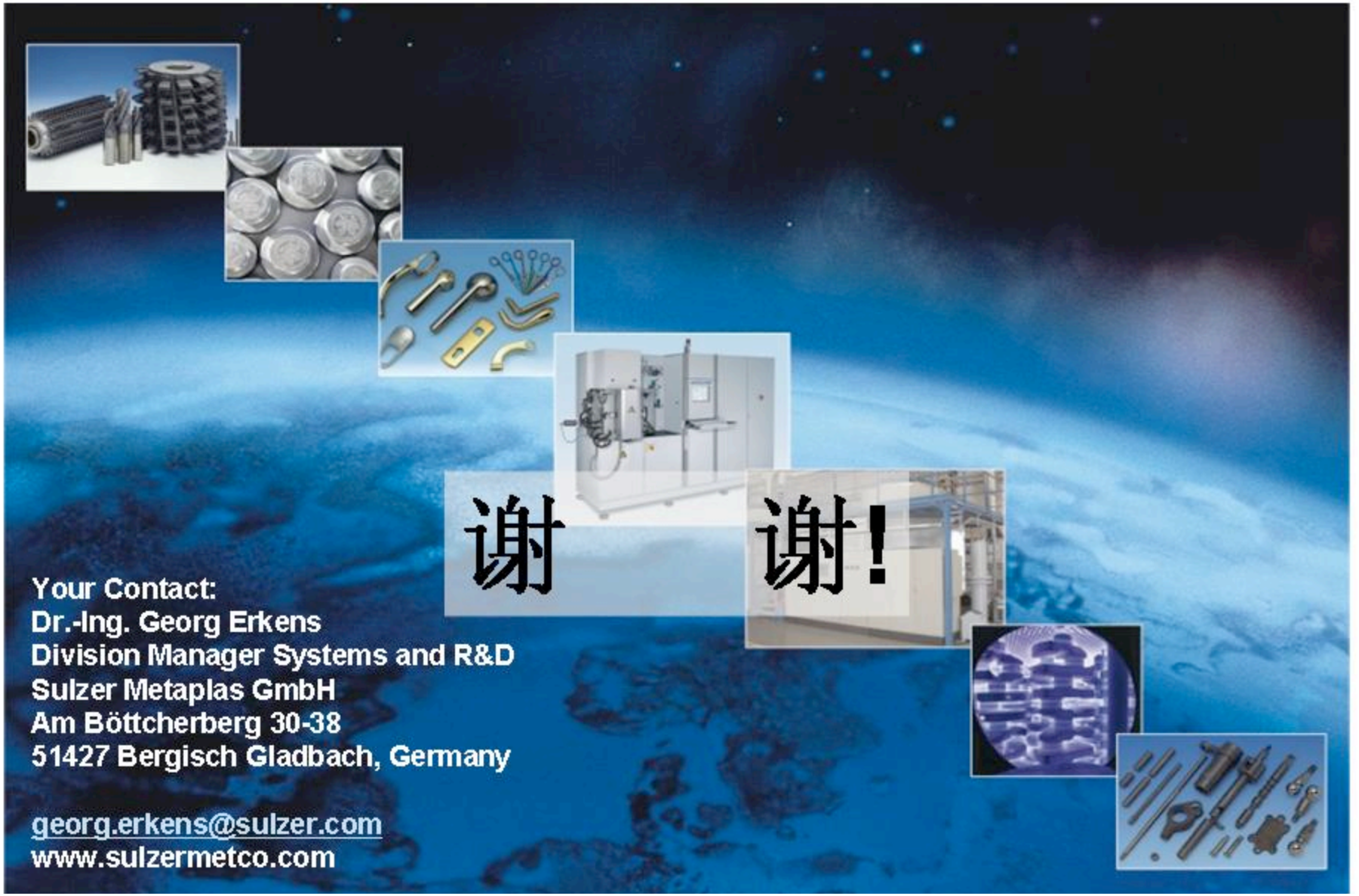

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