

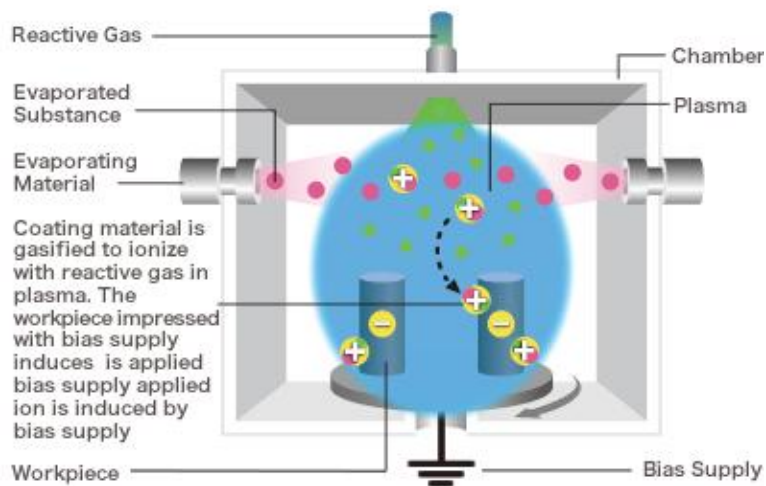
# Metkon Application Note

**Metallographic Preparation of PVD Coated Samples**

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**Physical vapor deposition (PVD)** describes a variety of vacuum deposition methods used to deposit thin films by the condensation of a vaporized form of the desired film material onto various workpiece surfaces. The coating method involves purely physical processes such as high-temperature vacuum evaporation with subsequent condensation, or plasma sputter bombardment rather than involving a chemical reaction at the surface to be coated as in chemical vapor deposition.



### ***PVD Process***

**PVD is used in the manufacture of items**, including semiconductor devices, aluminized PET film for balloons and snack bags, and coated cutting tools for metalworking. Besides PVD tools for fabrication, special smaller tools (mainly for scientific purposes) have been developed. They mainly serve the purpose of extreme thin films like atomic layers and are used mostly for small substrates.

**Common coatings applied by PVD** are Titanium nitride, Zirconium nitride, Chromium nitride, Titanium aluminum nitride.



This study includes metallographic examination of PVD coated cutting tool and nitration steel.



## MICRACUT 201

Automatic High Speed Precision Cut-off Machine, Programmable with 5,7" HMI touch screen control, with Siemens PLC control unit, coloured LCD display of cutting parameter. Moving table feed

system, compact cutting motor, with variable cut-off wheel speed from 500 to 5000 rpm, automatic feeding with adjustable feed speed, motorised positioning system with digital readout on the LCD, library of cutting programs for different materials, Ability to mount diamond cup grinding wheel for thin section applications

with built-in recirculation cooling unit, complete and ready for operation.

Without clamping tools and specimen vises.

230 V, 50 Hz, AC.

Includes a standard set of cutting consumables composed of;

\*1 pc. Diamond cutting Disc 200 mm dia.

\*10 abrasive thin cut-off wheels 200 mm dia.

\*1 lt of Metcool II cooling fluid.

	Order Code	Description
Equipment Used	17 06	MICRACUT 201
Clamping Devices	GR 0825	Manual X-axis positioning unit for specimen vises with dovetail plates.(0-25 mm)
	GR 0401	Specimen Holder
Cutting Fluid	19 905	Nature Friendly Soluble Oil, 1 lt.
Cutting Disc	19 151	ø 150 Diamond Cut-off wheels (Resin Bonded)



## ECOPRESS 100 (25 07)

Programmable Automatic Mounting Press with one cylinder, 5,7" HMI touch screen control, with Siemens PLC control unit, programmable with coloured LCD display, program based mounting sequences, electro hydraulic pressure (requires no air), pressure upto 300 bar, temperature upto 200 C, operation time upto 59:99 minutes, short cycle time, thermostatically controlled heating power of 1250W, automatic cooling cycle with two modes of cooling rates(fast cooling and slow cooling), programmable preheating and preloading, selectable mould sizes from 25 mm to 50 mm, audible warning signal, ready for operation.

230 V, 1-phase, 50 Hz.

Mould assemblies are ordered separately.

Includes a standard set of mounting consumables composed of 3 different hot mounting compounds; 1 kg of each and a total of 3 kg.

	Order Code	Description
Equipment Used	25 07	ECOPRESS 100 Automatic Mounting Press
	26 06-02	Mould Assembly, 40mm with intermediate ram
Mounting Powder	29 011	Epoxy 1kg.



### DIGIPREP 251

Programmable with coloured 5,7" HMI touch screen control, with Siemens PLC control unit. Base Unit with large 0,75HP Motor, Variable wheel speed 50-600 rpm, Quite belt drive, Complementary or Contra rotational direction, Soft Start and Stop function, Retractable water hose, with water supply and drain tubes. sample preparation parameters, central and/or individual force application, steel mounting column, with variable specimen holder speed 50-150 rpm, 100 Watt DC motor, LED lighting, quick-locking swing mounted design, audible warning signal, with holding chuck. Air supply tubes, Complete and ready for operation. Without Specimen Holders. 230 V, 1-phase, 50 Hz.

Includes working kit "250 mm Aluminium wheel and splash guard", Includes the following standard set of consumables;

\*Special Magnetic Foil, Ø 250 mm.

\*Thin Metal Plate(1 pcs), Ø 250 mm

\*Magneto grinding disc 18 mic., 250 mm dia.

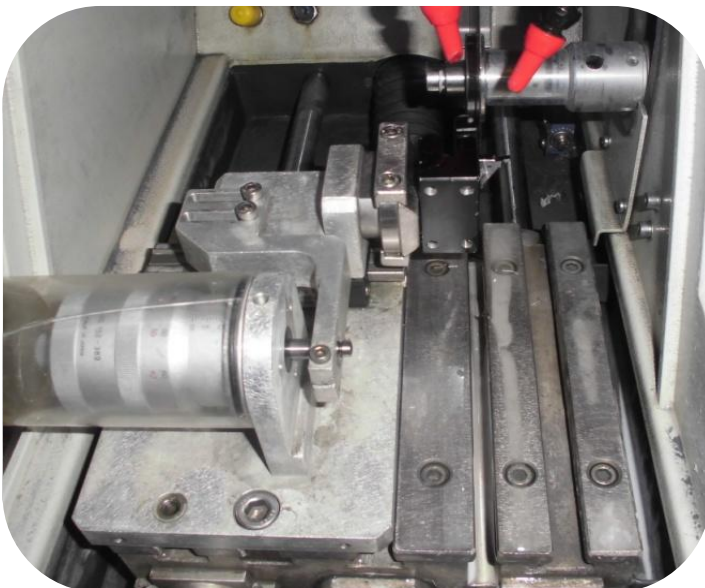
\*An assortment of 5 polishing cloths 250 mm dia.

\*Diamond suspensions one of each of 6 mic. and 1 mic., plus lubricant

	Order Code	Description
<b>Equipment Used</b>	45 03	DIGIPREP 251 Grinding & Polishing System
<b>Equipment Accessories</b>	31 22	Aluminum wheel, 250 mm
	31 63	Splash Guard, 250 mm
	39-003-250	Ø 250 mm, Special Magnetic Foil
	39-093-250	Ø 250 mm, Thin Metal Plate(5 pcs.)
<b>Sample Holder</b>	33 01	Specimen holder, 6 x Ø40 mm

## SAMPLE PREPARATION PROCESSES

Samples are attached as they shown in the above photos with manual x-axis(GR0825) and specimen holder(GR 0401).



GR 0825



GR 0400

The cutting parameters are below;

## Nitration Steel,

The Table feedrate is adjusted to; **50  $\mu$  / sec**

The Rpm is adjusted to; **2000**

The Travel is adjusted to; **35 mm**

The Force is adjusted to; **3A**

Cutting Tool,

The Table feedrate is adjusted to; **70  $\mu$  / sec**

The Rpm is adjusted to; **1800**

The Travel is adjusted to; **25 mm**

The Force is adjusted to; **3A**



Mounting parameters are following;

**Heating Temperature** : 160°C

**Pressure** : 230 bar

**Heating Time** : 3 min

Cooling Type : Standart Cooling

**Cooling Temperature** : 35°C

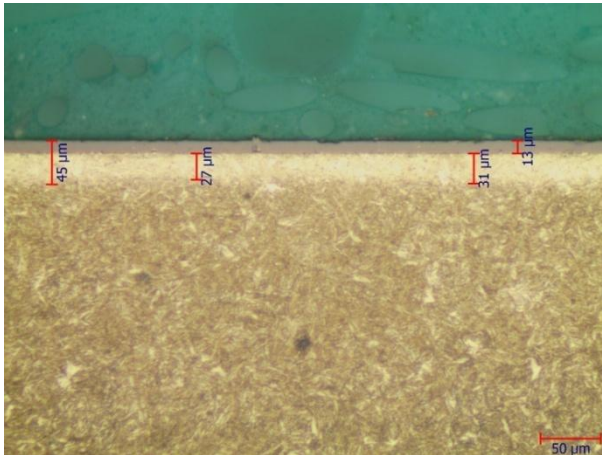
The polishing operation have been made with DIGIPREP 251 machine by using following parameters;

	Surface	Abrasive	Lubricant	Force per sample(N)	Time(min.)	Disk speed(rpm)	Head speed(rpm)
Grind. Step 1	MAGNETO II [38-040-018]	18 micron Diamond	Water	25 N	1 min.	250	100
Grind. Step 2	MAGNETO III [38-040-006]	6 micron Diamond	Water	30 N	2 min.	250	100
Polishing Step 1	Metapo B [39-033-250]	3μ diamond susp. [39-420-M]	DIAPAT [39-502]	20N	3 min.	200	75
Polishing Step 2	FEDO-1 cloth [39-065-250]	1μ diamond susp. [39-410-M]	DIAPAT [39-502]	15N	1 min.	200	50
Etching:	%3 Nitral						

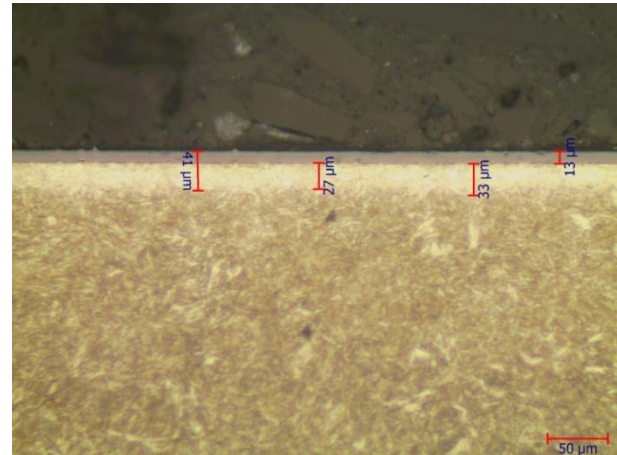


After the preparation; samples observed in the metallographic microscope. Microstructure of samples can be seen below.

Nitration steel sample mounted with Diallylphtalat and Epoxy for observe nitration diffusion thickness;

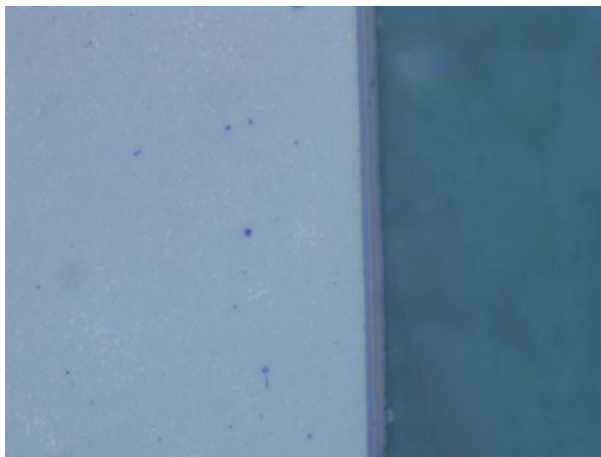


**500x-DAP**

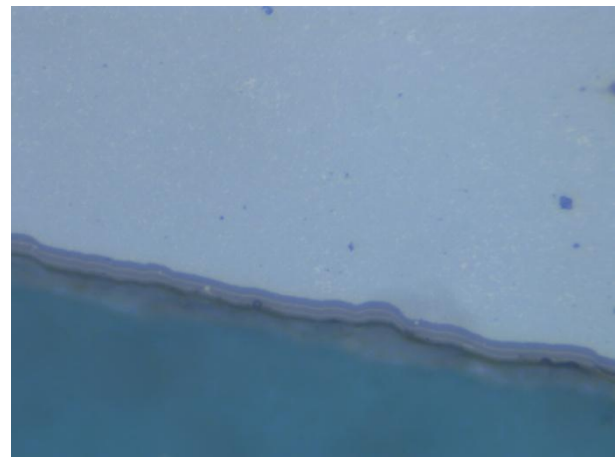


**500x-Epoxy**

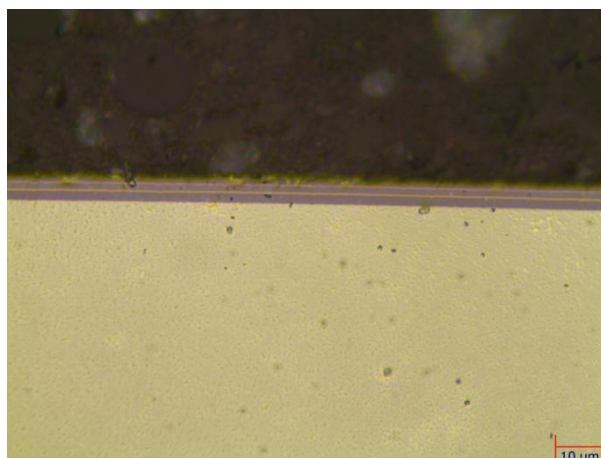
Cutting tool sample mounted with DAP to observe 3 coating layer(Each one of them appox. 2-3 micron).



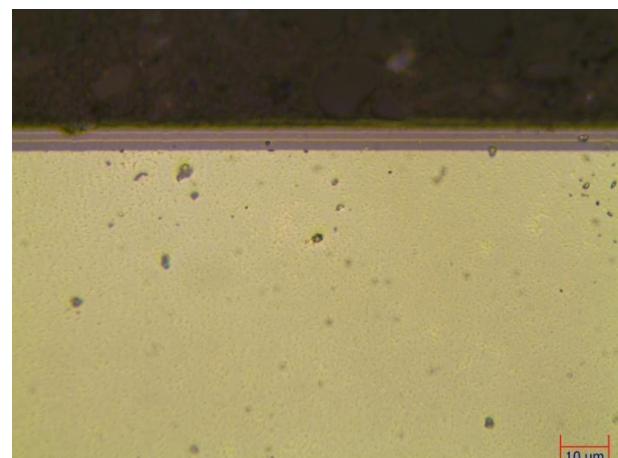
**500x-DAP**



**500x-DAP**



**1000x-Epoxy**



**1000x-Epoxy**