

Magnetic Thin Film Coating on TNMG tool Insert by Physical Vapour Deposition and its analysis

Sourabh V. Helavi Reddy¹, Prof. Chandan A. Waghmare²

¹PG Student, Department of Mechanical Engineering,
Rajarambapu Institute of Technology, Rajaramnagar, India.

²Professor, Department of Mechanical Engineering
Rajarambapu Institute of Technology Rajaramnagar, India

ABSTRACT

The purpose is to study the effect of various cutting parameters Spindle speed, feed rate and depth of cut by turning process on EN-9 steel with uncoated, coated, and coated and magnetized tool insert of tungsten Carbide tool insert. Coating on tool insert is by Physical Vapour Deposition method. Experiments were conducted on CNC and the influence of cutting parameters on Tool Insert was studied using Design of experiments. optimize cutting parameters to increase Tool life.

Key Words—Coating of TNMG tool, Physical Vapour Deposition, Magnetizing the Tool, Tool Life.

I. INTRODUCTION

In industries, now a day tools are used to remove the excess material from the casting and obtaining finished product.

Mostly Tungsten carbide or cemented carbide tools are used for machining of castings. Tool life is the most important factor in tool study. More the tool life, more number of jobs will be machined. Coated tools have more efficiency than uncoated tools. PVD coating is most essential and easy method to coat tool inserts. Nickel chromium has good hardness and ferromagnetic properties. It can sustain the higher temperatures obtained while machining the components.

Materials and Methods:

Machine: CNC/ VTL the main spindle runs on high precision turning of components made of hardened and precision drawn EN-9 steel.

The Tool: Tungsten carbide has comparatively better resistance and wear. The single point TNMG Tool insert specifications are as follows:

Table. 1 Tool specifications

Back Rake Angle	12°
Side Rake Angle	12°
End relief	10°
End cutting edge Angle	30°
Side cutting edge angle	15°
Nose Radius	0.8mm

Work Piece: Work piece of std. dimensions was used for turning process. Work piece diameter: 100mm, Work piece length : 200mm

Tool wear Measurement: a new cutting edge was used for each run. Tool makers microscope was used to obtain the tool wear.

Coating on TNMG tool insert is done by one of the physical vapour deposition methods i.e. DC Sputtering. DC sputtering is a basic sputtering method using a constant (DC) voltage between the substrate (anode) and the target (cathode). Commonly argon (Ar) ions are used as the particles bombarding the target surface. Argon atoms are introduced into the chamber vacuumed to a very low pressure of about 1-10m Torr.

A DC voltage (0.5-5 kV) ionizes the argon atoms forming an ionized gas (plasma). The positively charged argon ions accelerate towards the cathode (target), bombard its surface and break the target atoms out. The atoms travel at various directions and settle on the substrate surface forming a deposited layer.

DC sputtering is used for deposition of conductive materials (metals). The coating deposited on the anodically connected substrate does not change the anode conductivity. Non-conductive materials cannot be deposited by DC sputtering since the non conductive coating on the substrate prevents the electron flow through the anode. The main disadvantage of the basic DC sputtering method is too low density of argon ions producing a low deposition rate (sputtering yield).

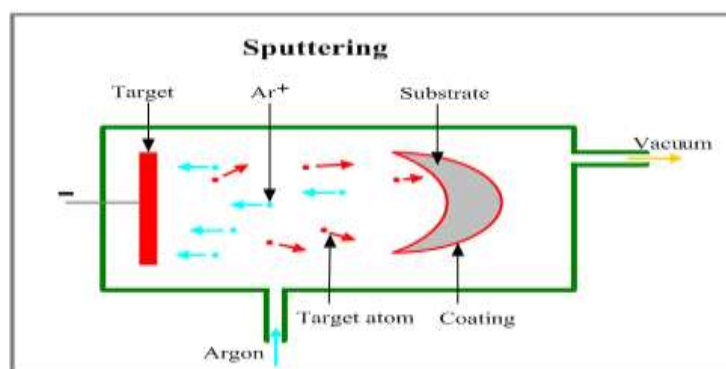


Fig. DC Sputtering

II. EXPERIMENTAL PROCEDURE & WORK

Coating Tungsten carbide Inserts with Nickel chromium by Physical vapour deposition method. Thickness of coating will be of $3\mu\text{m}$. The test runs will be taken on CNC. The component used for turning is EN-9 steel. After coating of Tool inserts, some of the tools will be ferromagnetic properties and further it will be tested on EN-9 steel.



Fig. CNC Machine.

Accordingly the present study has been done through the following plan of Experiment.

- Checking and performing the machining operation.
- Performing coated and uncoated carbide inserts.
- Cutting of EN-9 steel by saw and preparing it for turning operation.
- Performing turning operations on various speeds, feeds and depth of cut.
- After taking experiments on coated uncoated and coated magnetized tool, investigating tools on tool makers microscope.
- Measuring cutting tool life by continuously giving constant depth of cut till cutting tool fully wear out.

Table. 2 Input Parameters.

Sr. no.	Speed (Rpm)	Feed (mm/rev)	Depth of Cut (mm)
1	320	0.3	1
2	350	0.5	1.5
3	400	0.7	2

III. RESULTS AND DISCUSSION

Testing uncoated, coated and coated magnetized tool inserts on EN-9 steel. On the results and images taken on high resolution microscope and checking the thickness on Scanning electron microscope, analysis is done.

The results obtained by coated, uncoated and coated magnetized are varying. Coated magnetized tool is more efficient than the coated and uncoated tool insert

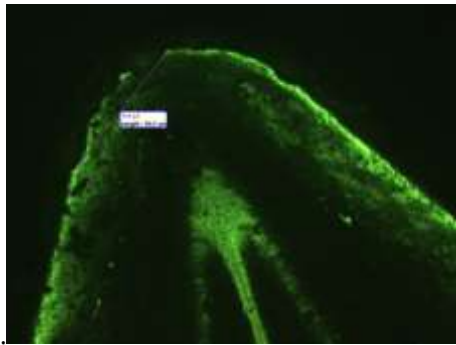


Fig. Magnetized coated Tool wear after 50 jobs

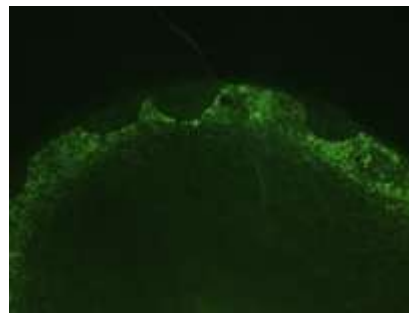


Fig. Unused tool WC

After taking experiments with coated magnetized tool the wear the values of back rake angle side rake angle is 11° , flank wear obtained was 10mm, crater wear was of 20mm. the experiments were carried on EN-9 Steel. The total tool wear obtained was 50mm.

Uncoated tool machines lesser number of jobs as compared to coated tools as well as magnetized coated tools.

IV. CONCLUSIONS

The influence of spindle speed, feed and depth of cut on output parameters are analyzed such as MRR, Tool nose wear.

The tool life was increased of coated and magnetized tool as compared to only coated tool. The Nickel chromium coating was essential for tool life increase. PVD coating is essential for tool coatings because it is cheaper than other types of coatings like CVD.

PVD is pollution free coating process. Due to magnetization of coated tool, the adhering capacity of coating is increased and tool life increases.

REFERENCES

- [1] Aharon Inspektor, Paul A. Salvador, (2014), 'Architecture of PVD coatings for metalcutting applications', *Surface & Coatings Technology*, Vol. 01, Pg. 1-16.
- [2] AnilKrishna .Battu, K. I. V. Vandana, K. SivajiBabu, Dec. (2015), 'Significance of Surface Pre-treatment for different cutting tools coted by ca-physical vapour deposition', *International Journal Of Advanced Research in Engineering & Management (IJAREM)*, Vol. 01, Pg. 152-158.

- [3] C. Ducros, V. Benevent, F. Sanchette, (2003), 'Deposition, characterization and machining performance of multilayer PVD coatings on cemented carbide cutting tools', *Surface and Coatings Technology*, 163 –164, Pg. 681–688.
- [4] B. Navins, P. Panjan, I. Milos, (1997), 'Industrial applications of CrN (PVD) coatings, deposited at high and low temperatures', *Surface and Coatings Technology*, 97, Pg. 182-191.
- [5] B. Navins, P. Panjan, I. Milos, (1999), 'PVD coatings as an environmentally clean alternative to electroplating and electroless processes', *Surface and Coatings Technology*, 116-119, Pg. 476-487.