

i

(MAF)

MAF

/  $\mu m$

## *Nanometric Finishing of Flat Surfaces Using Magnetic Field*

M. Vahdati

### **ABSTRACT**

The need for mirror-finished surfaces has grown rapidly in recent years. This is due to improvements of new products application in high technology industries. New requirements urge new production methods. One of which, in the field of machining technology, is Magnetic Abrasive Finishing. This results in surface roughness of materials in the order of sub-micron and nano level. The technology is based on the magnetic field force, which is exerted on the abrasive powder and runs the powder tool on the surface of work piece.

The process was applied to flat planes. A special apparatus was designed and made for implementation of experiments. Many properties of different factors affecting this process were examined and their influence on the surface roughness was cleared.

**KEYWORDS** : Magnetic abrasive finishing, Nano Machining, Magnets, Surface Roughness, Abrasive Tool, Magnetic Field.

---

// :

// :

i

Email:vahdai@kntu.ac.ir

(MAF)

( )

.[ ]

MAF

SEM<sup>5</sup> AFM<sup>4</sup>

.[ ]

.[ ]

.[ ]

SiC

.[ ]

[ ]

MAF

.[ ]

.[ ]

.[ ] MAF

.[ ]

MAF



$$f_n = nF_z \quad ( )$$

$$f_n = \frac{B^2}{2\mu_0} \left(1 - \frac{1}{\mu_m}\right) S \quad ( )$$

( )

:

:n

: $\mu_0$

: $\mu_m$

:B

:S

)

(

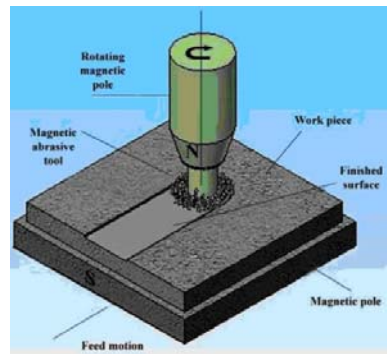
:

( )

$$F = \mu \left( \frac{dB}{dX} \right)_{\max}$$

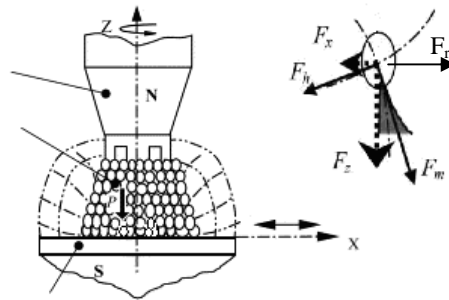
( )

: $\mu$



(MAF)

(: )



(: )

( ) [ ]

$F_r$  ( )

$F_r$   $F_x$

$F_h$

$F_m$

( )  $F_t$

$$F_t = F_m + F_h \quad ( )$$

$F_x$  ( )

$F_t$

N-S

$F_t$

$F_x$

$F_z$

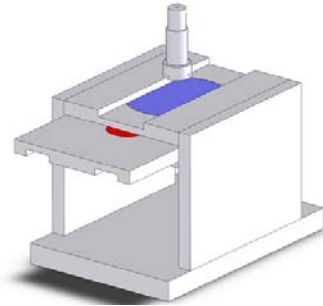
Z

$F_z$

MAF

( )

( )



:( )

S  
S

N

.( )

N  
Nd-Fe-B

N  
 $\phi$  \*

Nd-  
T  
x  
N

Fe-B  
/  
 $\phi$  x  $\phi$

S

( )



N

:( )

)

MAF

(

(SiC)

(AL<sub>2</sub>O<sub>3</sub>)

(B<sub>4</sub>C)

(FeTiO<sub>3</sub>) ( )

(SiC)

N

( )



(N)

(N)

SiC

min

mm

( )



MAF

( )

AA

( )

[ ]

\*

$\phi$

(SiC)

MAF

:

min

( )

SiC

rpm

( )

(N)

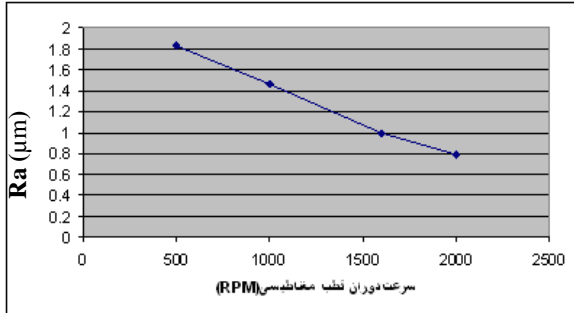
(N)

(N)

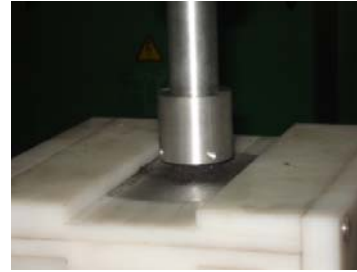
( )

(.)

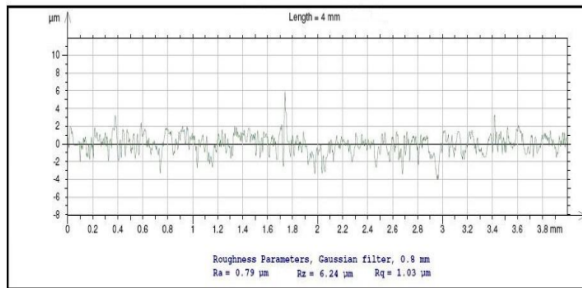
rpm



(:)



(:)



(:)

mm

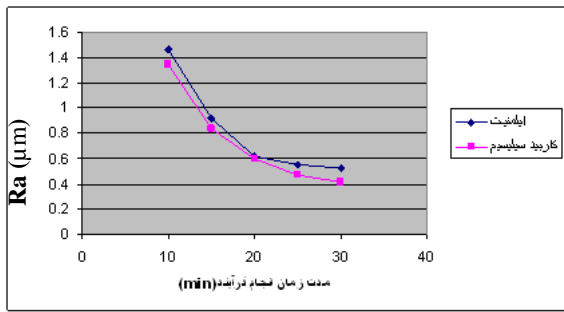
( )

( )

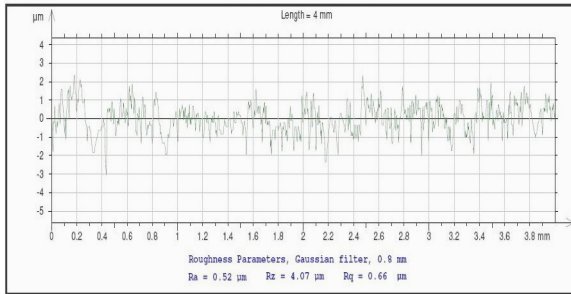
( )

( )





( ) :



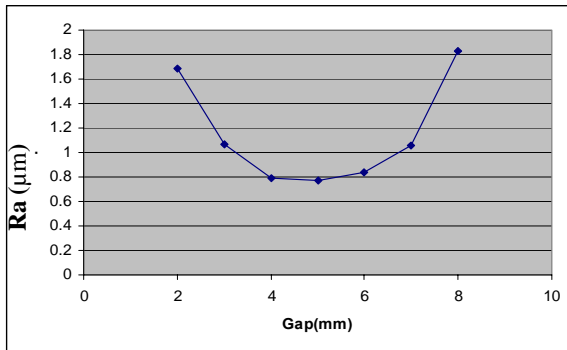
( )

(Gap)

(N)

MAF

( )



(Gap)

( ) :

Gap= mm  
mm

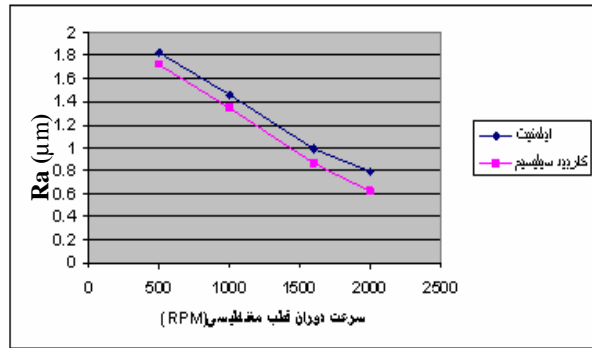
MAF

( )

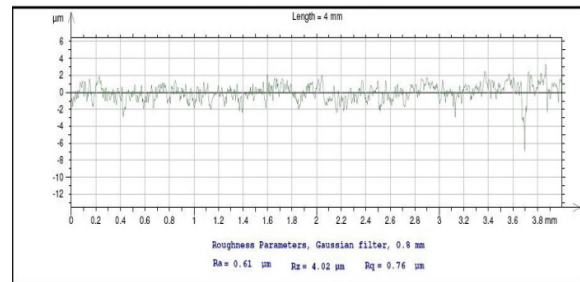
SiC

( ) ( )

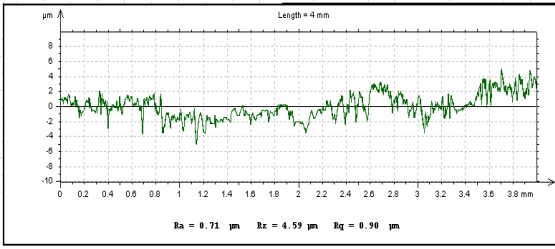
( )



( ) :

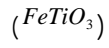


( ) :

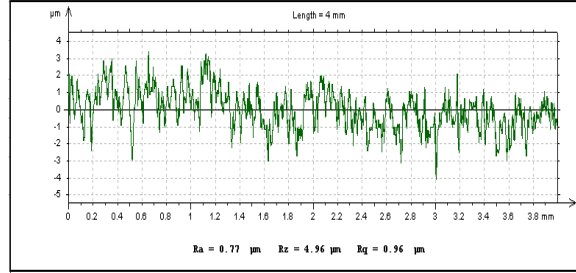


( )

AA



(SiC)



:( )

( )

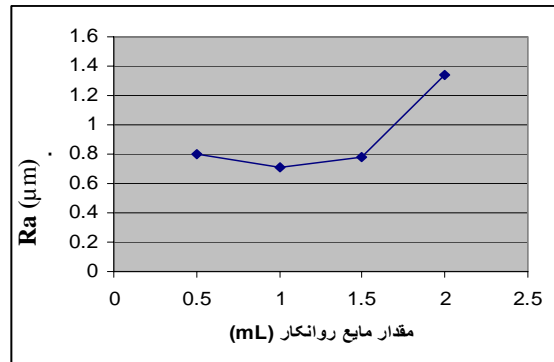
ml

( )

SiC

ml

MAF



:( )

rpm

mm (Gap)

/ µm SiC



/ / / /



AA				:( )			
( Mpa)	( Gpa)	( HV)	( HB)		( Mpa)	( Mpa)	( Mpa)
	/						

AA		:( )	
$\phi$	*	:	
( Nd - Fe - B ) Rare Earth :			
S	$\phi$ ×	N	$\phi$ × :
/ T:			
:	:	mm:	~ g: :
( wt %)	~ g:	( SiC )	:
( wt%)			
:			
, , , rpm			
min			

:( )						
( )		(Gap)				
	σ	mm		/ T	rpm	AA
	σ	mm		/ T	rpm	AA
	σ	mm		/ T	rpm	AA
	σ	mm		/ T	rpm	AA
	σ	mm		/ T	rpm	AA
	σ	mm	SiC	/ T	rpm	AA
	σ	mm	SiC	/ T	rpm	AA
	σ	mm	SiC	/ T	rpm	AA
	σ	mm	SiC	/ T	rpm	AA
	σ	mm	SiC	/ T	rpm	AA

- H. Yamaguchi, T. Shinmura, "Study of an internal magnetic abrasive finishing using a pole rotation system Discussion of the characteristic abrasive behavior", Journal of the International Societies for Precision Engineering, 24, pp. 237-244, 2000 [ ]
- V.K. Jain, Prashant Kumar, P.K. Behera, S.C. Jayswal, "Effect of working gap and circumferential speed on the performance of magnetic abrasive finishing process", Wear, 250, pp. 384-390, 2001 [ ]
- Geeng-Wei Chang, Biing-Hwa Yan, "Study on cylindrical magnetic abrasive finishing using unbounded magnetic abrasives", International Journal of Machine Tools & Manufacturing, 42, pp. 575-583, 2002 [ ]
- T. Mori, K. Hirota and Y. Kawashima, "Clarification of magnetic abrasive finishing mechanism", Journal of Materials Processing Technology, Volumes 143-144, pp. 682-686, 2003 [ ]
- Edward P.Furlani, "Permanent Magnet and Electromechanical Devices", Academic Press, ISBN 0-12-269951-3, 2001. [ ]
- T. Shinmura; H. Yamaguchi; "A new process for internal finishing of tube by the application of a new magnetic field", JSPE Journal, Vol. 38, No. 01, pp.15-18, 1994. [ ]
- T. Shinmura; K. Takazawa; E. Hatano; "Study on magnetic abrasive finishing", Ann CIRP 39, pp. 325-328, 1990 [ ]
- H. Yamaguchi, T. Shinmura, "Development of a new type of magnetic finishing tool for internal finishing of tubes using rotating magnetic field", Transactions of NAMRI/SME, Vol XXII, 1994. [ ]
- M. Fox, K. Agrawal, T. Shinmura and R. Komanduri, "Magnetic abrasive finishing of rollers", Ann. CIRP 43(1), pp. 181-184., 1994 [ ]
- H. Yamaguchi, T. Shinmura and K. Kuga, "New internal finishing process applying magnetic abrasive machining". Transactions of the Japan Society of Mechanical Engineers, Part C, 62, 600, pp. 3313-3319, 1995-6 [ ]
- H. Yamaguchi, T. Kaneko, T. Shinmura, "Development of a new internal finishing process applying magnetic abrasive finishing by use of pole rotating system", International Journal of the Japan Society for Precision Engineering, Vol. 30, No.4, 316-322, 1996-11. [ ]

- 
- <sup>1</sup> Magnetic Abrasive Finishing
  - <sup>2</sup> Magnetic Abrasive Finishing
  - <sup>3</sup> Electrolysis Finishing
  - <sup>4</sup> Atomic Force Microscope
  - <sup>5</sup> Scanning Electron Microscope
  - <sup>6</sup> Gap
  - <sup>7</sup> Rare Earth
  - <sup>8</sup> Gap
  - <sup>9</sup> Gage Block
  - <sup>10</sup> Material Removal Rate

