REPORT: Nd-Fe-B magnet cutting test by Laser-MicroJet®

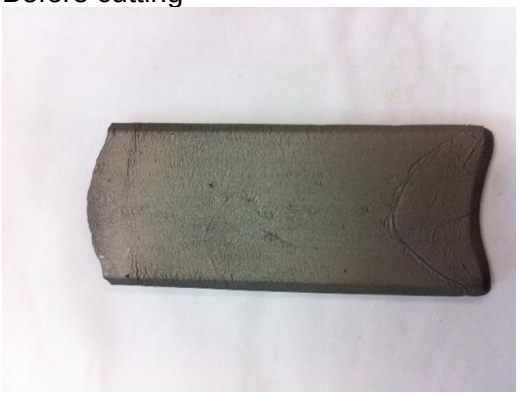
for Anoymous

By Masaki Takano, Synova Japan

TASK

The Laser-MicroJet® technology has been tested for Ne-Fe-B magnet cut with L18 DOE to clear the impact factor for the cutting speed.

Before cutting



After cutting

SAMPLE DESCRIPTION AND PREPARATION

SAMPLE	Material	Ne-Fe-B
	Dimension	37x85 *mm*
	Thickness	4 *mm*
	Quantity	5 *pcs*

Release of application report			
Project Leader		Responsible Application Group	
Name:	Masaki Takano	Name:	D^{r} Benjamin Carron
Date:	2012.09.04	Date:	
Visum:		Visum:	

PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LDS300M equipped with a green laser has been used as the machine configuration in our lab.

1. DOE Plan

Factor/Level

	A	B	C	D	E	F	G	H
	Nozzle size(um)	Height (mm)	Water pressure (bar)	Rep ratio(kHz)	＊1)Peak power (kW)	*2)overlap ratio (%)	Assist gas pressure(Mpa)	誤差
Level1	80	10	200	10	17	99.125	0.05	
Level2	100	15	250	15	24	97.5	0.15	
Level3	-	20	300	20	29	95.875	0.25	

B Height : Distance between the sample surface and coupling cover.
D Rep.ratio : laser frequency
E Peak power: Laser peak power of one pulse(Calculate with laser frequency and Avg power and pulse width)
F Overlap ratio: Calculate with nozzle size and laser frequency and axis feed rate.

No＼Factor	Nozzle size(um)	Height (mm)	Water pressure (bar)	Rep ratio(kHz)	*1)Peak power (kW)	*2)overlap ratio (%)	Assist gas pressure(Mpa)	Error
1	80	10	200	10	17	99.125	0.05	0
2	80	10	250	15	24	97.5	0.15	0
3	80	10	300	20	29	95.875	0.25	0
4	80	15	200	10	24	97.5	0.25	0
5	80	15	250	15	29	95.875	0.05	0
6	80	15	300	20	17	99.125	0.15	0
7	80	20	200	15	17	95.875	0.15	0
8	80	20	250	20	24	99.125	0.25	0
9	80	20	300	10	29	97.5	0.05	0
10	100	10	200	20	29	97.5	0.15	0
11	100	10	250	10	17	95.875	0.25	0
12	100	10	300	15	24	99.125	0.05	0
13	100	15	200	15	29	99.125	0.25	0
14	100	15	250	20	17	97.5	0.05	0
15	100	15	300	10	24	95.875	0.15	0
16	100	20	200	20	24	95.875	0.05	0
17	100	20	250	10	29	99.125	0.15	0
18	100	20	300	15	17	97.5	0.25	0

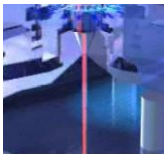
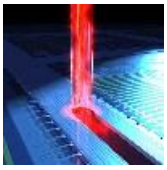
2. Factor analysis

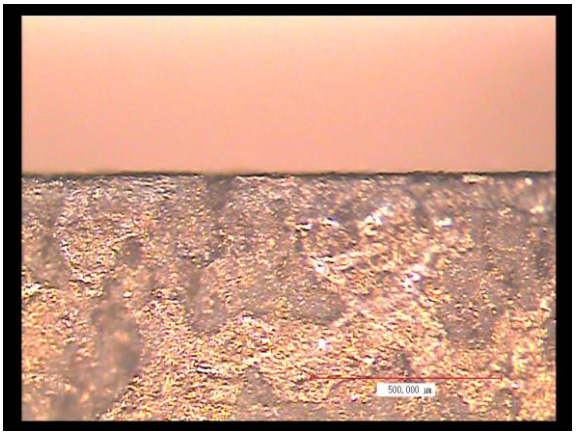
Factor/Level

	A	B	C	D	E	F	G	H
	Nozzle size(um)	Height (mm)	Water pressure (bar)	Rep ratio(kHz)	*1)Peak power (kW)	*2)overlap ratio (%)	Assist gas pressure(Mpa)	誤差
Level1	80	10	200	10	17	99.125	0.05	
Level2	100	15	250	15	24	97.5	0.15	
Level3	-	20	300	20	29	95.875	0.25	

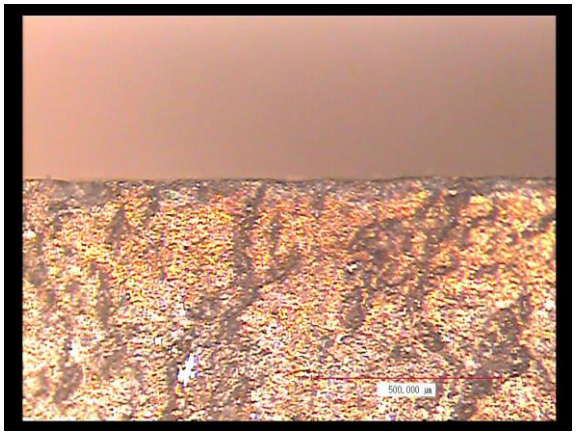
A , Nozzle size : Not so big impact in the level
B, Height : Not so big impact in the level
C, Water pressure : Higher pressure is better
D, Rep ratio : Not so big impact in the level
E, Peak power : Higher pressure is better
F, Overlap ratio : Lower overlap ratio(Higher feed rate) is better
G, Assist gas pressure : Not so big impact in the level

3. Results of the optimized condition

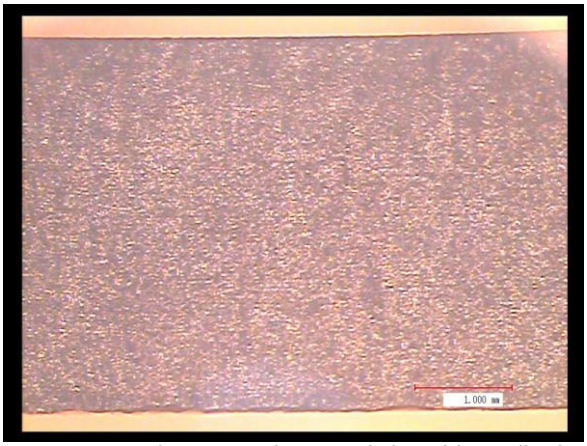
	**SYSTEM**	Machine type	LDS300M	
	**MICROJET® PARAMETER**	Nozzle diameter	80	*µm*
		Water pressure	300	*bar*
		Assist gas	He	
	**LASER PARAMETER**	Laser type	L202G	
		Wavelength	532	*nm*
		Pulse frequency	15	*kHz*
		Average power	70	*W*
	**CUTTING PARAMETER**	Feed rate	50	*mm/s*
		Number of passes	140	
		Total cutting speed	0.36	*mm/s/pass*
		Fixture	Clamp	



PICTURE: Microscope image of the edge after processing (bright field illumination; top view)



PICTURE: Microscope image of the edge after processing (bright field illumination; back view)



PICTURE: Microscope image of the side wall after processing (bright field illumination; side view)

- *The table below summarized the customer requirements and our expectations.*

	What are your priorities? (please put a cross)	Quantified expectations or improvements
• Cutting Speed	1 :Clear the factor for cutting speed	We could clear the factor for cutting speed.

CONCLUSION

The Ne-Fe-B magnet samples were investigated on SYNOVA LDS300 machine. This machine is based on the MicroJet® technology and combines the advantages the high energy pulsed laser with a hair-thin water jet.

-Cutting speed

We could clear the impact factor for cutting speed as the following.

C, Water pressure : Higher pressure is better
E, Peak power : Higher power is better
F, Overlap ratio : Lower overlap ratio (higher feed rate) is better

The optimized condition could obtain higher cutting speed than last live demo.
Last live demo condition: 0.27mm/sec
Optimized condition: 0.36mm/sec

-Cutting quality

The cutting quality of the optimized condition was not different with last live demo condition. No burr, No serious chipping.

We thank you for your interest in our technology and we hope our results meet your requirements. Our sales will contact you soon to obtain a feedback about the analysis of these results and to discuss with you the further steps.