REPORT: Copper tungsten and copper beryllium cutting by Laser-MicroJet®

for Anonymous

by Mr Stephane Delahaye; Synova SA

TASK

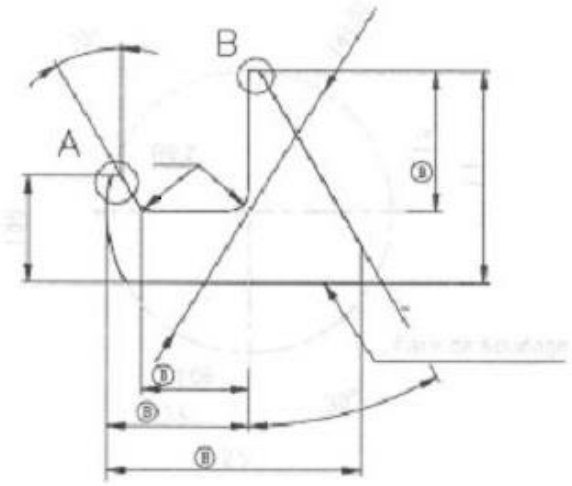
The Laser-MicroJet® technology has been tested for the cutting of 2mm thick copper tungsten samples. The goal was to improve the stability of the process, increase the nozzle lifetime and use the bridge option to hold the sample during the cut.
Reproducing the cutting of copper beryllium samples was also investigated on the same machine, with the same laser.

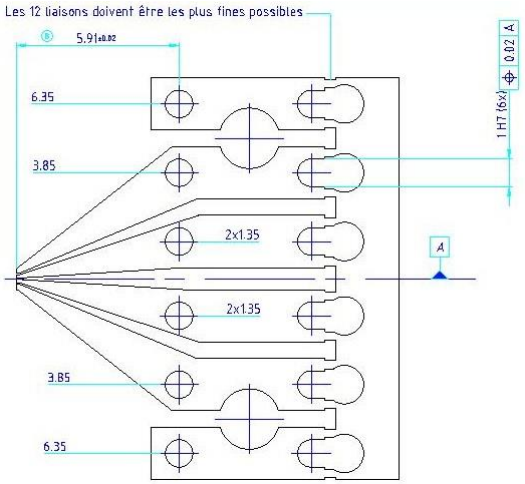
SAMPLE DESCRIPTION AND PREPARATION

SAMPLE 1	Material	Copper tungsten
	Dimension	~70*40 *mm*
	Thickness	2 *mm*
	Quantity	1 *pcs*
SAMPLE 2	Material	Copper beryllium
	Dimension	~200*200 *mm*
	Thickness	2 *µm*
	Quantity	1 *pcs*

Release of application report			
	Project Leader		Responsible Application Group
Name:	Mr Stephane Delahaye	Name:	Dr Benjamin Carron
Date:	22.06.2012	Date:	22.06.2012
Visum:	SD	Visum:	BC

The following picture gives an overview of the 2 samples:





PROCESS: INSTRUMENT & TEST PARAMETERS

For these experiments, the LCS300 equipped with frequency-doubled Q-switched Nd:YAG laser has been used as the machine configuration in our lab.
It is a fully automatic cassette-to-cassette clean-room compatible machine, allowing to cut, drill, groove, scribe, trench, mark, or grind wafers of any kind of semiconductor material.

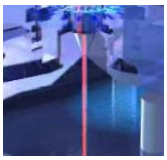
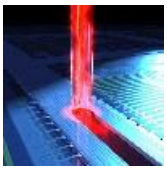
Major advantages of Laser-MicroJet® technology with regards to your application are:

- Cutting of arbitrary shapes
- Negligible heat damage to the material
- Parallel and smooth cut walls
- No slag/burr formation

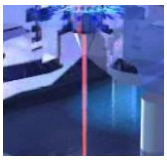
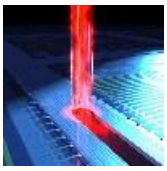
In the table below, the optimized processing parameters used in the experiments are summarized:

- **SAMPLE 1: Copper tungsten**

	**SYSTEM**	Machine type	LCS 300

	**MICROJET® PARAMETER**	Nozzle diameter	80	*µm*
		MicroJet® diameter	64	*µm*
		Water pressure	100	*bar*
		Assist gas	He	
	**LASER PARAMETER**	Laser type	L101G	
		Wavelength	532	*nm*
		Pulse frequency	8	*kHz*
		Average power	~42	*W*
		Pulse width	~110 ns	
	**CUTTING PARAMETER**	Cutting speed	2	*mm/s*
		Number of passes	32 without bridge + 30 with bridge	
		Overall speed	1.9	*mm/min*
		Fixing system	clamps	

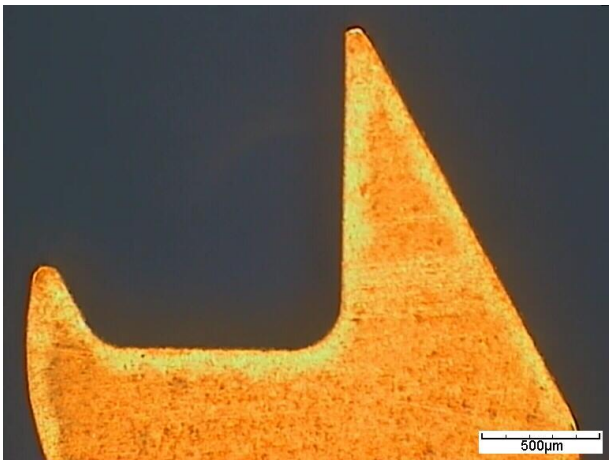
- **SAMPLE 2: Copper beryllium**

	**SYSTEM**	Machine type	LCS 300	
	**MICROJET® PARAMETER**	Nozzle diameter	40	*µm*
		MicroJet® diameter	~32	*µm*
		Water pressure	400	*bar*
		Assist gas	He	
	**LASER PARAMETER**	Laser type	L101G	
		Wavelength	532	*nm*
		Pulse frequency	8	*kHz*
		Average power	~22	*W*
		Pulse width	~110 ns	
	**CUTTING PARAMETER**	Cutting speed	1.1	*mm/s*
		Number of passes	1	
		Overall speed	1.1	*mm/s*
		Fixing system	clamps	

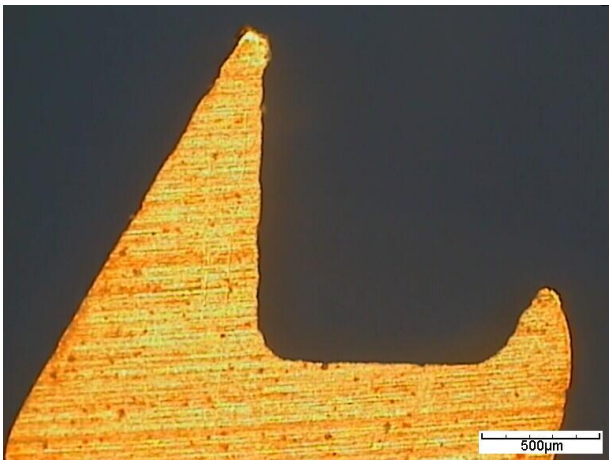
RESULTS

The following microscope picture give an overview on the quality obtained with the Laser-Microjet® technology.

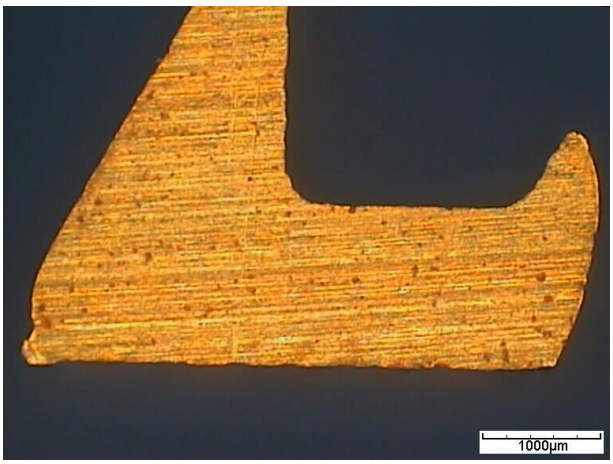
- **Sample 1**



PICTURE 1: Microscope image of the frontside (dark field illumination)



PICTURE 2: Microscope image of the backside (dark field illumination)

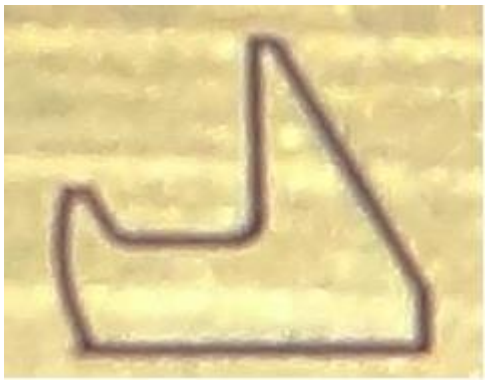


PICTURE 3: Microscope image of the backside which show the bridge (dark field illumination)

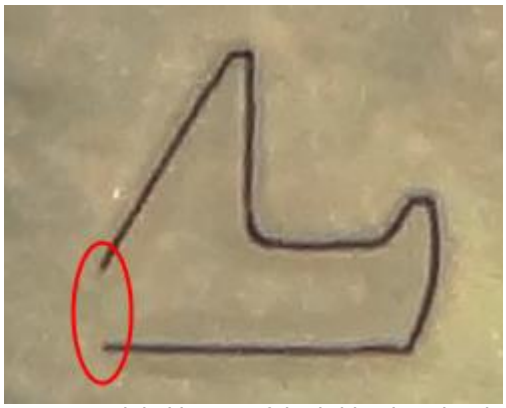
Bridge location and adjustments:

A bridge is necessary to hold the sample during the cut.
Thickness and length of the bridge can be directly adjusted by changing the setting parameters into the program.

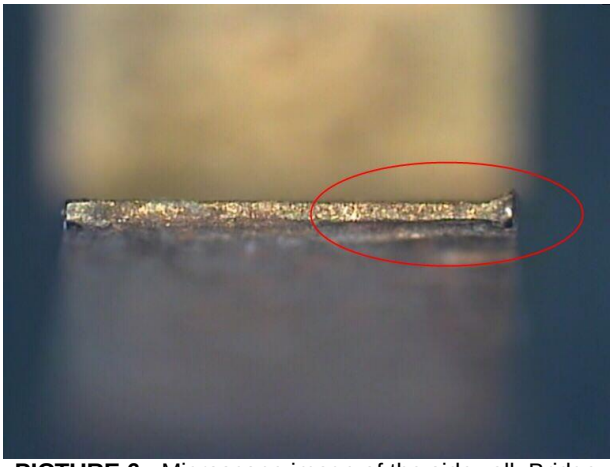
- Changing the number of passes “with” and “without bridge” will affect the thickness.
- The time the laser is switched off during the cut will affect the length



PICTURE 4: Digital image of frontside



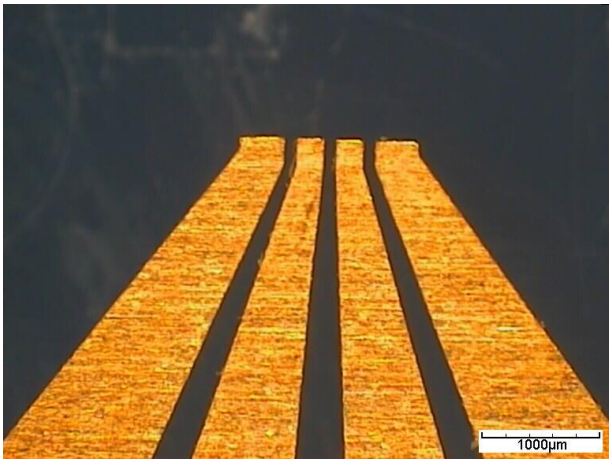
PICTURE 5: Digital image of the bridge location (much smaller on the real samples)



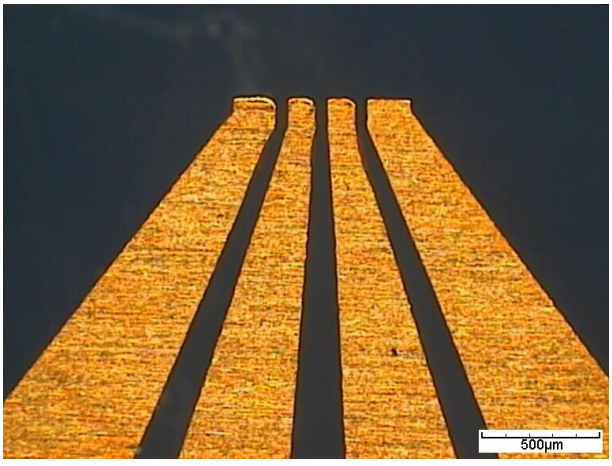
PICTURE 6: Microscope image of the sidewall. Bridge thickness can be adusted with the program

Note: when the settings are correctly adjusted the operator just need to push the sample to get it.

- **Sample 2**



PICTURE 7: Microscope image of the frontside (dark field illumination)



PICTURE 8: Microscope image of the backside (dark field illumination)

The table below summarises Anonymous expectations and our results.

	What are your priorities? (please put a cross)	Quantified expectations or improvements
Speed / throughput:	X	~ 4min30/ sample1
Burr-free:	X	No burrs have been observed
Heat-damage free:	X	No heat damage has been observed
Tolerances:	X	No tools available to check at Synova

CONCLUSION

The cutting of copper tungsten and copper beryllium samples was investigated on SYNOVA LCS 300. This machine is based on the MicroJet® technology and combines the advantages of the high energy pulsed laser with a hair-thin water jet. While the laser is used for material ablation, the water jet is used for guiding the laser light, cooling the edges and preventing the sample from particle contamination, advantages that are essential for the cutting of copper tungsten samples with high quality.

These tests show that:

- We successfully cut copper tungsten and copper beryllium samples with a very good overall quality
- Process has been stabilized and nozzle lifetime has been increased for Copper tungsten
- Same machine and laser allow the cut of copper tungsten and copper beryllium samples

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