G Series Application Note

Measurement of Micro Burrs around drilled holes

Bruker alicona

Bruker Alicona is a leading global supplier of optical metrology solutions based on the principle of Focus Variation.

Focus Variation works on the basis of moving a focal plane over a surface and collecting robust 3D data which can then be used to measure geometric form and surface finish from a single optical sensor.

Measurement processes can be fully automated and provide GD&T measurement capabilities across all industrial & medical sectors.

The systems are in use in Industry, Industrial Research, Universities and production facilities globally.

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Introduction

Burrs created during machining affects the quality of the work piece in many negative ways. Common machining processes such as stamping, drilling, turning, milling, punching and grinding all may produce burrs.

Burrs can be minimized by various means such as deburring, changing tool geometry and machining paths, different coolants, chamfering process and machining speeds. But even when using a mechanical deburring method, micro burrs can still remain around a hole and this of course could lead to part assembly issues and product failure when in use.

This application note describes how these burrs can be measured to provide the complete story to this difficult issue.

The study was conducted by Mitis, in order to confirm a cutting tool lifespan in the field of luxury watchmaking

System Used

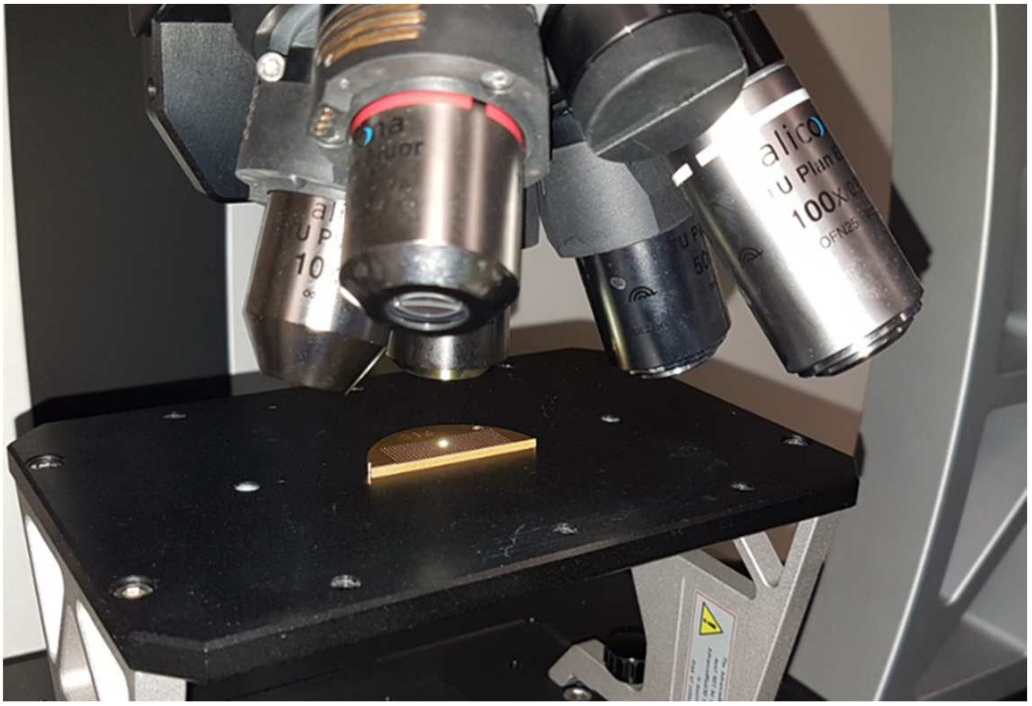
The system used to perform this measurement is the Bruker Alicona InfiniteFocusG5 plus system. This is an optical 3D metrology system that allows the measurement of 3D profile, 2D dimensions and surface finish with a single measurement system. This, unlike tactile profile-based measurement allows the automatic measurement of 2D data and 3D topography data without the risk of damage to the surface caused by a stylus.

Measurement Task

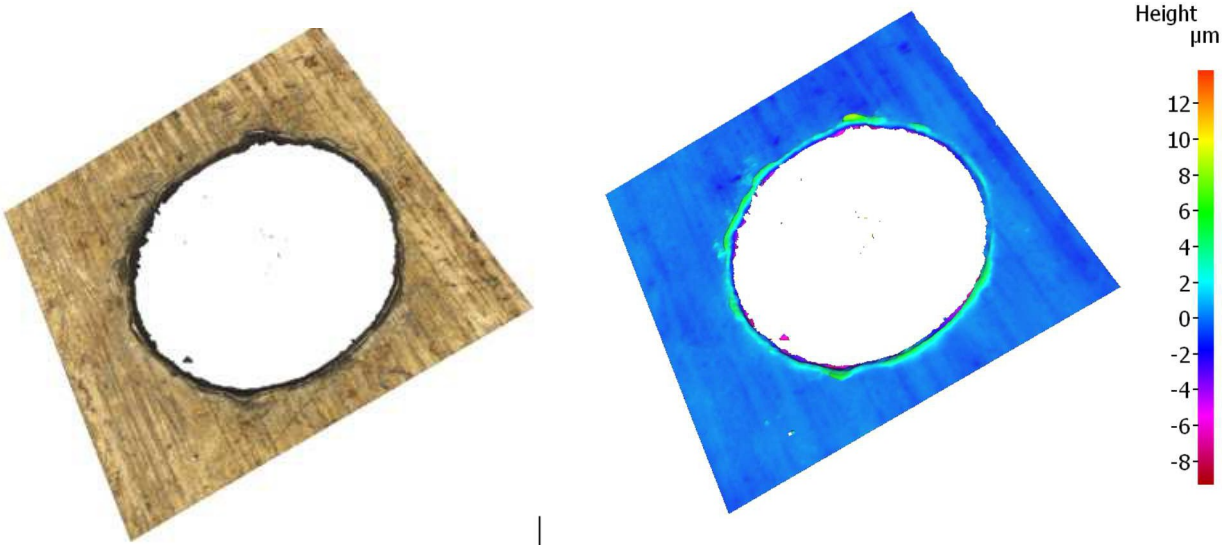
In order to assess the tool life validated for production it is necessary to measure the burrs produced at given time intervals. To conduct this test a series of drilled holes were put in a copper alloy test plate and these are used to precisely measure the burrs to quantify the effectiveness of each cutting tool and cutting process.

The automated burr measurement is achieved using the automatic defect detection module in the Bruker Alicona AutomationManager module.

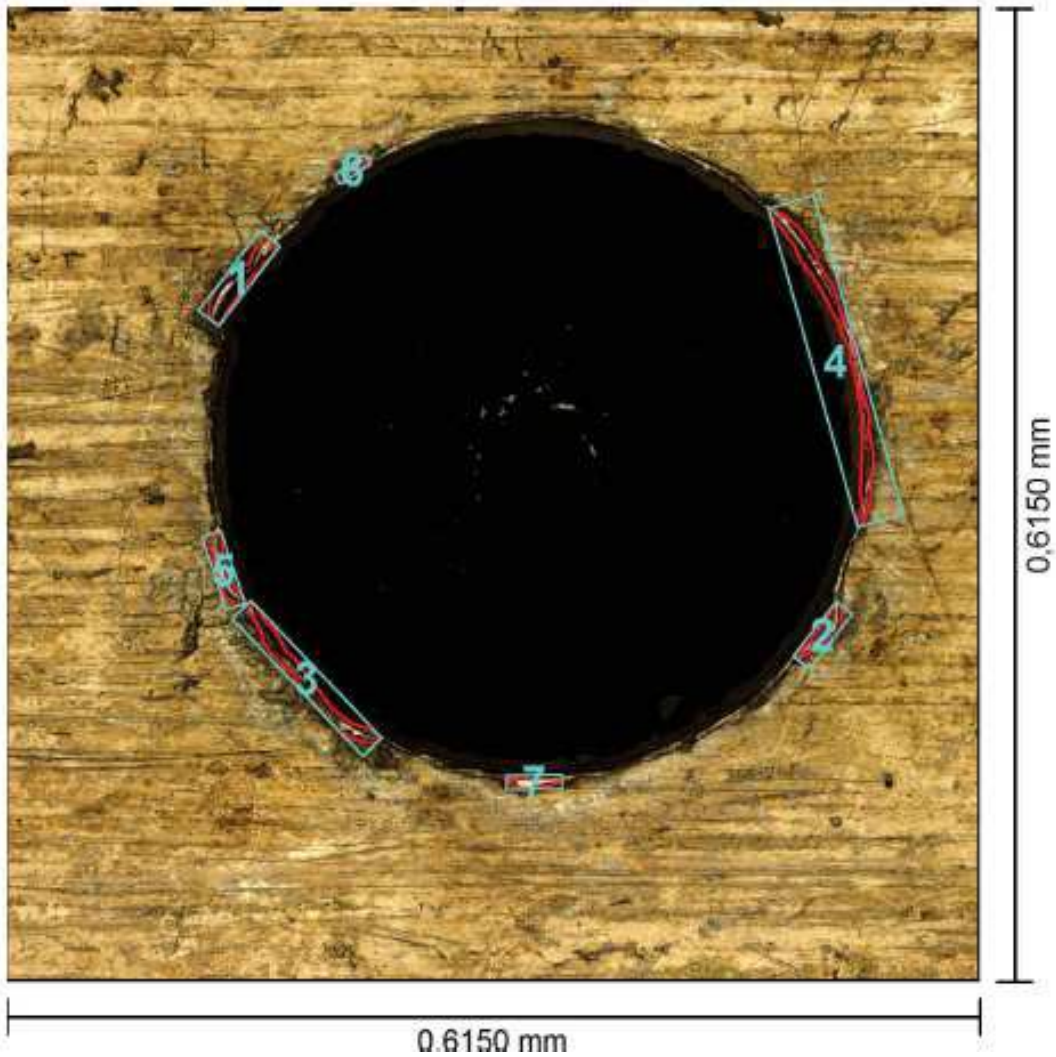
In use the sample can be simply placed on the motorised XY stage, (as shown below) or it can be placed in a customized holder if repeat or automatic measurements are required.



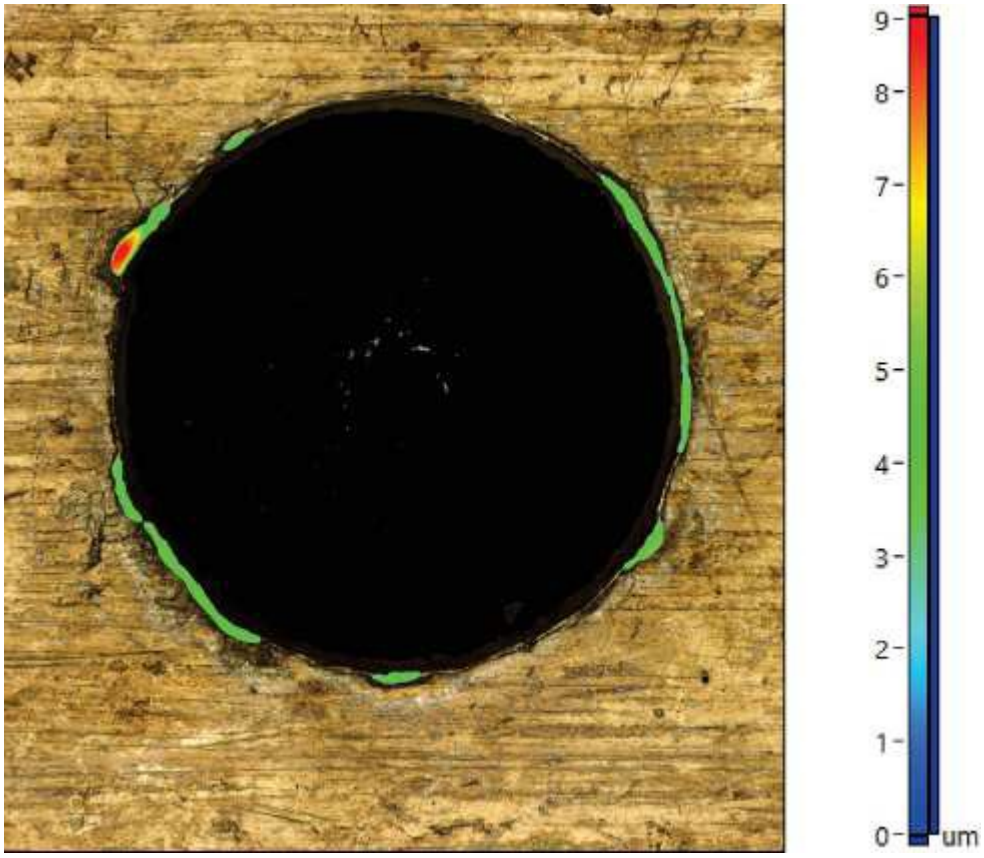
A scan is made and is shown as either a true color dataset or with pseudo color related to height as shown below.



These 3D data sets are then used in the AutomationManager with defect detection. A scan is made using pre-defined parameters and defects that fall within this range are displayed and numbered. In this case they are identified as 1-7. When pseudo color is added the maximum range of these defects can be shown. The used algorithm is based on artificial intelligence for detection of the burrs around the surface. The use of an artificial intelligence algorithm allows an operator independent analysis of the 3D data, as well as some operator time savings, as the analysis is conducted automatically.



7 Identified burrs identified with the defect detection module



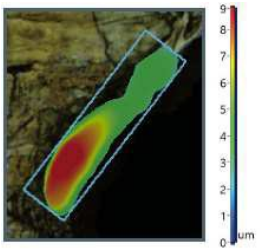
Pseudo colour data showing maximum range of defects.

A table of data is automatically produced as shown below.

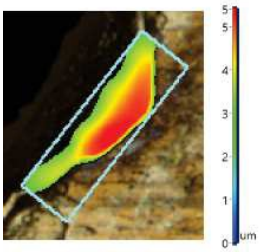
Name	Value	Unit	Description
#D	7	#	Number of found defects
MAX_D	0,00	µm	Maximum depth
MAX_H	8,78	µm	Maximum height
MAX_Pa	1299,98	µm²	Maximum projected area
MAX_Ta	1814,01	µm²	Maximum true area
MAX_Vb	0,00	µm³	Maximum volume below
MAX_Va	4853,66	µm³	Maximum volume above
%DA	1,55	%	Percentage of defect area
MAX_L	208,98	µm	Maximum length
MAX_W	29,87	µm	Maximum width

Using the built is analytical software it is now possible to carry out detailed analysis of each defect as shown below in specific results.

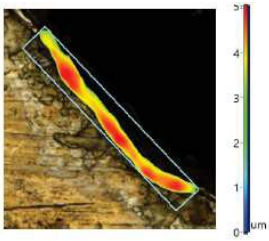
Specific Results



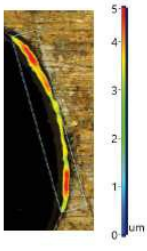
Defect 1					
Height [µm]	Volume above [µm³]	Projected area [µm²]	True area [µm²]	Length [µm]	Width [µm]
8,78	4028,86	697,22	1108,92	63,92	16,13



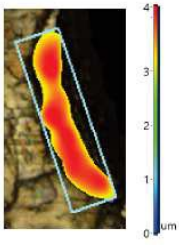
Defect 2					
Height [µm]	Volume above [µm³]	Projected area [µm²]	True area [µm²]	Length [µm]	Width [µm]
5,41	1336,08	328,24	489,29	44,08	13,01



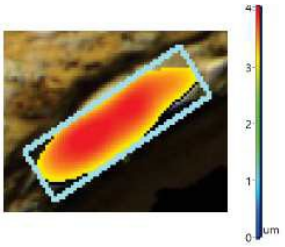
Defect 3					
Height [µm]	Volume above [µm³]	Projected area [µm²]	True area [µm²]	Length [µm]	Width [µm]
5,06	3782,38	901,86	1139,76	120,16	16,63



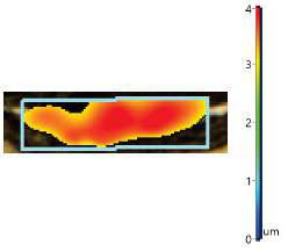
Defect 4					
Height [µm]	Volume above [µm³]	Projected area [µm²]	True area [µm²]	Length [µm]	Width [µm]
4,68	4853,66	1299,98	1814,01	208,98	29,87



Defect 5					
Height [µm]	Volume above [µm³]	Projected area [µm²]	True area [µm²]	Length [µm]	Width [µm]
4,19	1307,47	347,95	465,61	48,73	12,55



Defect 6					
Height [µm]	Volume above [µm³]	Projected area [µm²]	True area [µm²]	Length [µm]	Width [µm]
4,07	441,89	125,59	204,40	23,51	7,15



Defect 7					
Height [µm]	Volume above [µm³]	Projected area [µm²]	True area [µm²]	Length [µm]	Width [µm]
3,95	763,80	216,62	320,68	35,37	8,85

Summary:

The measurement of micro burrs is extremely challenging, especially when these defects are as low as 4 microns which would be difficult to see with the naked eye.

However, these defects can cause a significant decrease in the performance of components/tools. In cases such as surgical instruments, microelectronics, luxury watches such burrs can mean the difference between working or not working.

This report clearly shows that FocusVariation can automatically detect and measure these defects. In this case it is applied to components used in the luxury watch market. However, the technology can be used in any area where the removal or understanding of micro burrs is important.

We would like to thank the company Mitis for allowing this data to be used.

@Mitis

"Mitis is the reference of the Vibratory Drilling process, an ultimate solution for optimizing performance in machining production. Expert in axial cutting processes, Mitis closely supports the leading sectors of the industry through a constant approach of technological innovation."