Bruker alicona

That's metrology!

Application Note

Measurement Solutions for Industry

In this issue:

Pharmaceutical Tablets

In this issue we look at if optical metrology, more commonly used in Industrial Applications, be used in the measurement of tablets. From this data it could be possible to understand why some are easier to swallow than others, if a coating is firmly attached to the natural surface and could assist in the identification of counterfeits.

Our thanks to Optimax Imaging and Inspection, the UK distributor for Bruker Alicona, for providing the data for this application note.

Equipment Used

For this study and InfiniteFocus G5 system was used for all the measurements as shown in Figure 1.

Figure 1

A small selection of generic pills was used for this study to illustrate the various options available when using Optical Metrology systems. Using this technology, it is possible to measure form, surface texture, embossed letters and flashing caused by the tabletting process.

Method.

In the operational process a tablet is optically scanned, and a 3D model of the surface or edge of the tablet created. This is presented in true colour which is made from a 3D point cloud with registered true colour as shown in Figure 2

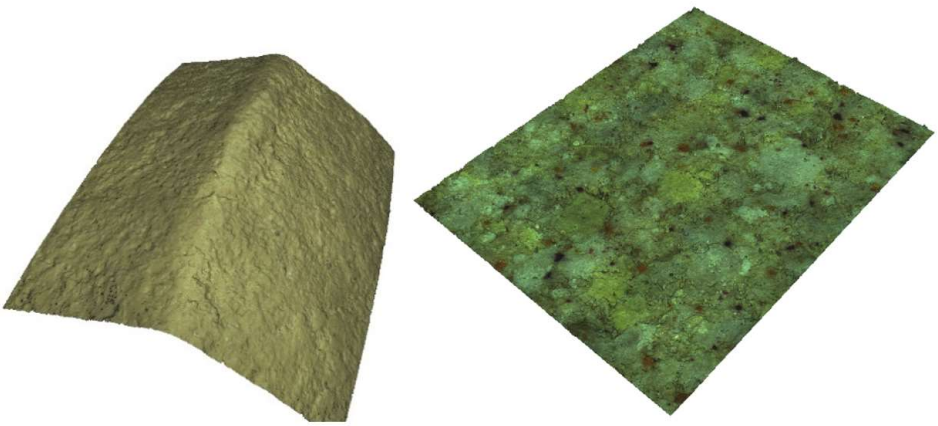
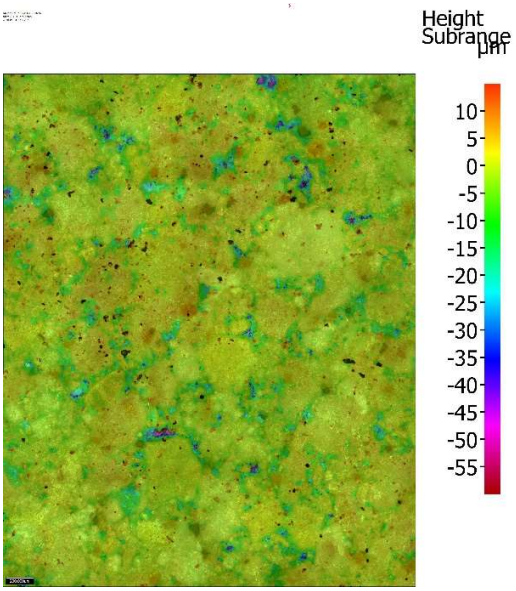


Figure 2

From this 3D model it is possible to make measurements according to the requirements.

For surface measurement a height map is applied to show overall topography of the surface and data is extracted to supply surface texture parameters as shown in Figure 3.



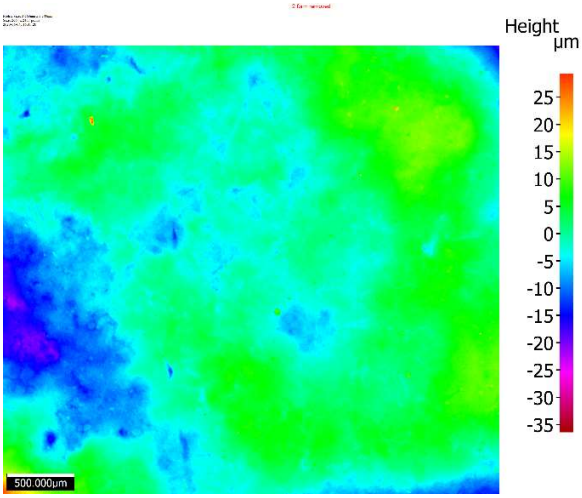
Sa	2.890	µm	Average height of selected area
Sq	5.075	µm	Root-Mean-Square height of sele
Sp	33.242	µm	Maximum peak height of selected
Sv	66.076	µm	Maximum valley depth of selectec
Sz	99.318	µm	Maximum height of selected area
S10z	88.206	µm	Ten point height of selected area
Ssk	-2.586		Skewness of selected area
Sku	21.575		Kurtosis of selected area
Sdq	0.859		Root mean square gradient
Sdr	25.891	%	Developed interfacial area ratio

Sk	4.586	µm	Core roughness depth, Height of the core material
Spk	5.261	µm	Reduced peak height, mean height of the peaks above the core material
Svk	11.658	µm	Reduced valley height, mean depth of the valleys below the core material
Smr1	10.610	%	Peak material component, the fraction of the surface which consists of peaks above the core material
Smr2	81.040	%	Peak material component, the fraction of the surface which will carry the load
Vmp	0.272	ml/m²	Peak material volume of the topographic surface (ml/m²)
Vmc	2.089	ml/m²	Core material volume of the topographic surface (ml/m²)
Vvc	2.367	ml/m²	Core void volume of the surface (ml/m²)
Vvv	1.144	ml/m²	Valley void volume of the surface (ml/m²)
Vvc/Vmc	1.134		Ratio of Vvc parameter to Vmc parameter

Figure 3

These parameters describe the surface of the tablet in detail and could provide information on how easy or difficult these pills are to swallow. The Vvc and Vmc numbers, for example display if the surface would hold a liquid or is so smooth that no surface liquid could be retained, and, the Sa number displays the roughness of a surface and both would have an effect on the smooth path of a pill as it is swallowed.

As a comparison, if a different pill is selected, we can again view the model and extract measurement data as shown in Figure 4.



Sa	5.850	µm	Average height of selected area
Sq	8.471	µm	Root-Mean-Square height of selected area
Sp	51.416	µm	Maximum peak height of selected area
Sv	55.123	µm	Maximum valley depth of selected area
Sz	106.540	µm	Maximum height of selected area
S10z	101.706	µm	Ten point height of selected area
Ssk	-0.807		Skewness of selected area
Sku	7.562		Kurtosis of selected area
Sdq	0.133		Root mean square gradient
Sdr	0.831	%	Developed interfacial area ratio

Sk	15.013	µm	Core roughness depth, Height of the core material
Spk	8.831	µm	Reduced peak height, mean height of the peaks above the core material
Svk	15.520	µm	Reduced valley height, mean depth of the valleys below the core material
Smr1	9.970	%	Peak material component, the fraction of the surface which consists of peaks above the core material
Smr2	84.820	%	Peak material component, the fraction of the surface which will carry the load
Vmp	0.441	ml/m²	Peak material volume of the topographic surface (ml/m²)
Vmc	5.663	ml/m²	Core material volume of the topographic surface (ml/m²)
Vvc	7.274	ml/m²	Core void volume of the surface (ml/m²)
Vvv	1.539	ml/m²	Valley void volume of the surface (ml/m²)
Vvc/Vmc	1.284		Ratio of Vvc parameter to Vmc parameter

Figure 4

If this data is compared, it can be seen the Sa value on the second example is double that of the first example and the ratio of Vmc to Vvc is much different. This could provide data as to if pill 2 is more difficult to swallow than pill 1 and if a coating is more effective on one surface than another.

Edge Measurement.

“Flashing” can occur in the pill stamping process which can leave a rough edge which can cause discomfort when a pill is swallowed. Using optical metrology, it is possible to produce a 3D data set of the edge and measurements made. Two different examples are shown in Figure 5.

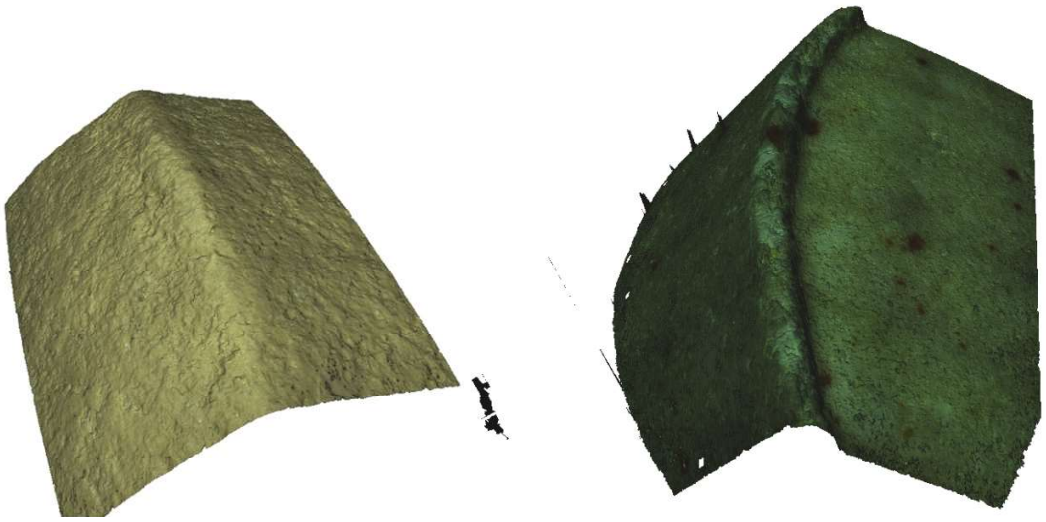
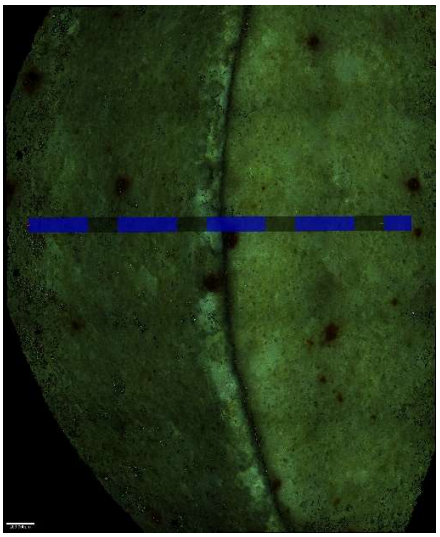


Figure 5



Using the second example it is now possible to perform a profile measurement by extracting a line across the edge to be measured creating a profile line on which measurements of height and width can be obtained as shown in Figure 6.

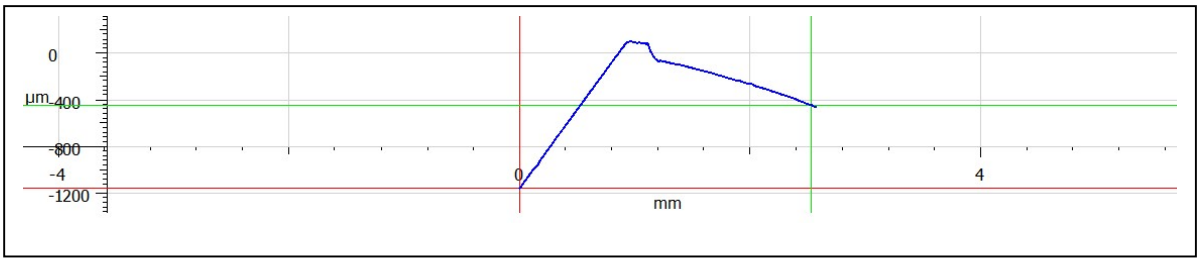


Figure 6

Counterfeit Identification.

Using the 3D data captured with the Focus Variation measurement system it is possible to measure surface features such as embossed text, this can be compared against CAD data taken from the tabletting tool. Any variance in the data would indicate if the product is genuine, as illustrated in Figure 7.

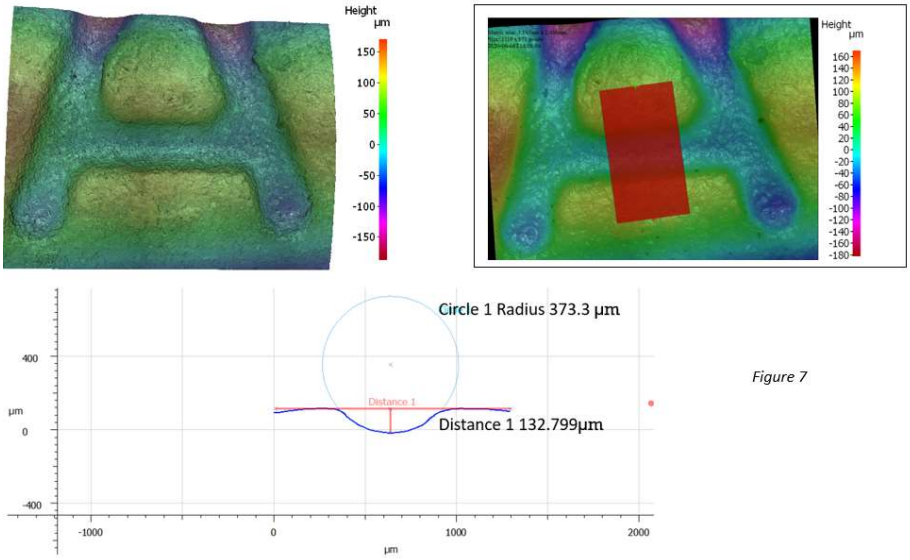


Figure 7

Figure 7

Conclusion:

It is clear from this study that Optical Metrology can be used to measure both the geometry and surface texture of pills. It allows comparisons to be drawn between the oral performance of different pills and to adjust surfaces and coatings to provide the best possible performance. It can also be used in the identification of counterfeit products making it an ideal tool for use in the pharmaceutical industry.