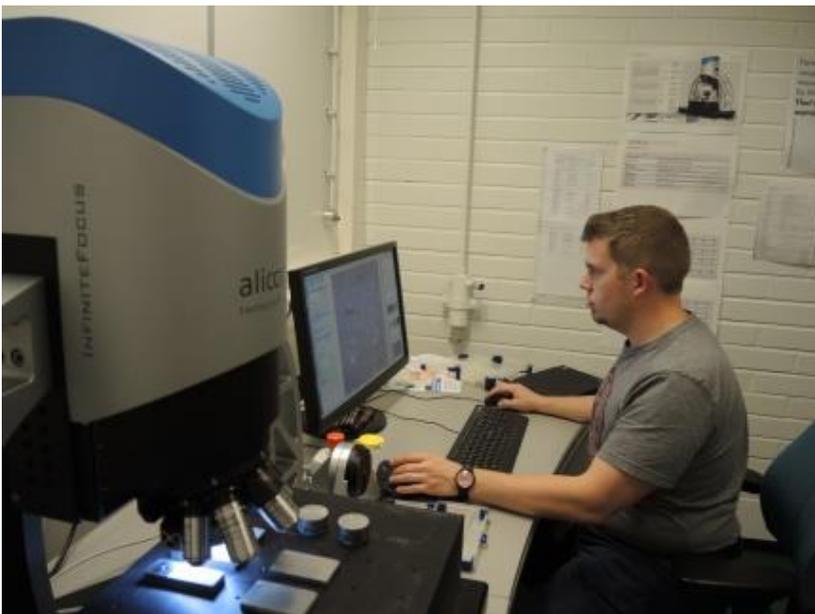


# Optical Metrology User Case Study: All in one measurement solution for materials research and evaluation and measurement of FSW probes



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.

Tampere University of Technology in Finland explores innovative approaches for a variety of technical applications in their research on materials. With Alicona they have found an all-round tool for the study of diverse materials and the geometrical verification of a wide range of components with different shapes and sizes.

The selection of a material is a key factor in the production of high-quality technical components. Technical innovation and new manufacturing processes are directly linked to the research and development of new materials. These materials must meet the requirements for wear resistance, corrosion resistance and a fully functional service life of the components and this is determined by the correct material selection for the component application.

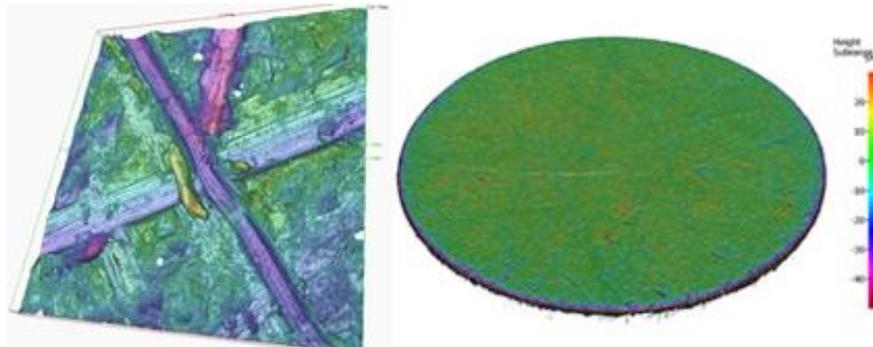
## Evaluation of surface deformation, wear rates and mechanisms

The Laboratory of Materials Science at Tampere University of Technology (TUT) in Tampere, Finland, conducts high-level research on the structure, properties, processing and use of practically any type of material. In collaboration with industry, a broad variety of technical applications are covered.

As this is a Materials Science department a wide variety of materials are used and include metals, polymers, textiles, wood, paper, ceramics, coatings and rocks. In addition, full form measurement of various tools and components is also a requirement.

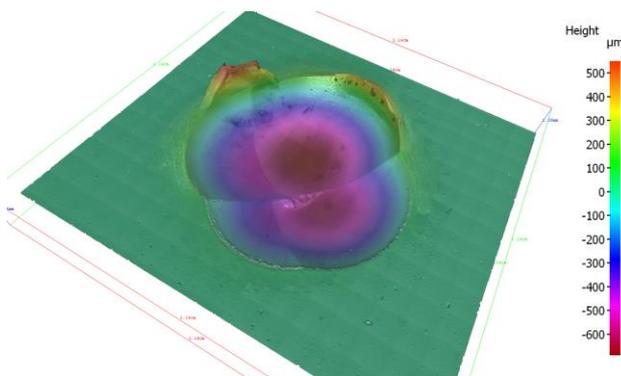
Using a InfiniteFocus G5 system fitted with a real3D rotation device, providing a 5 axis measurement platform, the users Niko Ojala and Jarmo Laakso are able to study the morphology of surfaces, verify dimensioning,

and evaluate surface deformation, wear intensities and mechanisms created by test methods such as pin on disk and impact testing.



*Crushing pin-on-disk high-stress abrasion wear test: The Alicona measurement system provides numerical quantification and a detailed 3D surface characterization of the specimens both in full macro and detailed micro levels. (picture on left has a surface area of  $3\text{mm}^2$  and the right-hand picture an area of  $1.00\text{mm}^2$ )*

Since components in materials testing often contain fractured or deformed surfaces, steep flanks or rough surface topographies are regularly encountered. Alicona offers a unique solution to document the entire surface even with these difficult to measure features.



3D surface measurement of a steel specimen after five impacts by the high velocity particle impact test at a temperature of  $-60^\circ\text{C}$ .

## Geometric verification of Friction Stir Welding tools for sealing nuclear fuel disposal canisters

The Applied Materials Science research group at the laboratory offers service for companies in any type of material related projects. In collaboration with two Scandinavian expert organizations for nuclear waste management, SKB and Posiva Oy, it was possible to verify the geometry of an FSW-probe, which is used for sealing nuclear fuel disposal canisters.

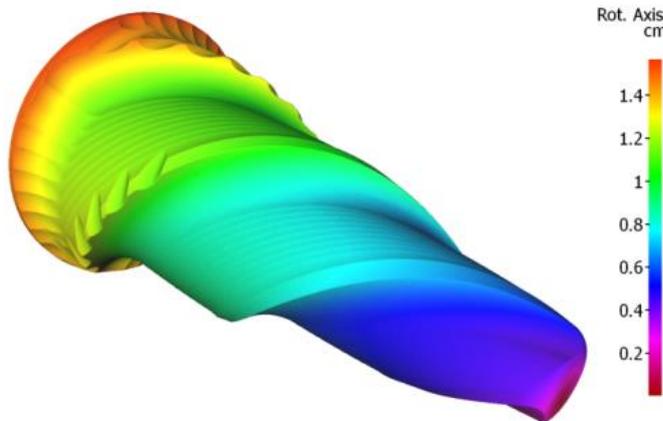
Using the InfiniteFocus G5 with the AdvancedReal3D Rotation Unit, it was possible to verify the geometry of an FSW-probe, which is used for sealing nuclear fuel disposal canisters. FSW (Friction Stir Welding) is a welding method in which frictional heat is generated between the tool and a target metal. This causes the metal to soften and weld together by mechanical intermixing. The probe is intended to be non-consumable, so the challenge is to prevent the probe material from melting, while it is traversed along the welding line. Thus, the accurate geometry of it is a key factor for an efficient welding process.

Using the InfiniteFocus it is possible to achieve full form measurements of tools and components. This enables members of the research group to measure dimensions such as length, diameter and radius, as well as roundness. Radii can be measured down to 2 $\mu$ m in lateral resolution. The measurements show if components are in accordance to the specified tolerances. Form deviations are evaluated by comparison to CAD data.



*Image of FSW-probe held in an advanced real3D rotation device on an Alicona G5 Infinite Focus system*

Picture ©SKB ans Posiva



*Full form measurement of an FSW-probe. With an AdvancedReal3D Rotation Unit in addition to InfiniteFocus the full form measurement is achieved.*

© SKB and Posiva Oy

**Easy quantification of material deformation on large measurement areas with Multi Measurement Automation.**

By using the MultiMeasurement function it is possible to set up an automatic measurement routine for about a dozen of specimens to be measured one after another or measure multiple locations in high-resolution. This saves both working and machine time for other tasks as and allows, for example, night-time can be fully utilized. "Versatility and agility are important, as well as user friendliness, and that's what Alicona gives us."

## User Comments:

“Initially, we were looking for a system that could measure specimens with both large areas of several square centimeters width and rough surfaces, like large wear or fracture surfaces with steep slopes. For us it was also important that the measurement system would be relatively fast. A third requirement was the possibility to do measurements by rotating the specimen and have real 3D datasets as a result”, Niko Ojala and Jarmo Laakso, researchers at the laboratory, explain.” With InfiniteFocus we have found a measurement system that suits our needs. Due to the high demand and interest towards the system, the utilization ratio has been up to 24/7. Previously we only had an interferometry system, but it was not able to measure large areas efficiently, in fact it would have needed days to do that. With Alicona we measure areas up to 200 x 200 mm at high measurement speed”, Niko and Jarmo explain. As measurements of large areas often also require long measurement depth z-ranges – as components can either have a curved form, large height differences or highly deformed surface – InfiniteFocus has proven to be the right tool”.

## Summary:

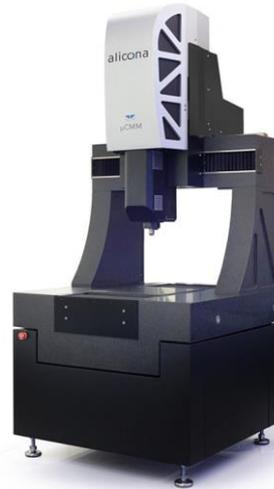
It can be clearly seen that Optical 3D metrology can offer a versatile tool for a materials research facility.

In a simple to use package, and not requiring any metrology knowledge to operate users can easily scan a surface and measure the features required.

## Equipment Available

These measurements can be made using one of the 2 products shown below from Bruker Alicona. the InfiniteFocusG5 plus will measure up to 200 x 200mm and the  $\mu$ CMM up to 300 x 300mm.

InfiniteFocusG5 plus system with 200 x 200mm XY stage and fitted with rotation device. Info at <https://bit.ly/2TF9ctH>



$\mu$ CMM 300 x 300 mm XY stage. Info at <http://bit.ly/34ht4tk>