NANOVEA

SHOT PEENED SURFACE ANALYSIS

USING 3D NON-CONTACT PROFILOMETER

Prepared by

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INTRODUCTION

Shot peening is a process in which a substrate is bombarded with round metal, glass, or ceramic beads—commonly referred to as "shot"—at a force intended to induce plasticity on the surface. Analyzing the characteristics before and after peening provides crucial insights for enhancing process comprehension and control. The surface roughness and coverage area of dimples left by the shot are especially noteworthy aspects of interest.

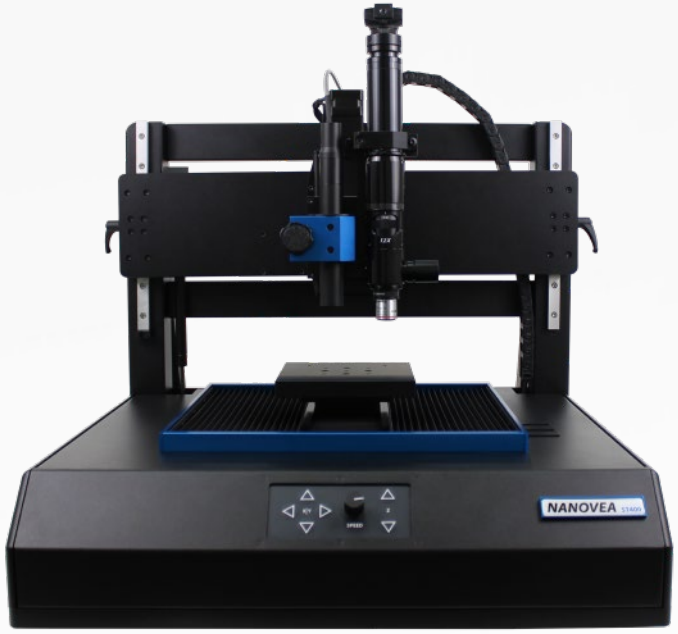
IMPORTANCE OF 3D NON-CONTACT PROFILOMETER FOR SHOT PEENED SURFACE ANALYSIS

Unlike traditional contact profilometers, which have traditionally been used for shot peened surface analysis, 3D non-contact measurement provides a complete 3D image to give a more comprehensive understanding of coverage area and surface topography. Without 3D capabilities, an inspection will solely rely on 2D information, which is insufficient for characterizing a surface. Understanding the topography, coverage area, and roughness in 3D is the best approach for controlling or improving the peening process. ***NANOVEA*** 3D Non-Contact Profilometers utilize Chromatic Light technology with a unique capability to measure steep angles found on machined and peened surfaces. Additionally, when other techniques fail to provide reliable data due to probe contact, surface variation, angle, or reflectivity, ***NANOVEA*** Profilometers succeed.

MEASUREMENT OBJECTIVE

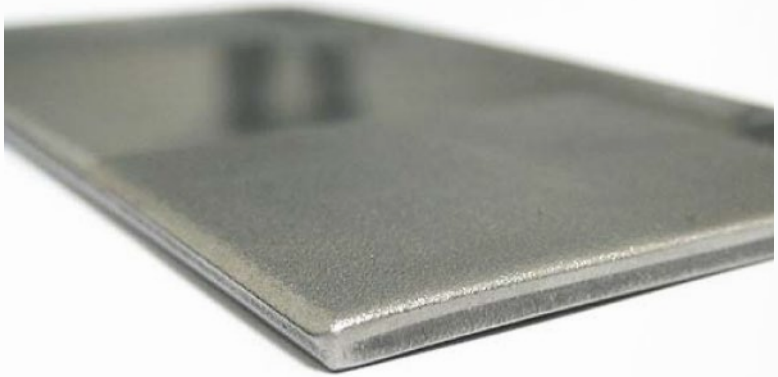
*In this application, the **NANOVEA** ST400 Non-Contact Profilometer is used to measure raw material and two differently peened surfaces for a comparative review. There is an endless list of surface parameters that can be automatically calculated after the 3D surface scan. Here, we will review the 3D surface and select areas of interest for further analysis, including quantifying and investigating the roughness, dimples, and surface area.*

CLICK HERE TO LEARN MORE
ABOUT THE INSTRUMENT



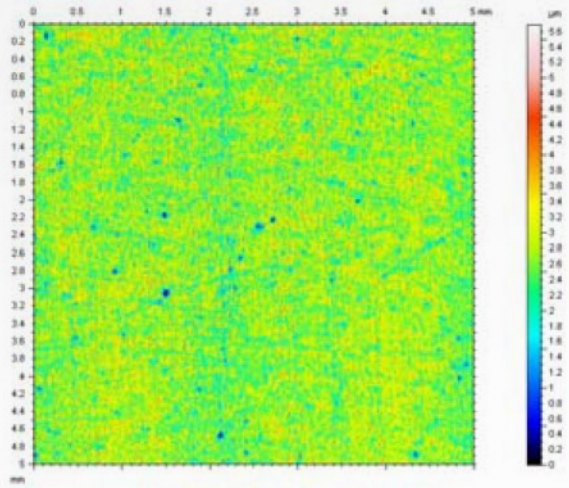
NANOVEA ST400

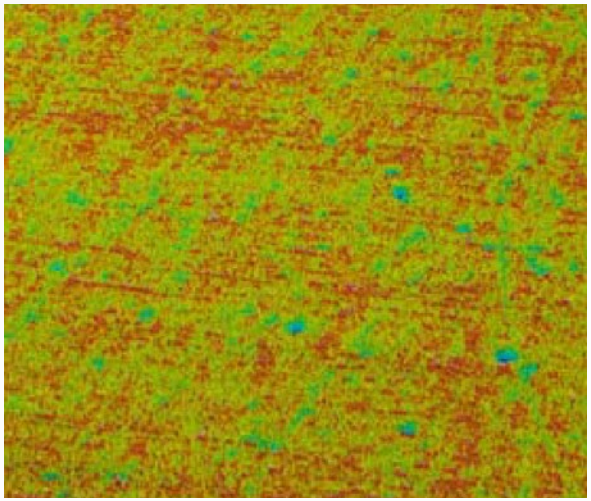
Modular Standard Optical Profilometer



THE SAMPLE

RESULTS STEEL SURFACE

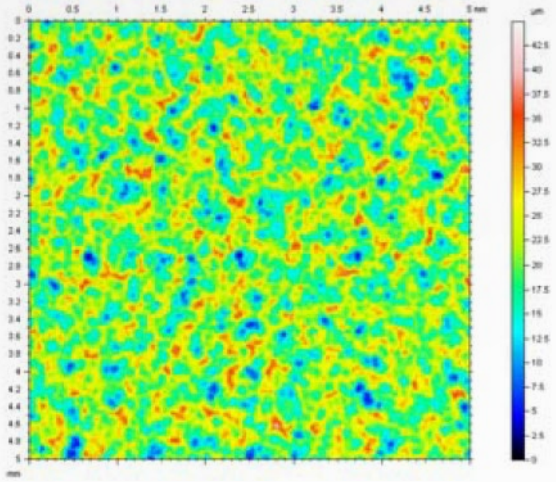


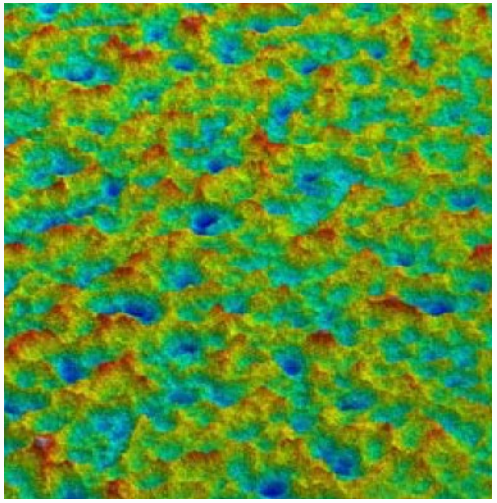


ISO 25178 3D ROUGNESS PARAMETERS

Sa	0.399 µm	Average Roughness
Sq	0.516 µm	RMS Roughness
Sz	5.686 µm	Maximum Peak-to-Valley
Sp	2.976 µm	Maximum Peak Height
Sv	2.711 µm	Maximum Pit Depth
Sku	3.9344	Kurtosis
Ssk	-0.0113	Skewness
Sal	0.0028 mm	Auto-Correlation Length
Str	0.0613	Texture Aspect Ratio
Sdar	26.539 mm²	Surface Area
Svk	0.589 µm	Reduced Valley Depth

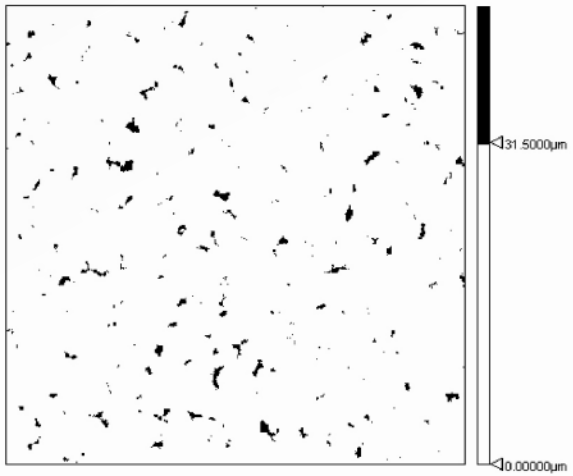
RESULTS PEENED SURFACE 1





SURFACE COVERAGE

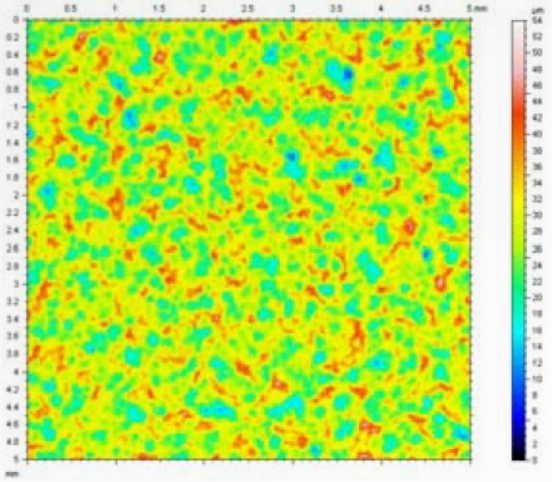
98.105%

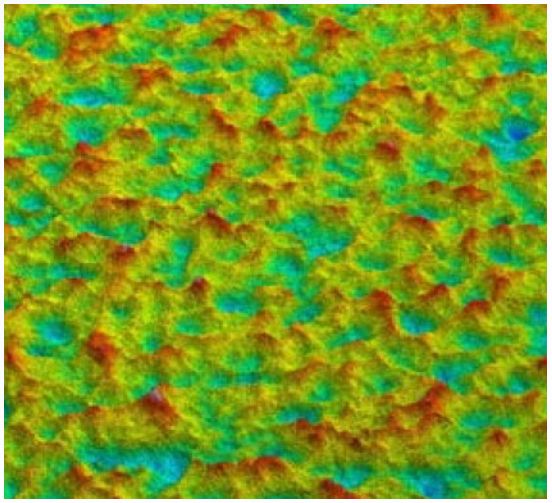


ISO 25178 3D ROUGNESS PARAMETERS

Sa	4.102 µm	Average Roughness
Sq	5.153 µm	RMS Roughness
Sz	44.975 µm	Maximum Peak-to-Valley
Sp	24.332 µm	Maximum Peak Height
Sv	20.644 µm	Maximum Pit Depth
Sku	3.0187	Kurtosis
Ssk	0.0625	Skewness
Sal	0.0976 mm	Auto-Correlation Length
Str	0.9278	Texture Aspect Ratio
Sdar	29.451 mm²	Surface Area
Svk	5.008 µm	Reduced Valley Depth

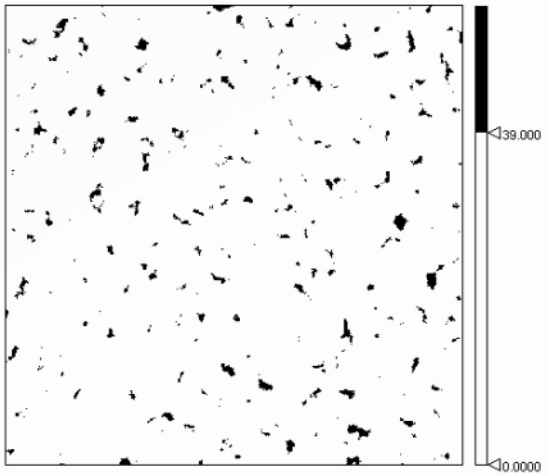
RESULTS PEENED SURFACE 2





SURFACE COVERAGE

97.366%



ISO 25178 3D ROUGNESS PARAMETERS

Sa	4.330 µm	Average Roughness
Sq	5.455µm	RMS Roughness
Sz	54.013 µm	Maximum Peak-to-Valley
Sp	25.908 µm	Maximum Peak Height
Sv	28.105 µm	Maximum Pit Depth
Sku	3.0642	Kurtosis
Ssk	0.1108	Skewness
Sal	0.1034 mm	Auto-Correlation Length
Str	0.9733	Texture Aspect Ratio
Sdar	29.623 mm²	Surface Area
Svk	5.167 µm	Reduced Valley Depth

CONCLUSION

In this shot peened surface analysis application, we have demonstrated how the ***NANOVEA*** ST400 3D Non-Contact Profiler precisely characterizes both the topography and nanometer details of a peened surface. It is evident that both Surface 1 and Surface 2 have a significant impact on all the parameters reported here when compared to the raw material. A simple visual examination of the images reveals the differences between the surfaces. This is further confirmed by observing the coverage area and the listed parameters. In comparison to Surface 2, Surface 1 exhibits a lower average roughness (Sa), shallower dents (Sv) and reduced surface area (Sdar), but a slightly higher coverage area.

From these 3D surface measurements, areas of interest can be readily identified and subjected to a comprehensive array of measurements, including Roughness, Finish, Texture, Shape, Topography, Flatness, Warpage, Planarity, Volume, Step-Height, and others. A 2D cross-section can quickly be chosen for detailed analysis. This information allows for a comprehensive investigation of peened surfaces, utilizing a complete range of surface measurement resources. Specific areas of interest could be further examined with an integrated AFM module. ***NANOVEA*** 3D Profilometers offer speeds up to 200 mm/s. They can be customized in terms of size, speeds, scanning capabilities, and can even comply with Class 1 Clean Room standards. Options like Indexing Conveyor and integration for Inline or Online usage are also available.

A special thanks to Mr. Hayden at IMF for supplying the sample shown in this note.
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