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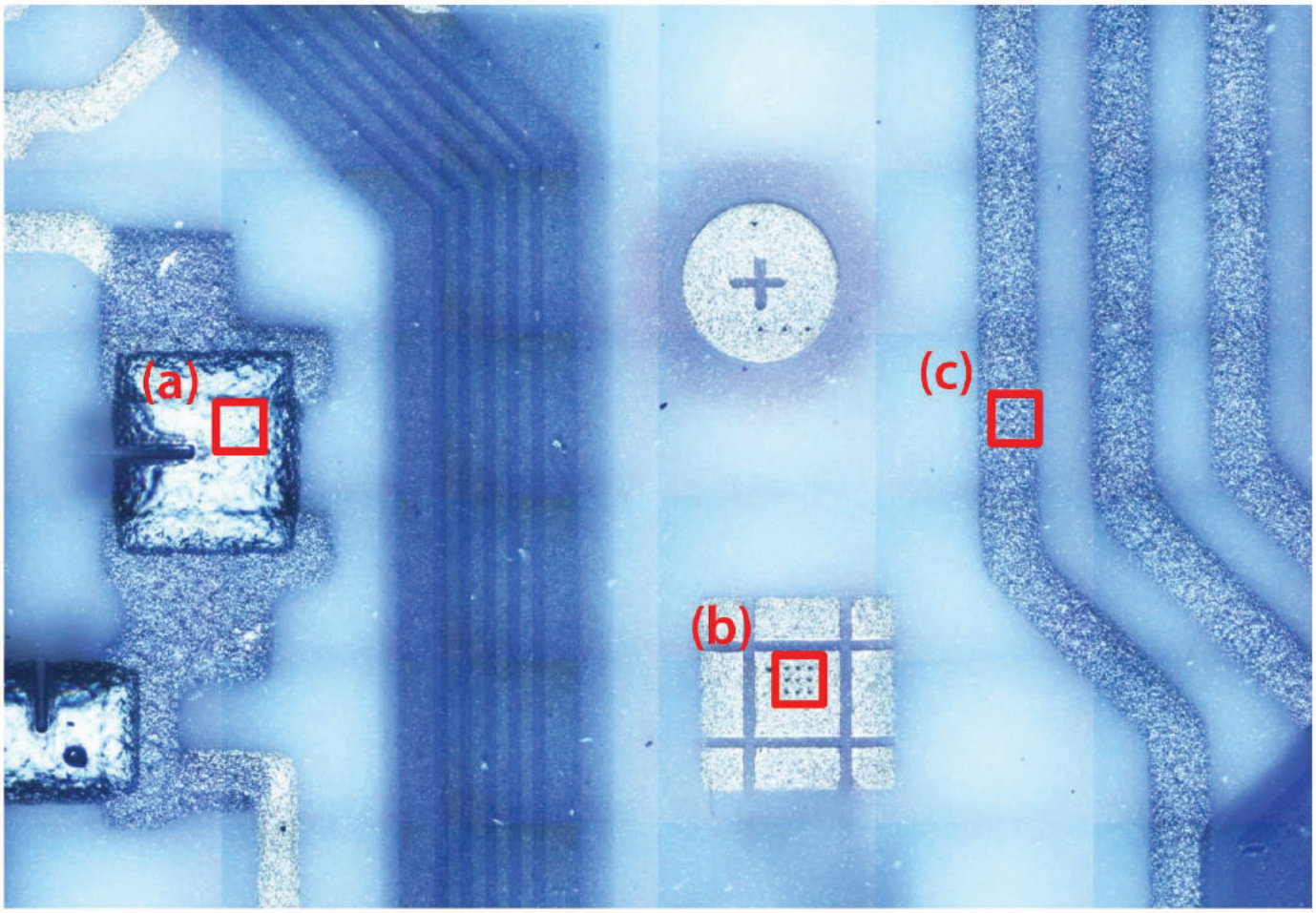
MECHANICAL MAPPING OF PCB

USING

BROADVIEW MAP SELECTION TOOL



Prepared by

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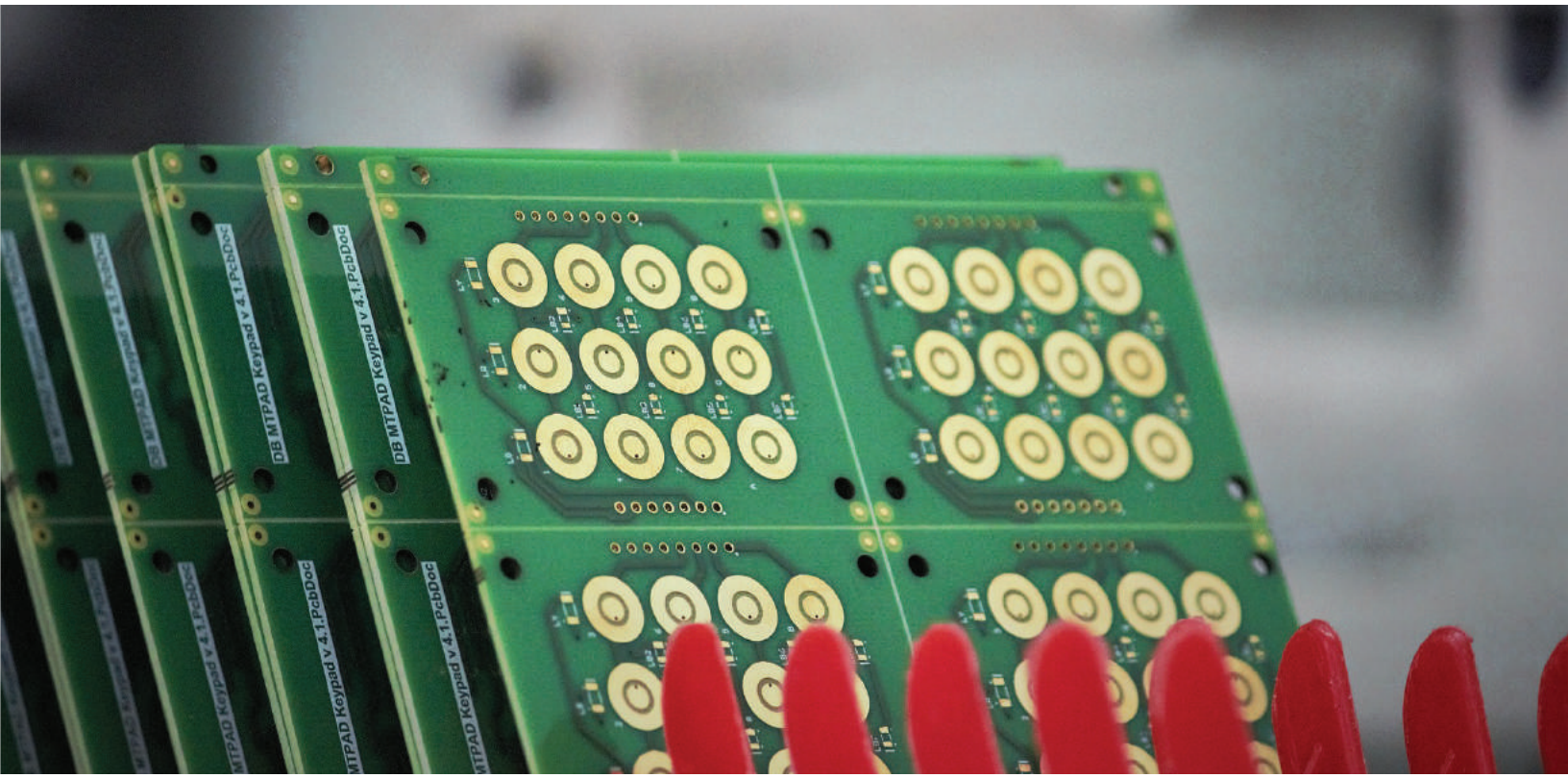


Introduction

Printed circuit boards (PCB) are widely used on a variety of electronic devices, including phones, radios, radar and computer systems. Mechanical integrity of the PCB is a key factor in manufacturing failure free product. The scale-down of the PCB production technology into the micron/nanometer level not only enables increased number of electronic components on a single board, but also brings challenges to defect inspection and quality control of the PCB.

Importance of Nanoindentation for PCB

The thinner wires and more complex structure of the electronic circuit on the advanced PCB demands high-precision mechanical integrity inspection. Nanoindentation is widely applied to measure the mechanical behaviors of materials at small scales[i ii]. In order to accurately evaluate the mechanical properties of different wires and electronic components on the PCB, high precision position control of the nanoindentation location is critical. A reliable and user-friendly procedure of nanoindentation testing can significantly facilitate the quality control and R&D of advanced PCB. In addition, the small indentation force applied using the nanoindentation technique provides an ideal non-destructive mechanical testing solution to prevent damages to PCB under the test.

MEASUREMENT OBJECTIVES

In this application, the Nanovea Mechanical Tester, in Nanoindentation mode is used to measure the mechanical properties of different locations of a PCB. We would like to showcase the capacity of Nanovea Mechanical Tester in performing nanoindentation measurement on a PCB with high precision and user friendliness using Broadview Map Selection Tool.

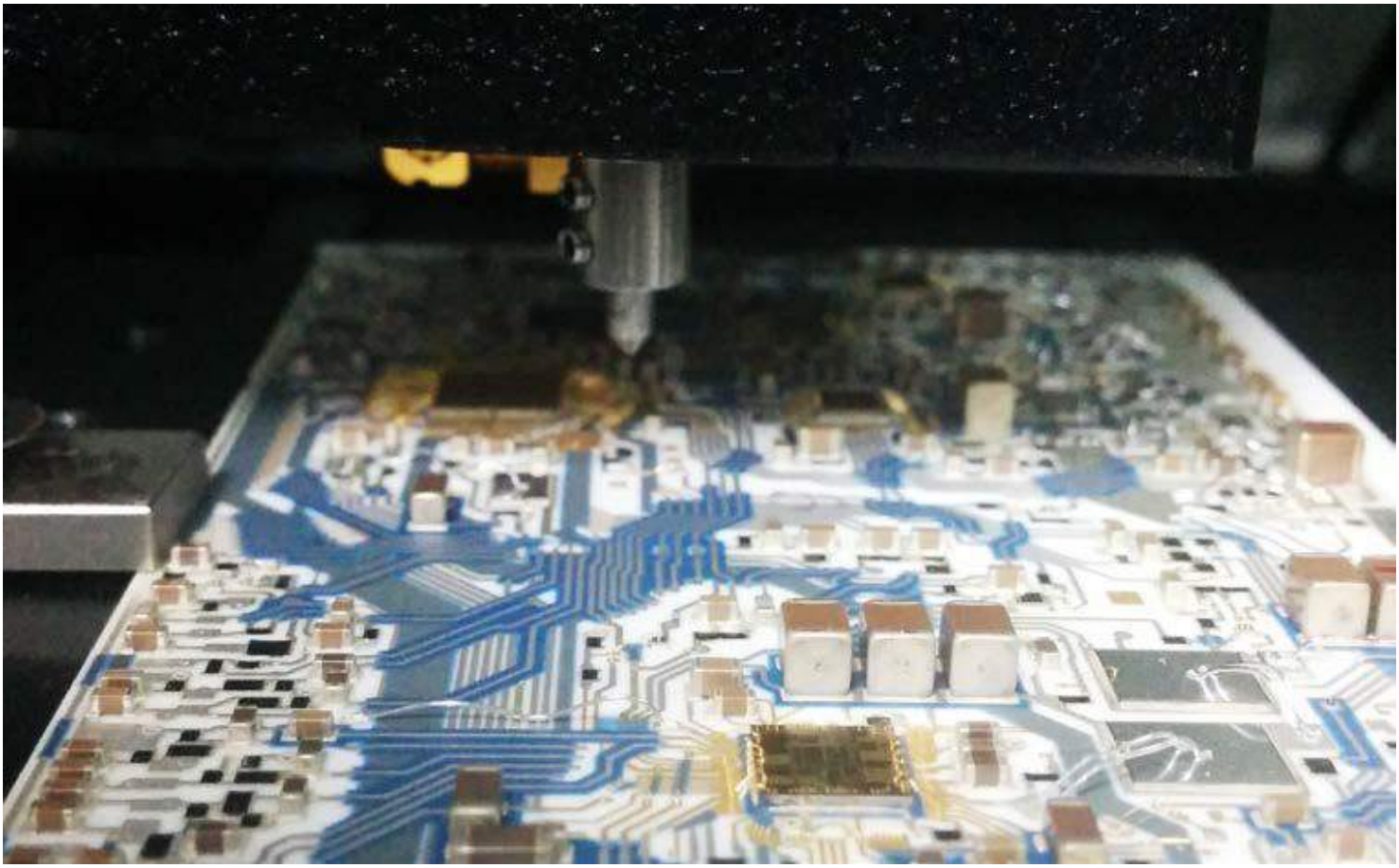


Fig. 1: Nanoindentation tip on the PCB.

TESTING CONDITIONS

Broadview Map Selection Tool provides a user-friendly tool to observe and precisely select the intended area for mechanical testing. In this particular study, a map of 10×10 images were taken by the optical microscope integrated in the Nanovea Mechanical Tester as shown in Fig. 2, in order to obtain a better observation of the overall area of interest on the PCB. Three representative areas on the PCB were directly selected on the image for nanoindentation mapping as numbered on Fig. 2. The nanoindentation mapping (3×3, spaced 50 µm apart, 9 indents in total) was performed under the test conditions summarized in Table 1.

The procedure set up by *Broadview Map Selection Tool* can be saved and reapplied on other samples of the same geometry, so that the indentations at the same load and location will be automatically performed. This function substantially facilitates quality control of large batches of samples of the same geometry. Moreover, the Fastmap function of Nanovea Mechanical Tester further accelerates the indentation tests.

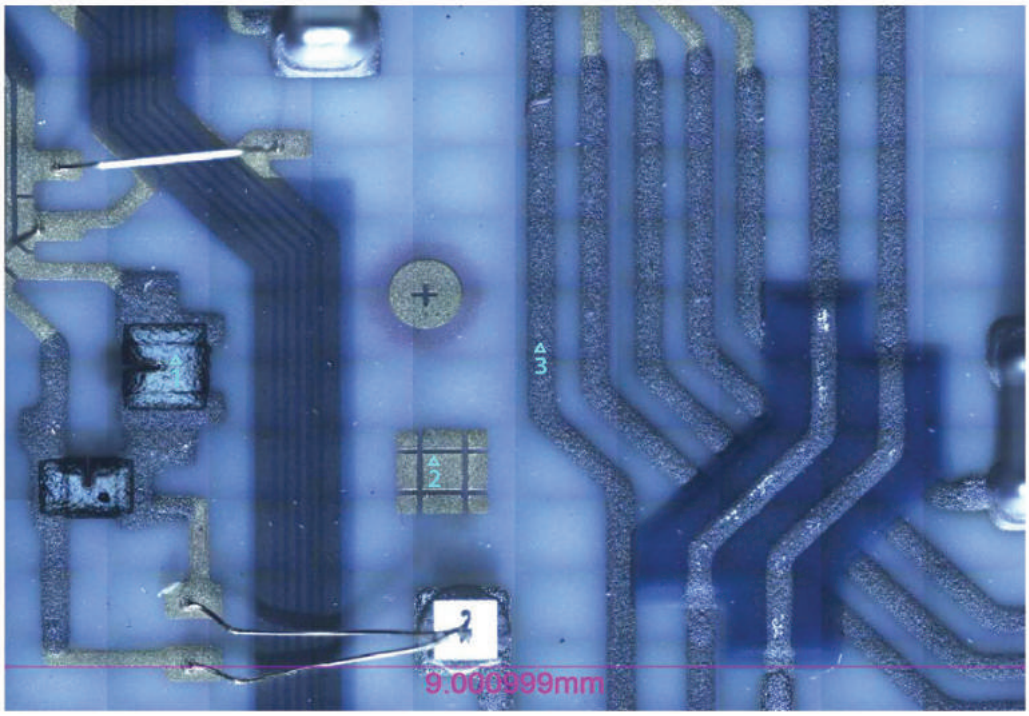


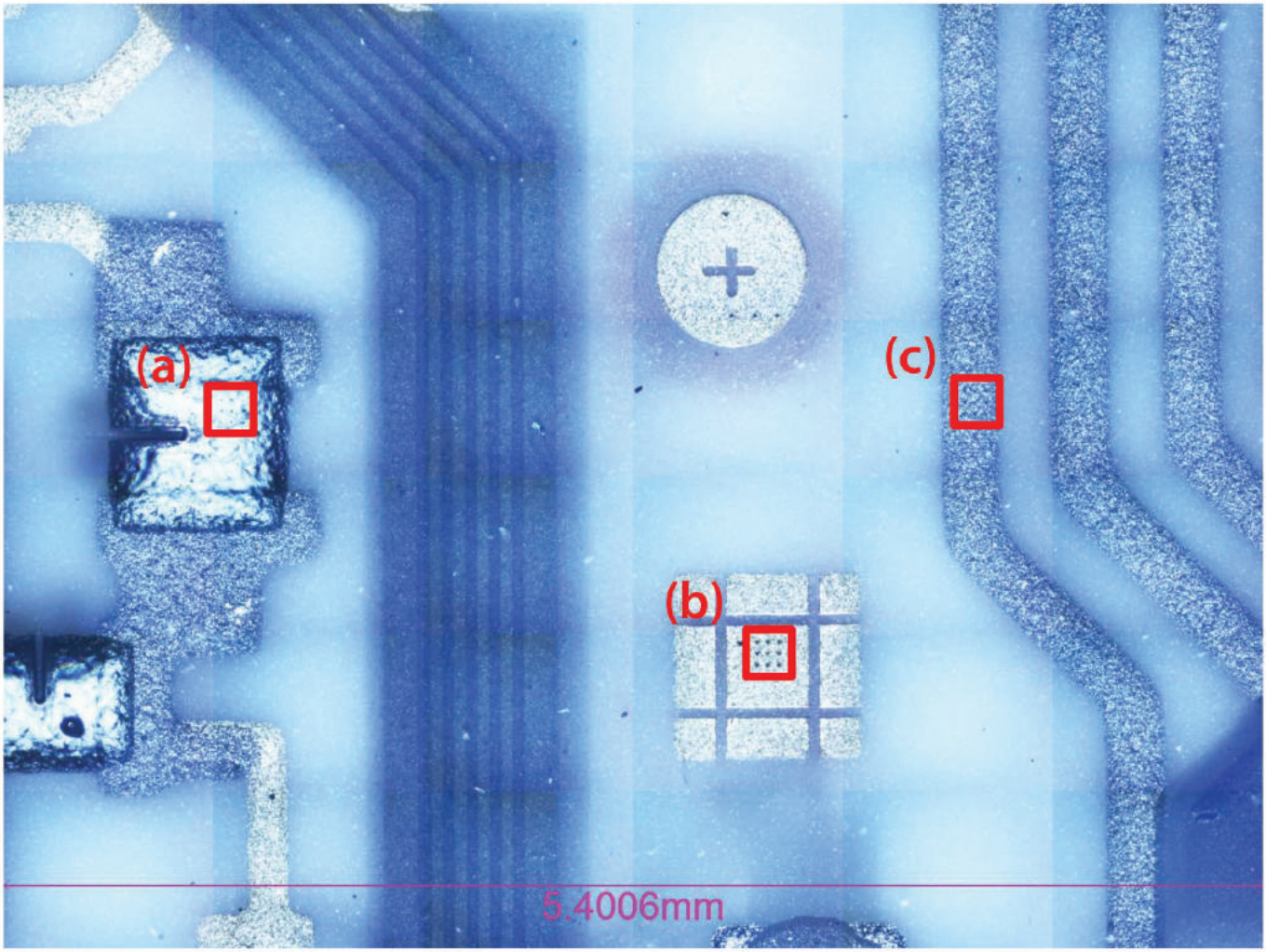
Fig. 2: Broadview Map Selection of nano indentations on the PCB.

Maximum force (mN)	200
Loading rate (mN /min)	400
Unloading rate (mN /min)	400
Indenter type	Berkovich

Table 1: Test conditions of the nanoindentation.

RESULTS AND DISCUSSION

The images of the 3×3 indentation matrix at the three selected areas are displayed in Fig. 3. We demonstrate that the excellent position control of the sample stage in Nanovea Mechanical Tester allows users to precisely pinpoint the target area on this image map for mechanical properties testing, i.e. 3×3 nanoindentation mapping. This makes measurement of the local mechanical properties at small scales substantially less time-consuming and more user friendly.



RESULTS AND DISCUSSION

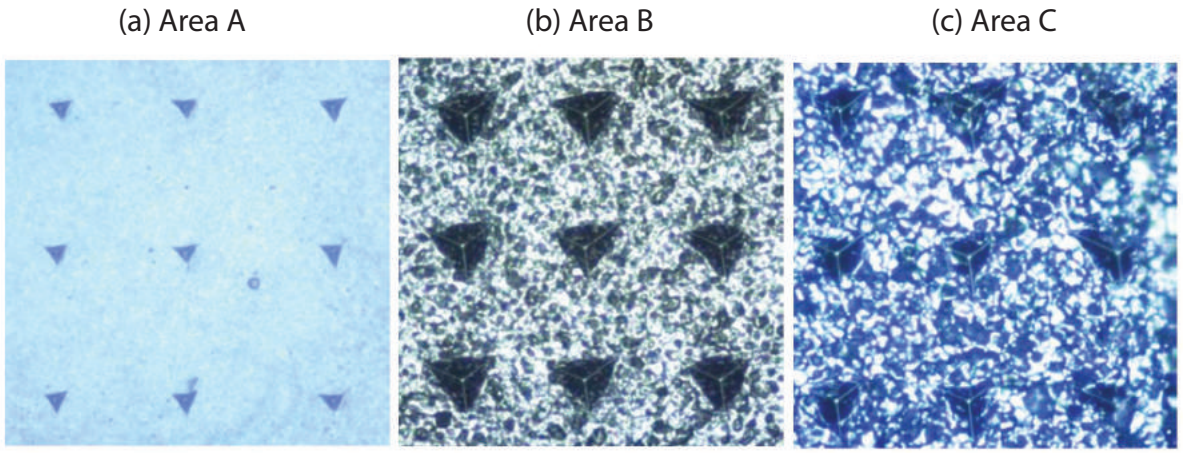


Fig. 3: Nano indentations on the PCB.

The representative load-displacement curves of the indentations are shown in Fig. 4, and the corresponding hardness and Young's Modulus calculated using Oliver and Pharr Method [iii] are summarized and compared in Fig.5. Area A possesses an average hardness of ~5.2 GPa, compared to ~0.91 GPa and ~0.59 GPa, respectively, for Areas B and C. It also has a higher Young's modulus of 22.9 GPa.

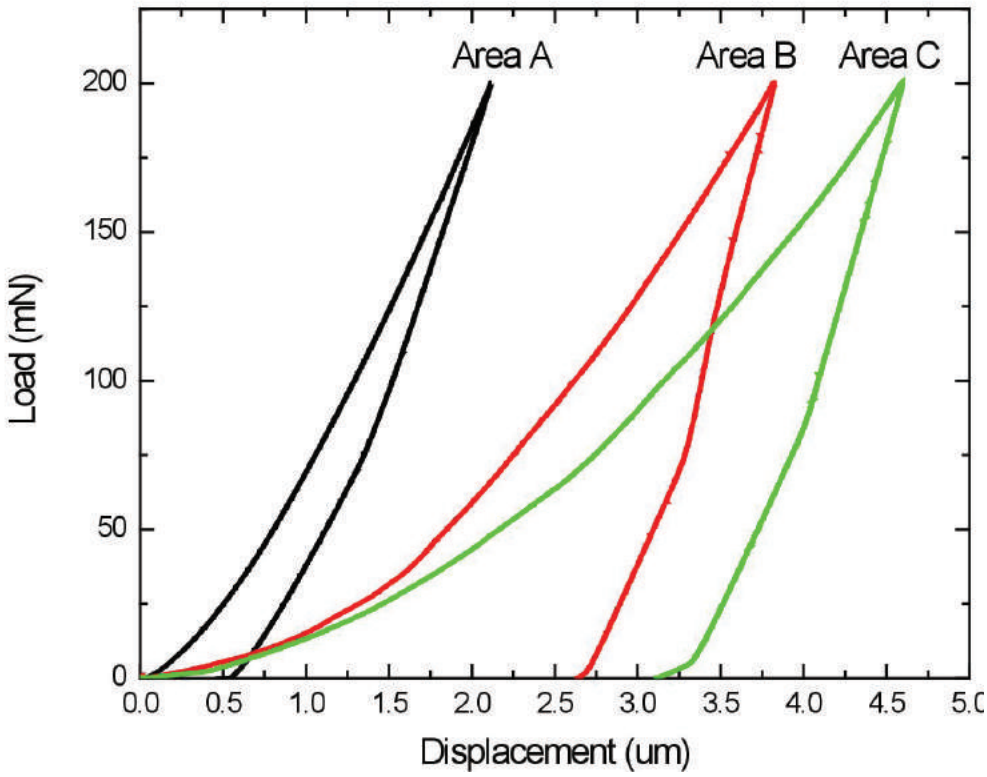


Fig. 4: Load-displacement curves of the indentations.

RESULTS AND DISCUSSION

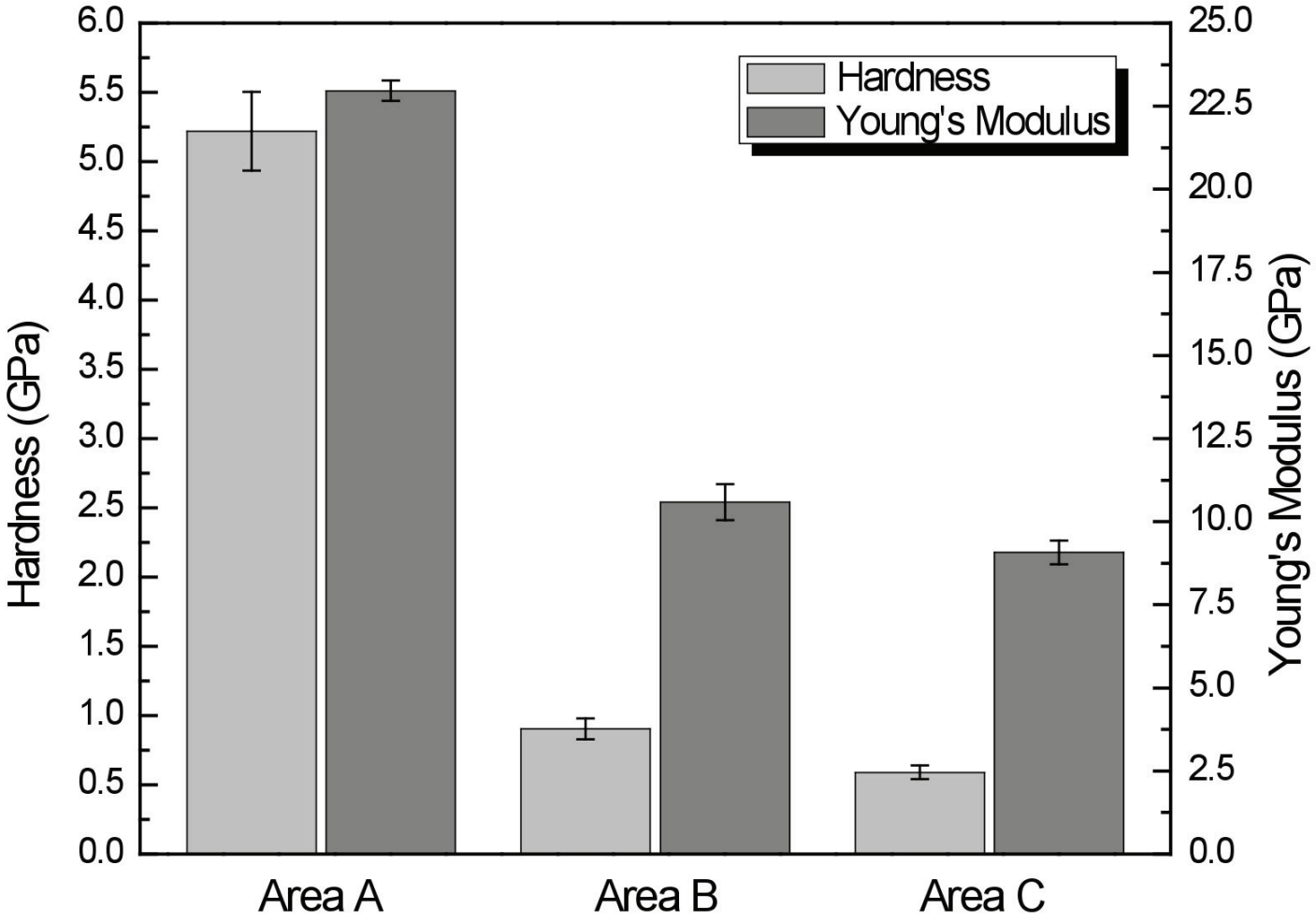


Fig. 5: Hardness and Young's Modulus at different locations of the PCB.

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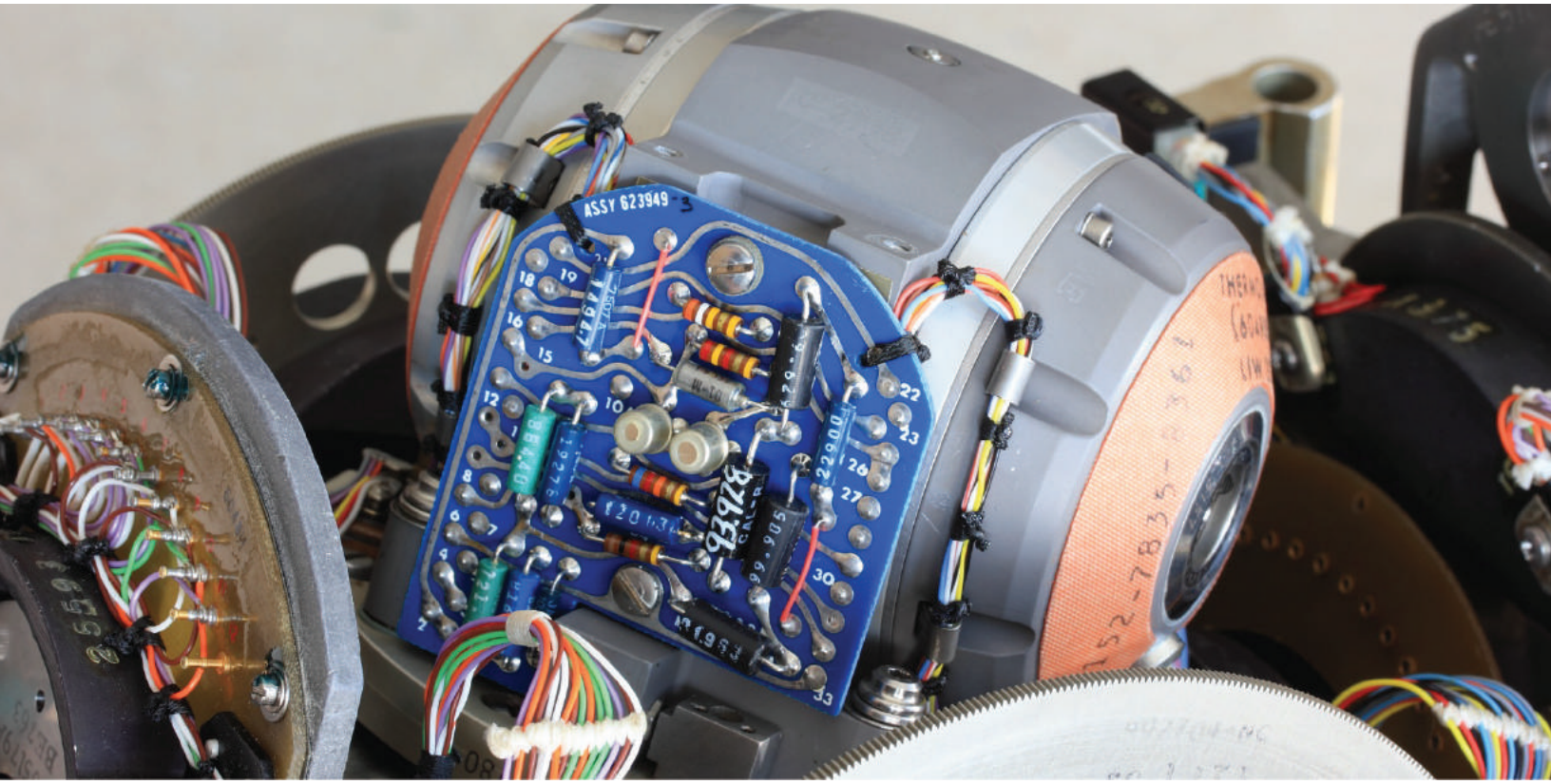

Conclusion

In this study, we showcased the capacity of Nanovea Mechanical Tester in performing nanoindentation mapping on target areas of a PCB using *Broadview Map Selection Tool*. The precise position control allows users to directly select the areas of interest for nanoindentation on a large optical image array and perform accurate mechanical property measurements. The superior precision and repeatability of the nanoindentation tests is attributed to the piezo load control and direct load/displacement measurement of the Nanovea Mechanical Tester.

The Nano, Micro or Macro modules of the Nanovea Mechanical Tester all include ISO and ASTM compliant indentation, scratch and wear tester modes, providing the widest and most user friendly range of testing available in a single system. Nanovea's unmatched range is an ideal solution for determining the full range of mechanical properties of thin or thick, soft or hard coatings, films and substrates, including hardness, Young's modulus, fracture toughness, adhesion, wear resistance and many others.

In addition, optional 3D non-contact profiler and AFM Module are available for high resolution 3D imaging of indentation, scratch and wear track in addition to other surface measurements such as roughness.

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