

APPLICATION NOTE

PUBLICATION

09/09_04

DATE

000210_APP

NUMBER

STUDY OF THE MECHANICAL PROPERTIES OF RED BLOOD CELLS WITH NANO VISION™ OPTION

innovation center

APPLICATION

AUTHOR

INTRODUCTION

MTS Nano Instruments has been investigating the properties of biological samples like wood cells, spider silk, human skin, and hair, for a long time. This application note represents a brief study of red blood cells (RBC). The imaging and testing of such cells was performed using the NANO **Vision™** nanomechanical microscopy in conjunction with the NANO **Indenter® DCM** indentation head assembly.

THE SAMPLE

A blood smear was prepared on a microscope slide. The microscope slide was then mounted as a regular sample in the NANO **Indenter xp**. The blood smear was dried for 1 hour before testing.

IMAGING THE SAMPLE

The sample is translated in X and Y under a diamond tip. A small load is applied to the tip in order to keep it in contact with the surface. The height variations recorded by the tip create the topographic image of the sample's surface. The piezo-actuated sample stage used in the NANO **Vision** option provides high accuracy in lateral positioning (2nm) and imaging the samples. A cube corner diamond tip is used to image the surface profile of the sample. The **DCM** head provides a high degree of accuracy and excellent control for the application of the load during the imaging.

The image in **figure 1** shows the well-known biconcave disk shape of the red blood cells. A single cell (**figure 2**) was selected for the first study of mechanical properties.

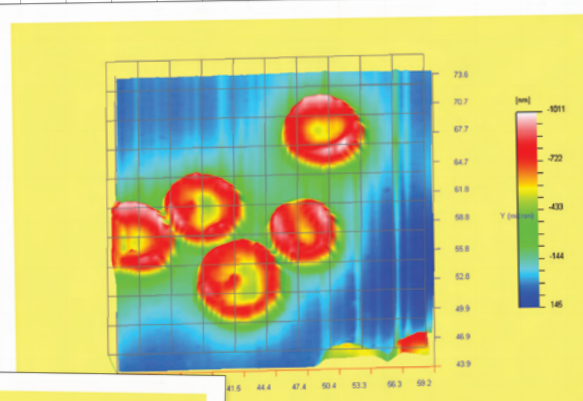


Figure 1: A group of red blood cells

INDENTATION

Two series of indentations were performed on the red blood cell sample. The first group of four indents was performed on a single red blood cell (**figure 3**). The four indents were made at a constant strain rate of 0.2 /s and with a maximum penetration depth of 1000nm. The modulus and hardness measurements (**figure 4** and **figure 5**) present a very good repeatability. The substrate effect is detected around 100nm on the modulus. The second group of indents was made on several cells. One indent was made at the center of each cell. The eight indents were

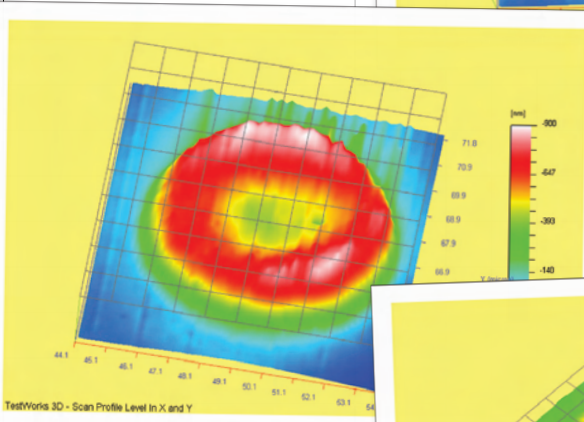
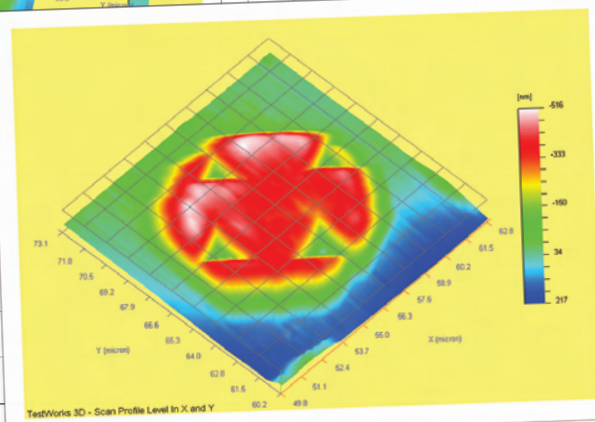


Figure 2 (above):

A single red blood cell

Figure 3 (right):

Four indents on a single RBC



RELATED PRODUCTS:



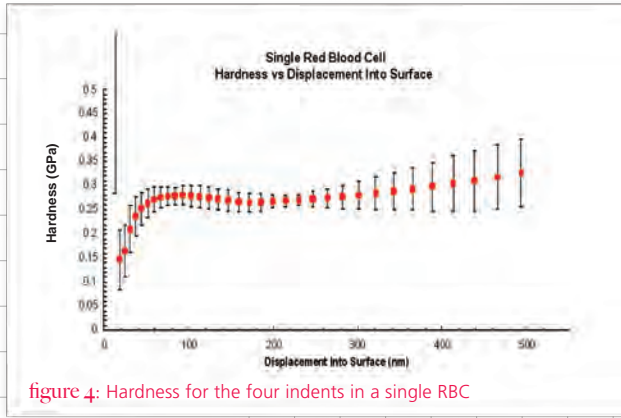


figure 4: Hardness for the four indents in a single RBC

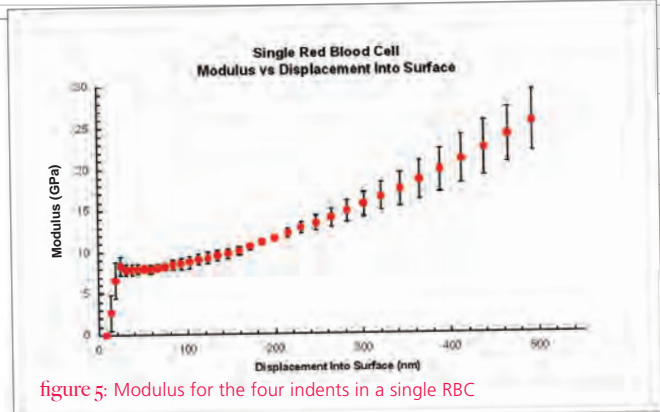


figure 5: Modulus for the four indents in a single RBC

figure 6: Average of Hardness for eight indents on different RBC

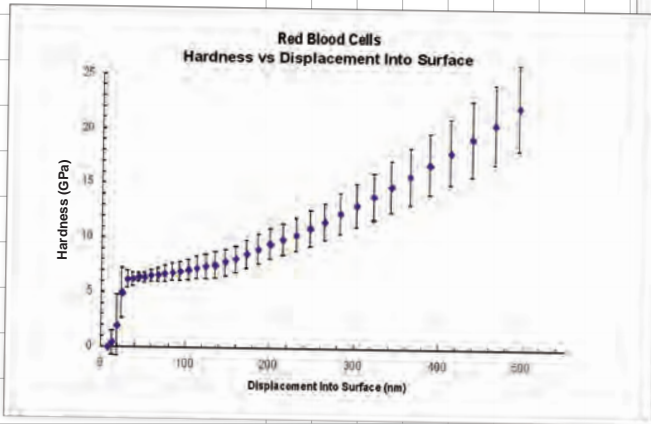
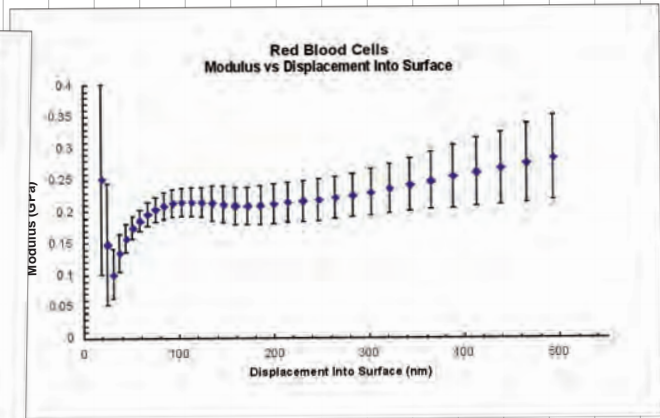


figure 7 (below): Average of Modulus for eight indents on different RBC



made at a constant strain rate of 0.2 /s and with a maximum penetration depth of 500 nm. The results for the measurement of modulus and hardness are consistent from cell to cell (figure 6 and figure 7). The indents were imaged via the same technique used previously.

allows the imaging of samples that are biological in origin such as red blood cells.

TestWorks 4 software, unequalled in the nanomechanical testing industry, allows a real-time display of the measurements during the experiment as well as a complete and easy review of images and plots after the test.

CONCLUSION

- The NANO **Vision** option

- The NANO **Indenter DCM** allows both indentation and imaging on the same platform with very high accuracy.
- This powerful range of capability supports investigation of different material properties for biological samples.
- The measurement of the properties of those cells yields and repeatable data.

For more information on NANO **Vision**, the NANO **Indenter XP**, or **TestWorks**, contact your local MTS sales engineer, or e-mail us at nano@mts.com. We also invite you to visit our website at www.mtsnano.com.



MTS Nano Instruments
+1 800-844-6266
www.mtsnano.com
nano@mts.com

Inspired science.

Characterizing surfaces down to the level of a few nanometers has become increasingly important for a wide range of manufacturers and researchers. Properties at the nano scale can affect the performance of a variety of scientific and consumer products. NANO **Indenter** systems from MTS NANO INSTRUMENTS use the most advanced technology available to acquire fast, accurate mechanical data on a variety of surfaces at the submicron scale.