

Volume Loss Measurement

Keywords: volume loss measurement, abrasion, wear, hardness, coating thickness measurement, Laser-induced breakdown spectroscopy, LIBS, 3D industrial inspection, low coherence interferometry, white light interferometry, fiber-based profilometry, hard-to-reach surfaces

Introduction

Loss of material due to abrasion, erosion, or other types of wear is an important phenomenon in industries such as aerospace and automotive. Wear is quantified by measuring the volume loss after a wear test or after use of a component in the field. Profilometers based on low-coherence interferometry are the device of choice for volume loss measurements. These fiber-based instruments can measure volume loss with micron precision on samples and components of various shapes and sizes.

Fiber-based profilometers are also useful for measuring the thickness of coatings when combined with LIBS technology. Surface roughness can also be evaluated.

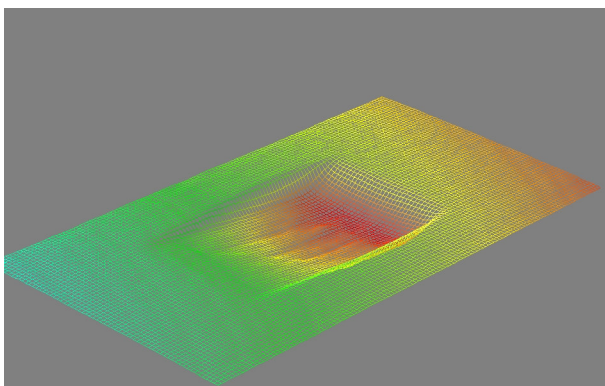


Figure 1: 3D rendering of the scanned surface of a sample (25 x 50 mm) after abrasion

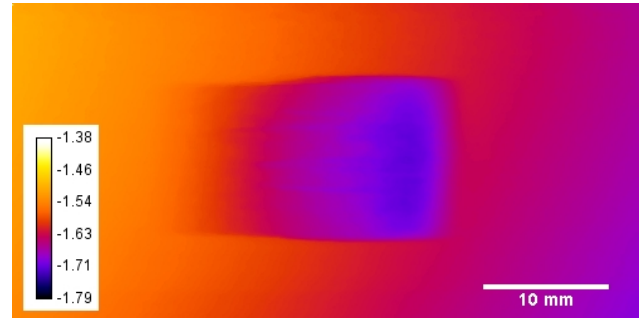


Figure 2: Top view of the surface of the same sample as Figure 1 (color represents depth)

How Volume Loss is Measured

Data is acquired from the worn region of the sample and from the intact region around it. A reference plane is constructed for the intact surface. Volume loss is calculated from the differences between the interpolated reference plane and the actual worn surface.

Dimensions of Scanned Objects

A fiber-based profilometer can scan objects from a few microns in width (Figure 4) to a cylindrical surface with a diameter of several meters (Figure 3).

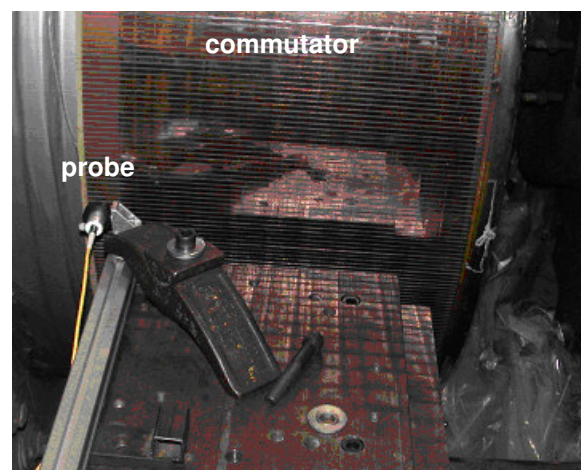


Figure 3: The probe of a fiber-based profilometer can scan large objects such as commutators

Using LIBS with Fiber-based Profilometry to Measure Coating Thickness

Laser-induced breakdown spectroscopy (LIBS) is a technique used to identify the atomic structure of a sample. A LIBS device pulses a powerful laser beam focused on a sample which vaporizes some material, then it performs spectral analysis on the resulting plasma. Fiber-based profilometry can be used in conjunction with LIBS to measure the depth to which material has been removed. Since the light sources used for both techniques are in the same range, customized devices have been constructed using a common light path configuration. These devices are ideal for measuring coating thickness.

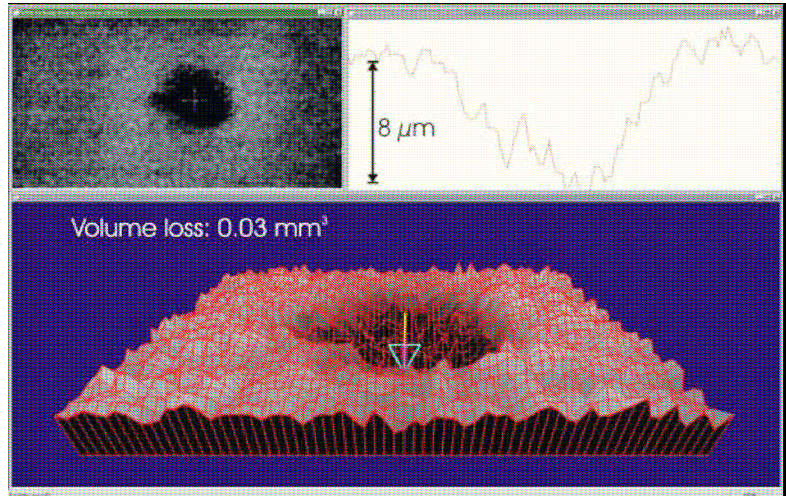


Figure 4: A profilometer can calculate the volume loss of a crater produced by a LIBS laser

Software Application Calculates Volume Loss

After the profilometer acquires data by scanning the sample or component, the profilometer's software program calculates the volume loss. It constructs a reference plane by interpolating to the surrounding area in a square or circular region of interest.

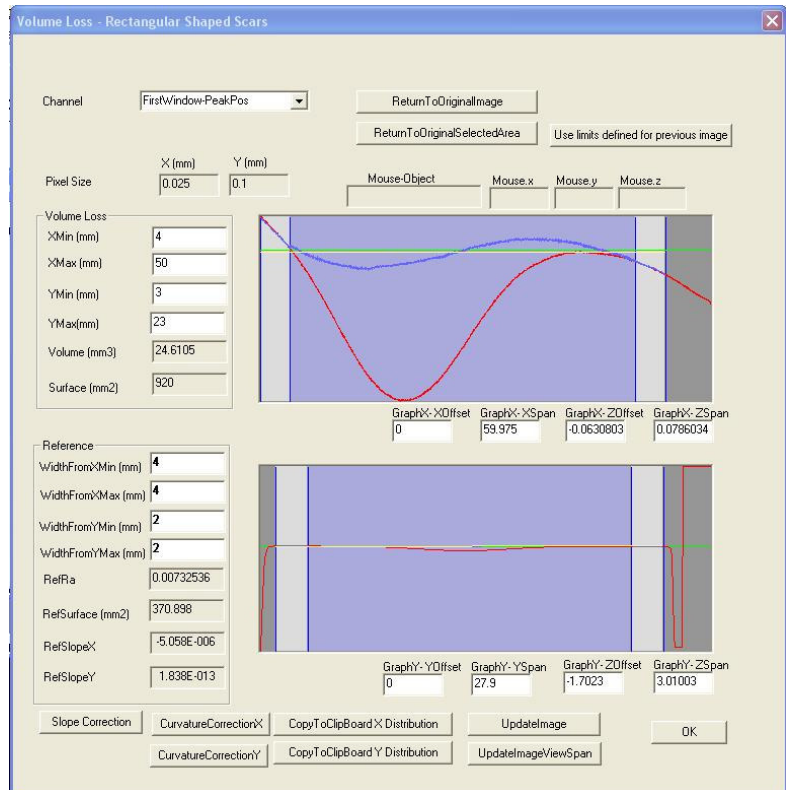


Figure 6: Software display for volume loss analysis