GNR OPTICA

ANALYTICAL INSTRUMENTS GROUP

SpiderX

Portable Residual Stress X-Ray Diffractometer

www.gnr.it

GNR Analytical Instrument offers equipment based on X-Ray Diffraction to measure residual stress state and retained austenite content.

Residual Stress could be induced by machining, grinding, rolling deep drawing, welding, thermal hardening and shot peening; its quantification allows to prevent fatigue damage and to control durability and safety of material.

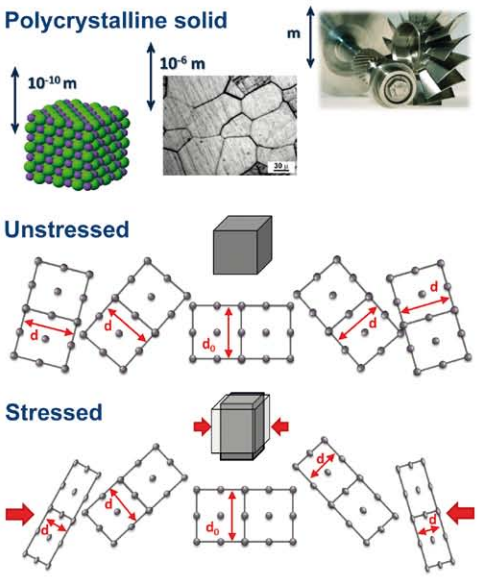
X-Ray Diffraction is a conventional and time proven technique to measure residual stress. Using the interatomic spacing as the ultimate gage length, the X-Ray Diffraction technique is ideal for crystalline samples, especially for metals and ceramics. It measures the absolute stress without the need of an unstressed calibration sample.

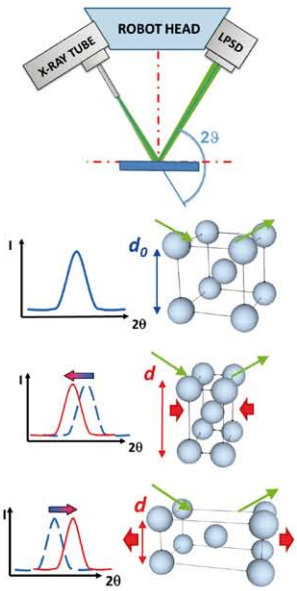
GNR SpiderX is a portable residual stress diffractometer. It has been designed focusing on the following specification: exceptional portability lightness, easiness to set up, outstanding performances and negligible X-Ray emissions. The result is a compact and smart instrument, based on a low power X-Ray tube and a fast and highly efficient detector, the combination of which ensures accurate and fast measurements.

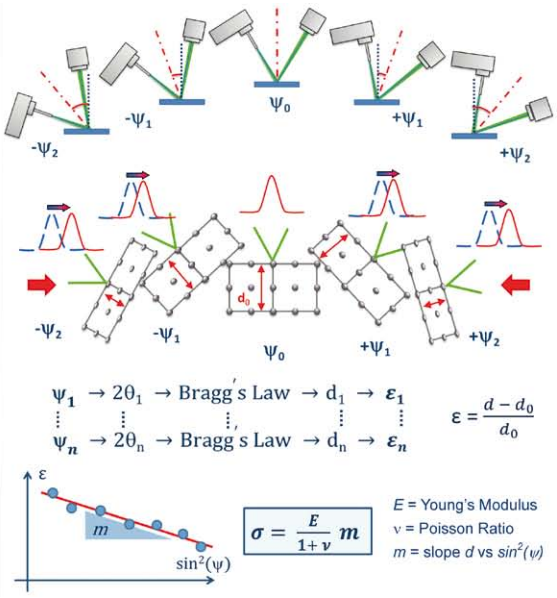
GNR SpiderX unit includes everything needed taking advantage of its portability and lightness for making residual stress measurements by X-Ray Diffraction in a portable manner.

GNR SpiderX main components are:

- PSI Arc
- Anthropomorphic Arm
- X-Ray Source
- Linear position sensitive detector
- Laser
- Batteries
- Tripod
- Case
- Main Unit
- Acquisition and Analysis Software







PSI Arc

The head of the goniometer rotates along a curved sector of 90 degrees, for the determination of the stress status in polycrystalline materials. The 2-Theta angle can be changed from 135° to 165° in order to analyze Fe (ferrite, austenite), Al, Ni, Cu, Ti and Mg alloys.

Anthropomorphic Arm

A small anthropomorphic arm allows movements with 6 degrees of freedom (3 translations and 3 orientations) however still ensuring the necessary stability. Optional Φ rotation for Bi-axial and Tri-axial stress state analysis.

X-Ray Source

A low power X-ray tube allows to use SpiderX without any water chiller. The user can easily change the X-ray tube without any special tools.

Detector

GNR SpiderX is equipped with a Multi Strip Detector. GNR adopts DECTRIS MYTHEN X-Ray Detector.

MYTHEN, linear silicon strip detector, based on single photon counting technology, provides noise-free performance, high intensity measurement and fast data acquisition.

The high efficient 1-dimensional multi strip detector simultaneously captures a large angular range and reduces measurement time from hours into minutes.

- Mythen can decrease measurement time significantly down in comparison with a scintillator detector without affecting data quality like intensity, resolution and peak shape.
- Compact size, air cooled (no gas, water o liquid nitrogen needed) and maintenance-free detector.
- Fluorescence background suppression by setting an appropriate energy threshold

MYTHEN2 R	1D
Number or Strips	640
Sensor thickness [µm]	320
Strip width [µm]	50
Strip length [mm]	8
Dynamic range [bit]	24
Energy range [keV]	5-40
Max Couting Rate [counts/s/strip]	$1x10^6$
Frame rate [Hz]	25
Point-spread function [strip]	1
Cooling	Air
Dimensions [WHD mm]	38x62x22
Module Weight [g]	100

As option other type of linear silicon strip detector is available on request.

Laser

A laser beam assures the correct positioning of the goniometer in combination with a micrometric screw.
The laser positioning system allows aligning the instrument without any contact between collimator and sample.

Batteries

The extreme portability of the SpiderX system is also ensured by means of a system of batteries that allows an autonomy of about 2 hours of full operation mode, without being plug to the main power supply.

Tripod

Tripod, produced by the ManfrottoTM Company, supplied with the instrument, has three legs, with three telescopic rods each.
In this way, it is possible to place the head of the goniometer at the desired height, giving it the preferred orientation.
Any orientation is possible, like 90° (a sample with vertical surface) or even 180°, for upside down measurements.

Case

The case supplied together with the instrument provides a safe housing of the goniometer and all the accessories.

Main Unit

GNR SpiderX contains into the trolley all components required (power supply, HV generator, control unit)

Acquisition and Analysis Software

GNR SpiderX works with an easy to use software for the complete analysis of residual stress. It allows the complete control of the hardware and the setting up of the measurements.

Outdoor Analysis: On Site Use

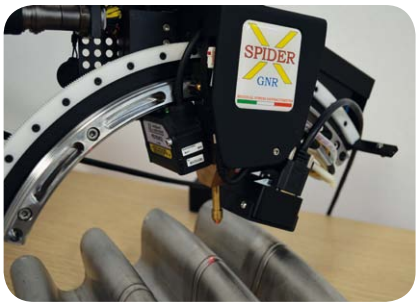
- Non-destructive on-site measurement of big samples
- Easily access to the measurement point thanks to the versatility of the goniometer head
- The battery allows on-site measurement without the main power supply
- Single case contains goniometer and power supply with a total weight of approx. 19 Kg.

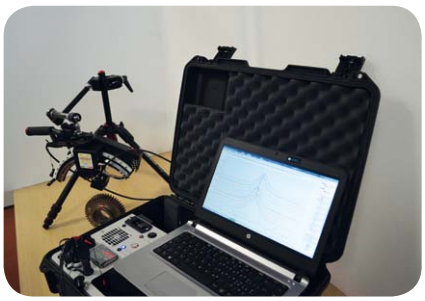




Indoor Analysis: Laboratory Use

- **GNR SpiderX** can be mounted either in a closed cabin, suitable for laboratory analysis
- The anthropomorphic arm allows changing easily the measuring point



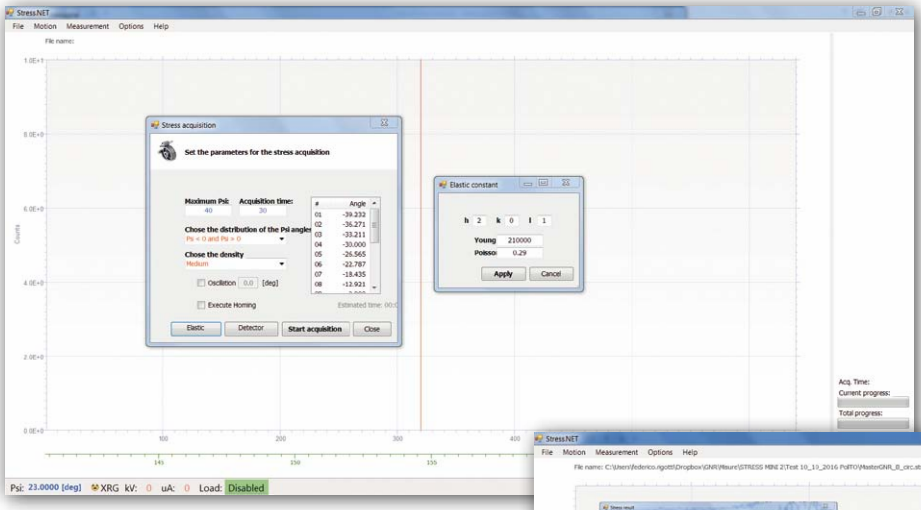



GNR SpiderX Software supports several tasks of analysis, from Data Acquisition, having the full control of all the process and hardware settings (generator and tube, detector, measurements set up) to Data Analysis, calculating the residual stress or retained austenite values.

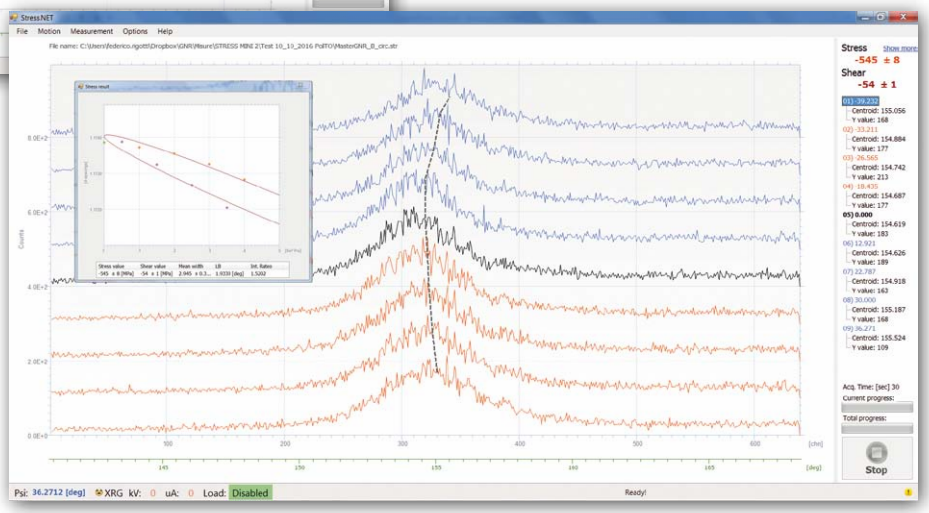
An extremely easy to use software for uni-axial residual stress state analysis has been developed in compliance with ASTM E915 practice and UNI EN 15305.

GNR SpiderX Software allows to measure and to calculate residual stress on any polycrystalline materials:

- Acquisition time / steps: 30-120 s
- Number of steps: 5-17
- Peak position determination by centroid method
- Normal and shear component analysis available for uni-axial measurement



Measure Panel



Data Acquisition

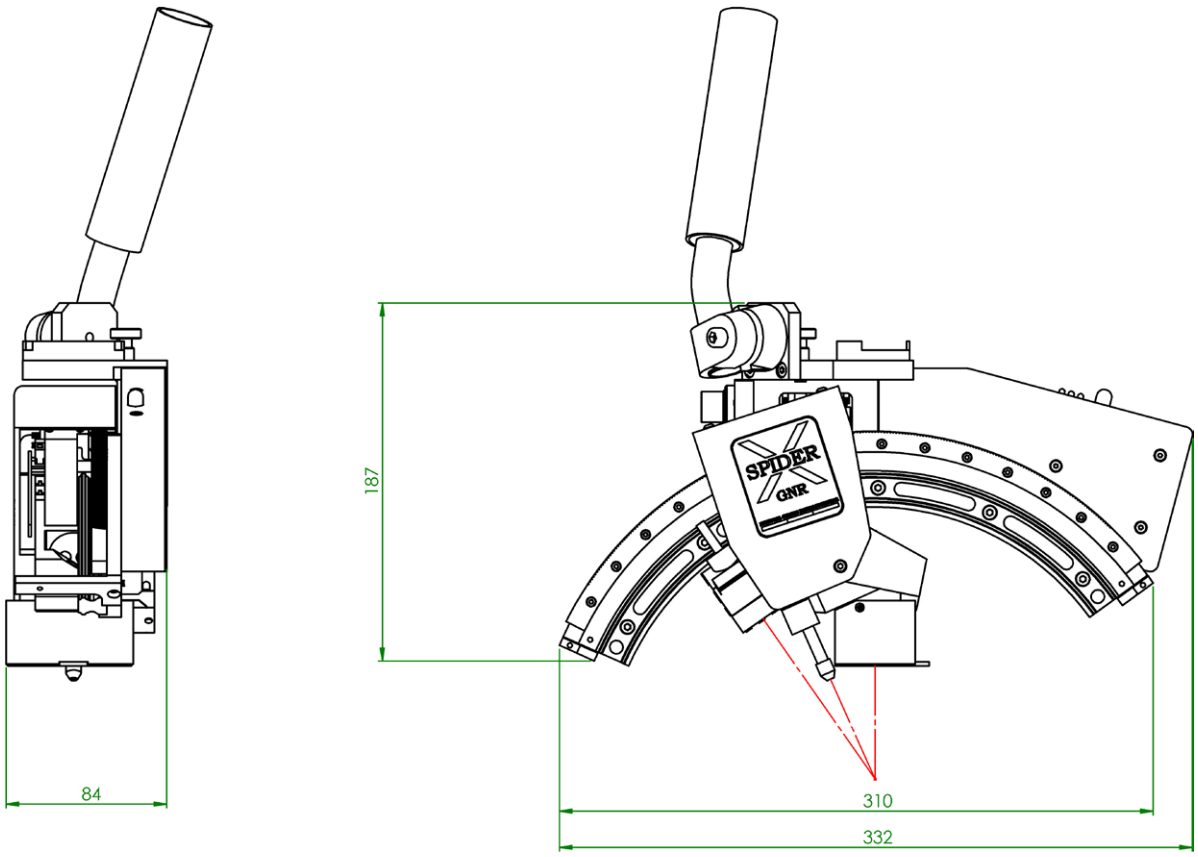
Fully featured Windows software using thread-based multi-tasking:

- X-Ray tube run-up and control
- Settable Miller indices, Young's moduls and Poisson's ratio
- Detectors, DC motors, power supply, safety interlock functions control
- Ω-mode
- Microsoft Windows operating system
- Project Manager

Options, available with additional hardware:

- Retained austenite testing
- Bi-axial and Tri-axial stress state analysis

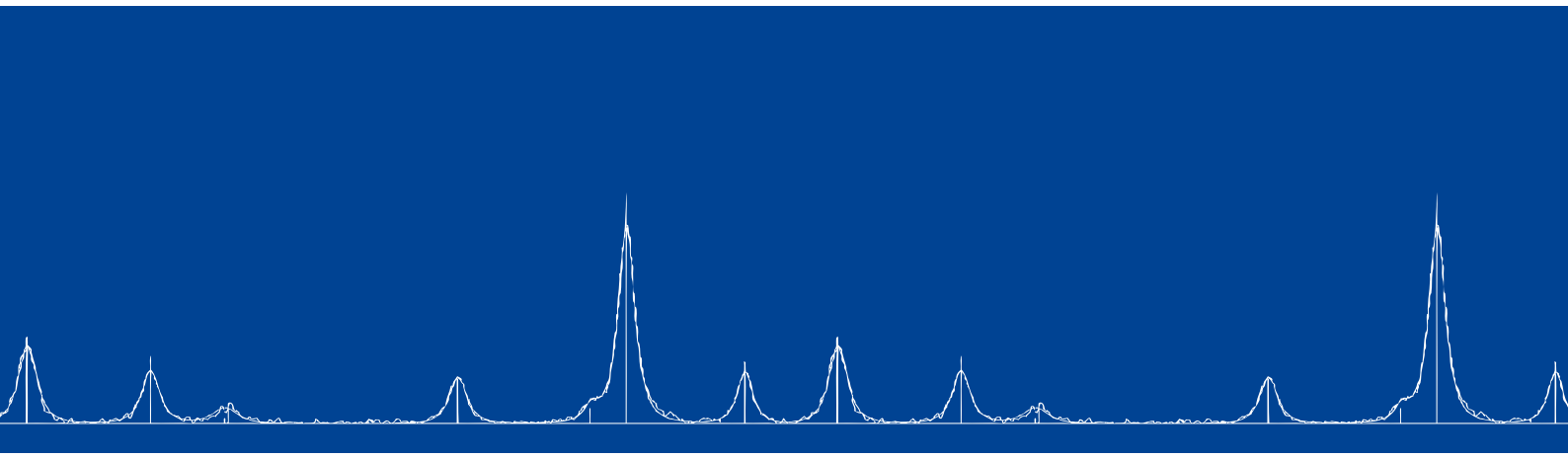
Goniometer	Programmable max. - 45° / + 45° PSI scan 2-Theta range: from 135° to 165° Radius: 70 mm Manual alignment procedure assisted by laser
X-Ray Tube	High brilliance miniature X-ray tube 4 W (40 kV, 0.1 mA) Cr anode provided as standard Other anodes available as options
Detector	Fast Detector (DECTRIS Mythen Multi Strip Detector)
Optics	Standard monocapillary diameter collimators: 0.5, 1 and 2 mm Other diameters available
Laser	Laser repeatability: better than 4 microns
Weight	PSI arc 2.85 Kg



Dimensions (mm)

Safety Assurance

GNR SpiderX complies with the statutory requirements regarding X-Ray, machine and electrical safety. Maximum X-Ray safety with radiation level significantly below the annual dose limit for general public (1 mSv/year) following ANSI N43.3 - 1993 and other industry standards for open beam X-Ray operation.



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