Jordan Atomic Energy Commission
Research and information laboratories directorate
Material Testing Laboratory

International School on Nuclear Physics and Engineering NPhE-2020

INVESTIGATING THE MICROSTRUCTURAL HOMOGENEITY AND DEFORMATION BEHAVIOR OF STEEL STANDARD SPECIMEN

CONTACT INFORMATION

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International School on Nuclear Physics and Engineering NPhE-2020

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To date, the list of applied methods of nondestructive testing of NPP equipment includes ultra-sonic, radiographic, eddy current, capillary and a number of other known methods

PURPOSE OF RESEARCH

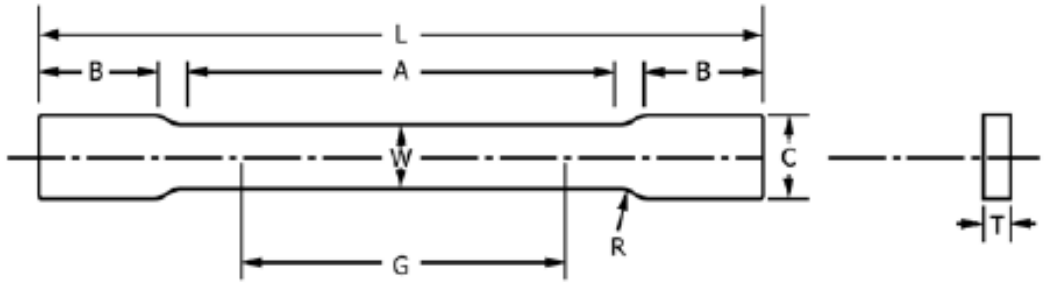
and tasks done to achieve the target

Studying the early stages of micro-deformation in steel standard specimen using SCP method

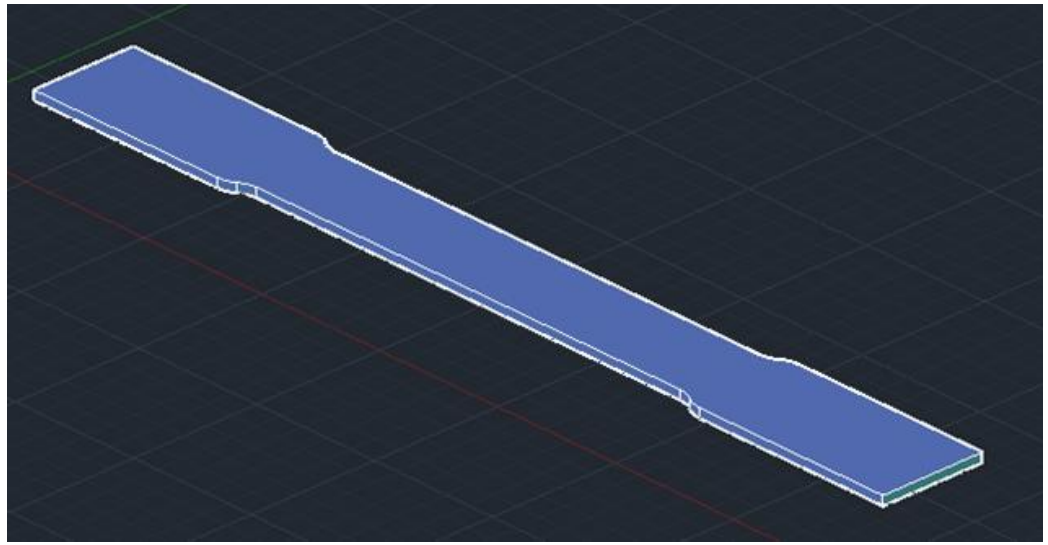
1. Specimen made up of steel were exposed to uniaxial tensile test using the universal testing machine H50KS
2. The distribution of contact potential differences on the specimen surface was measured (before and after a tensile test) using SCP method by a specially designed and manufactured device.
3. Results obtained by SCP method ,before and after Exposing the specimen to deformation due to uniaxial tensile test , were analyzed and compared.

SPECIMEN’S GEOMETRY

Dimensions



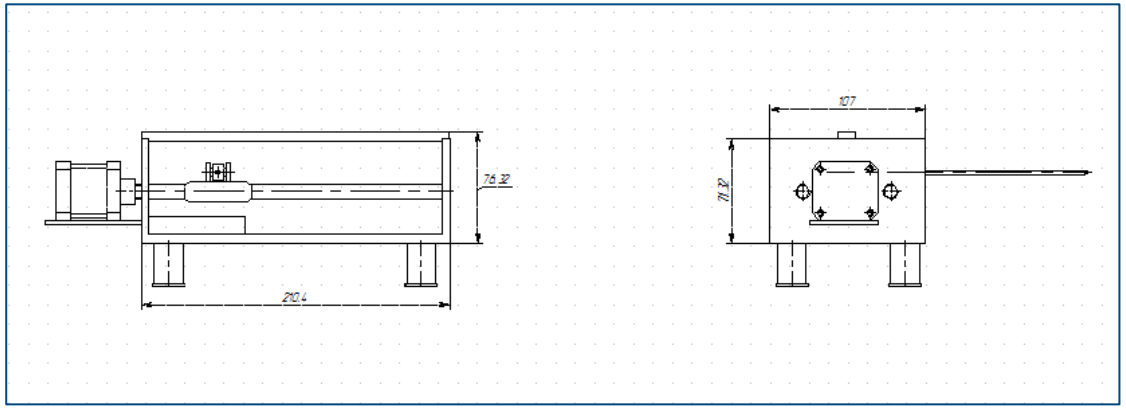
G—Gauge length	50.0 mm
W—Width	13.5 mm
T—Thickness	3.13 mm
L—Overall length	150 mm



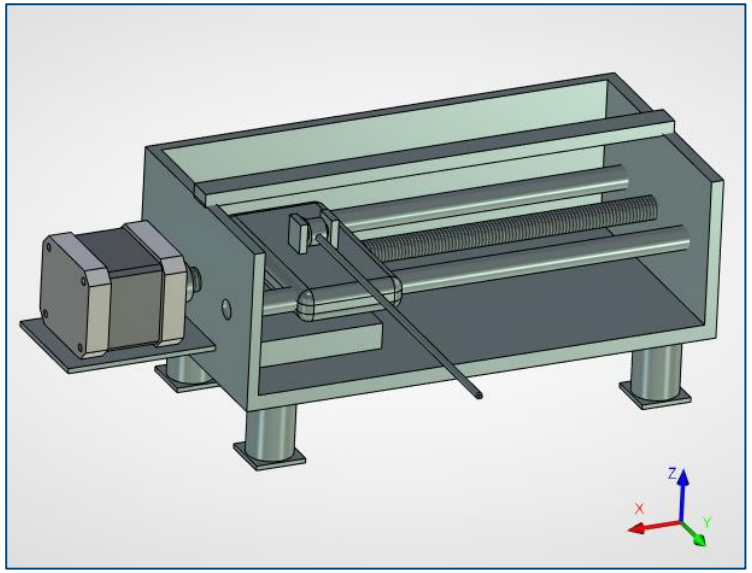
PREPARATION FOR THE EXPERIMENT

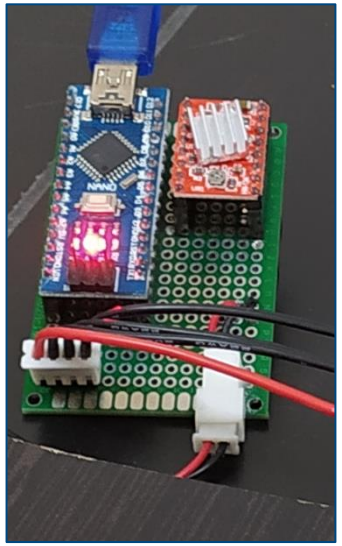
Semi-automated scanner device

In order to perform the SCP test, a semi-automated scanner device, that is remotely controlled, was designed and manufactured. Measured data is automatically recorded and saved to a special measuring information system (MIS)



Material of transducer Needle type (Ø2..3 mm)	high carbon steel wire and are nickel corrosion resistance
Device's material	Completely stainless steel
Length of Measuring rod., mm	30
Maximum sliding speed of the transducer over the sample surface, mm/sec	2,2
Minimum sliding speed of the transducer over the sample surface, mm/sec	0,2
Transducer sensitivity, µV	0,01



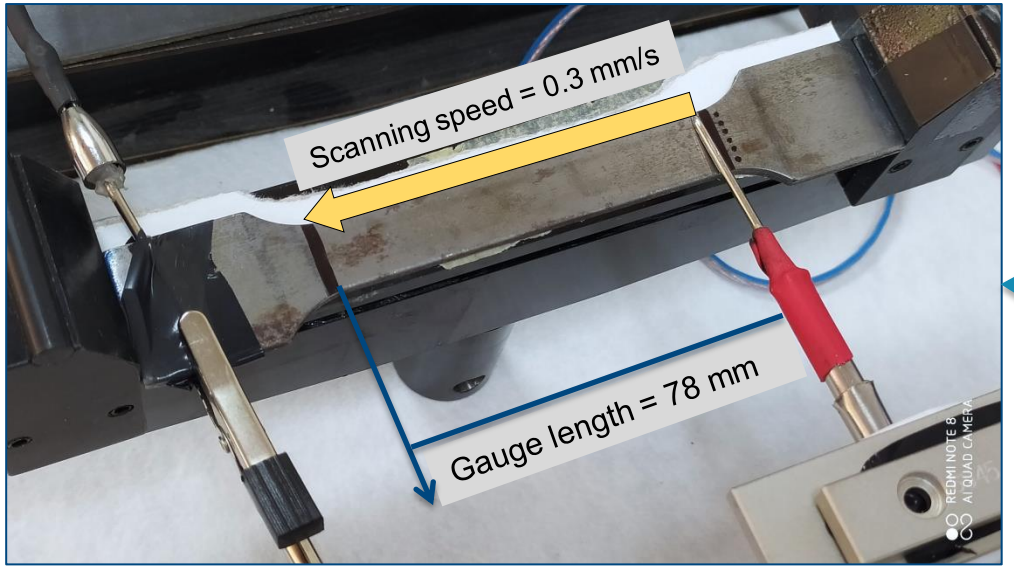


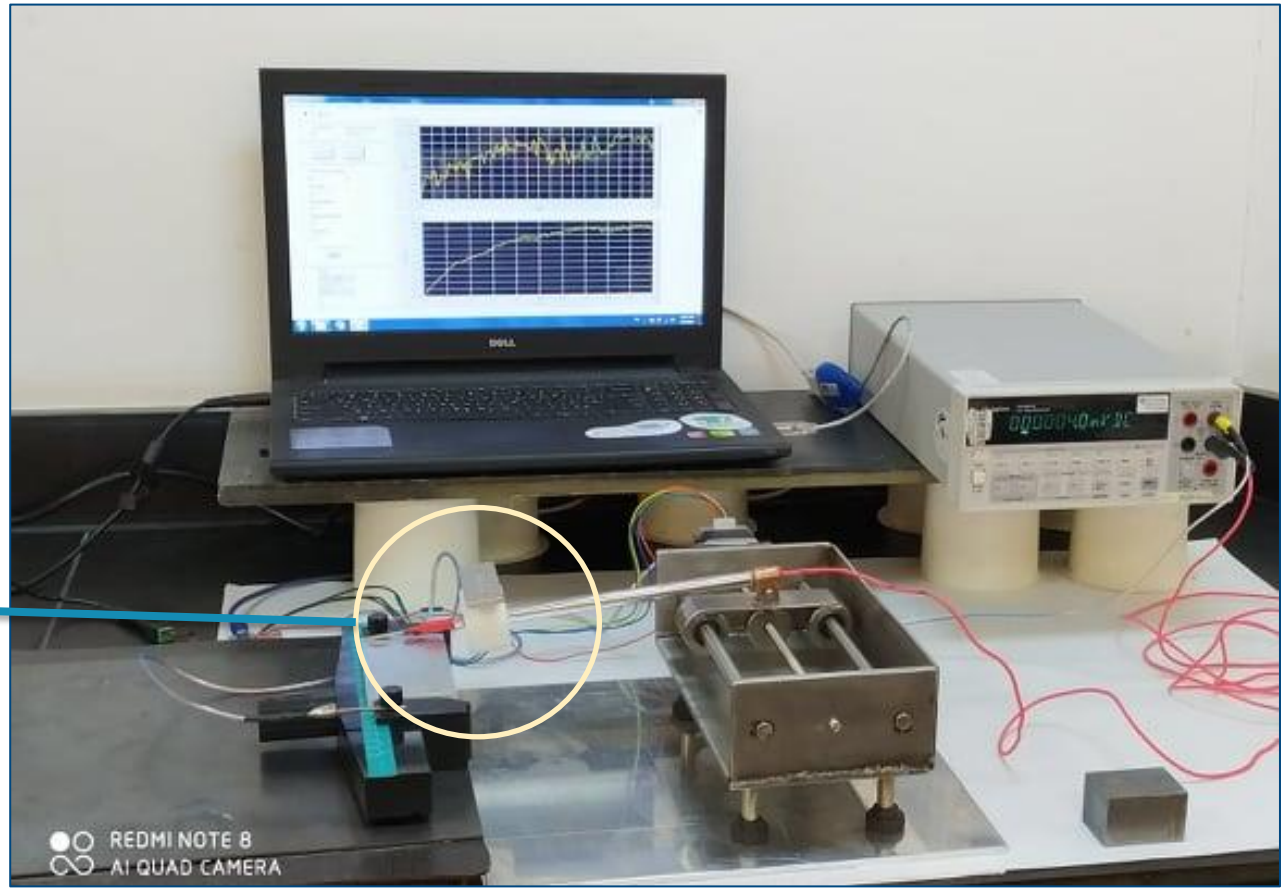
THE EXPERIMENT

SCP test using semi-automated scanner device before tensile test

In the Material Testing Laboratory, at Jordan Atomic Energy Commission, experiments were conducted under ambient conditions using standard reference specimen made up of steel

SCP was performed before and after a tensile test was conducted on a steel specimen



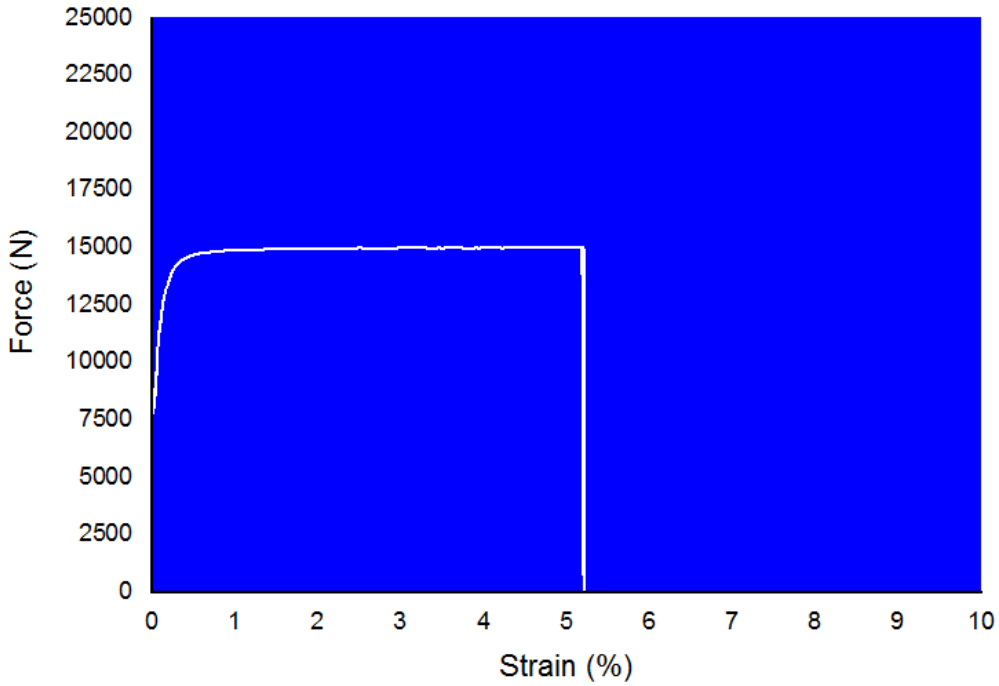


SCP station in Material Testing Laboratory

THE EXPERIMENT

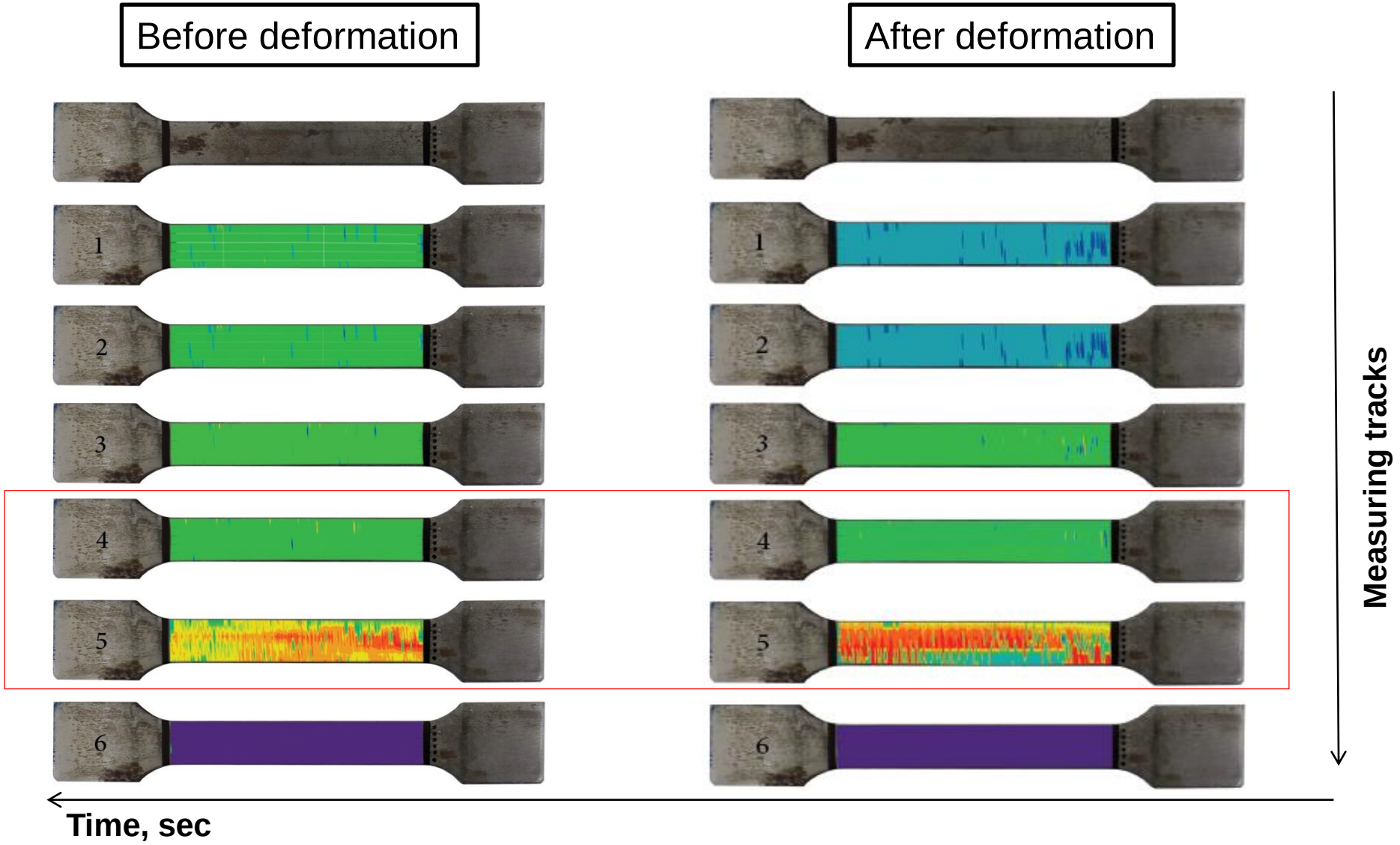
Uniaxial tensile test

Testing speed	1 mm/min
σ_{max}	354.5 MPa
ε_{max}	5.2 %



RESULTS

Potentiograms

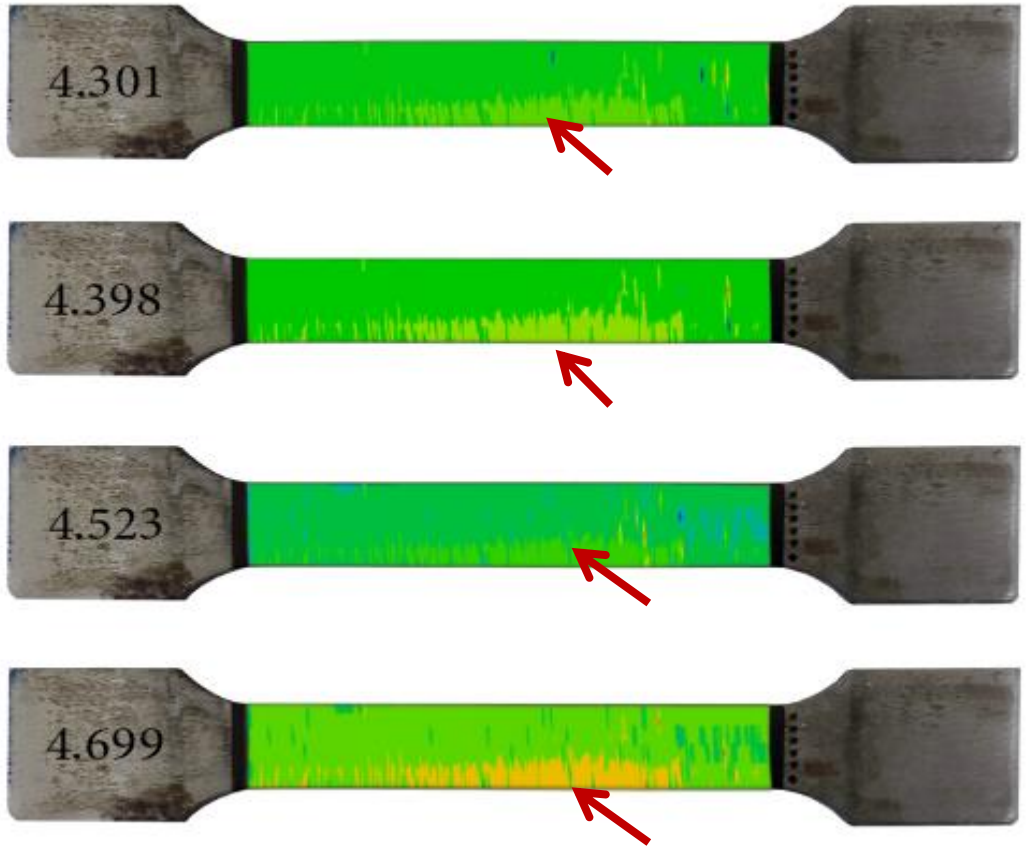


Potentiograms

SLS= 4.301- 4.699

Before deformation

After deformation

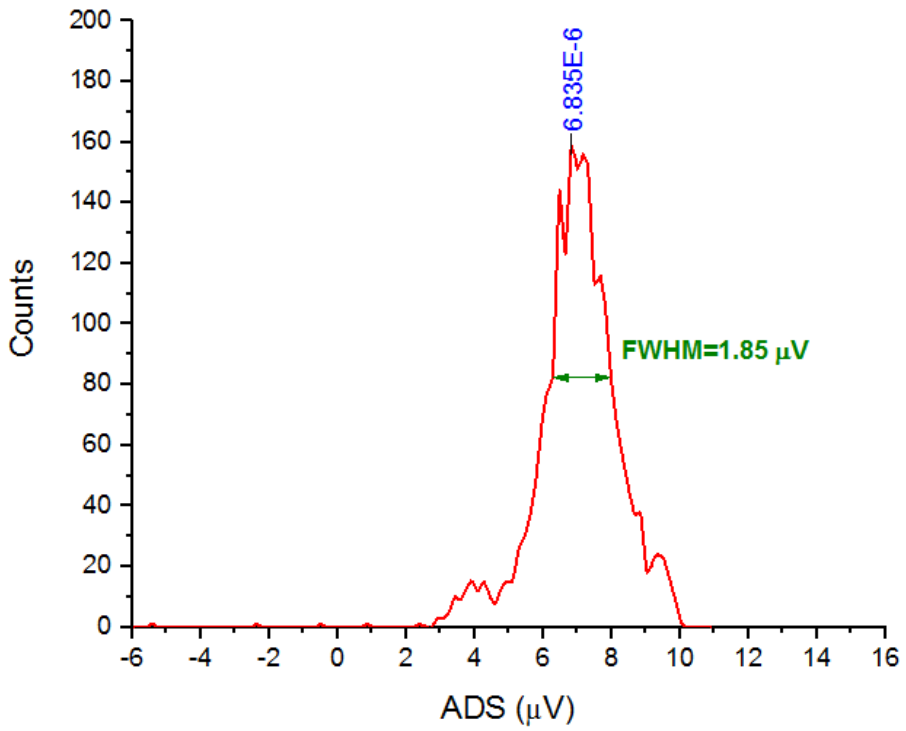


Results obtained from SCP test performed on the steel standard reference material specimen were represented using potentiograms. The potentiograms obtained show clearly the moment of formation of micro-deformations within the internal structure of the specimen, due to the tensile strain it is exposed to, causing the detection of a structural level signal (SLS ≈5) which is equivalent to 10 µV.

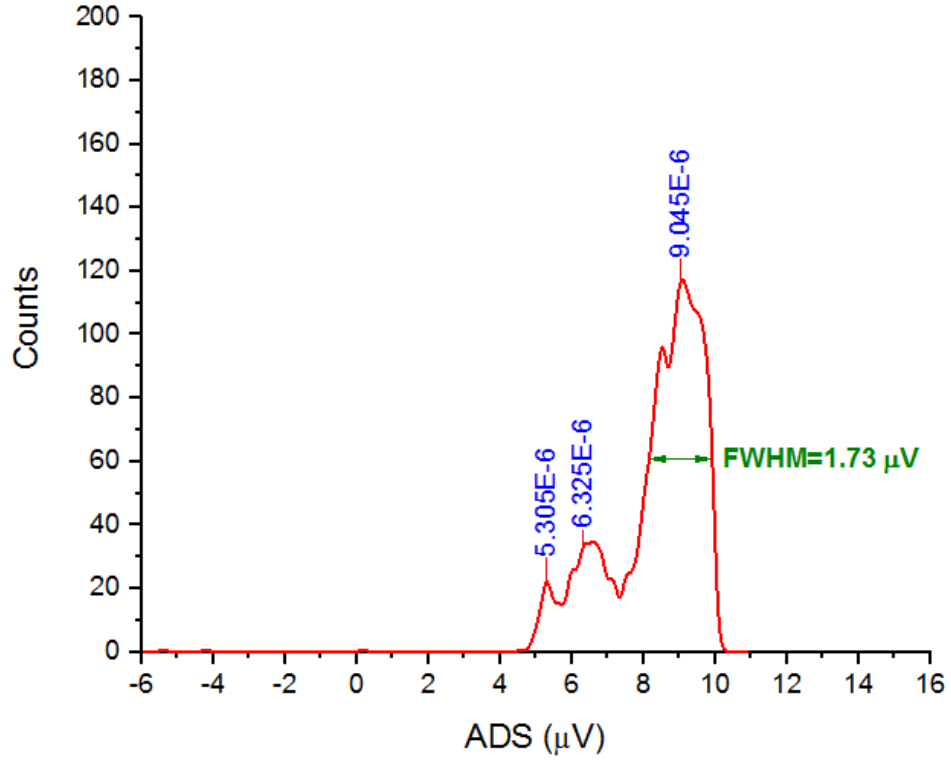
RESULTS

Histograms

Before deformation



After deformation

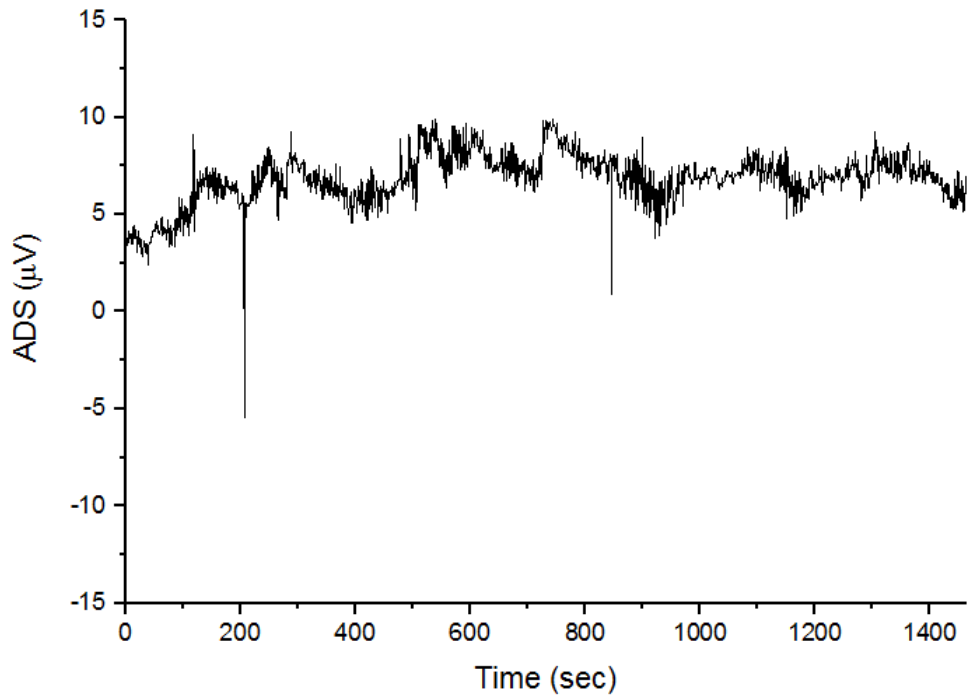


The moment micro-deformations appeared was further proved by the results obtained from full width at half maximum (FWHM) of distribution histograms at (SLS≈5) before and after the tensile test was conducted. The values obtained from the FWHM distribution histograms of contact potential differences, measured at the surface, were found to be lower after the tensile test. Furthermore, it was observed that additional micro-deformations peaks appeared in the histograms after the tensile test have been performed, which were not present before the test.

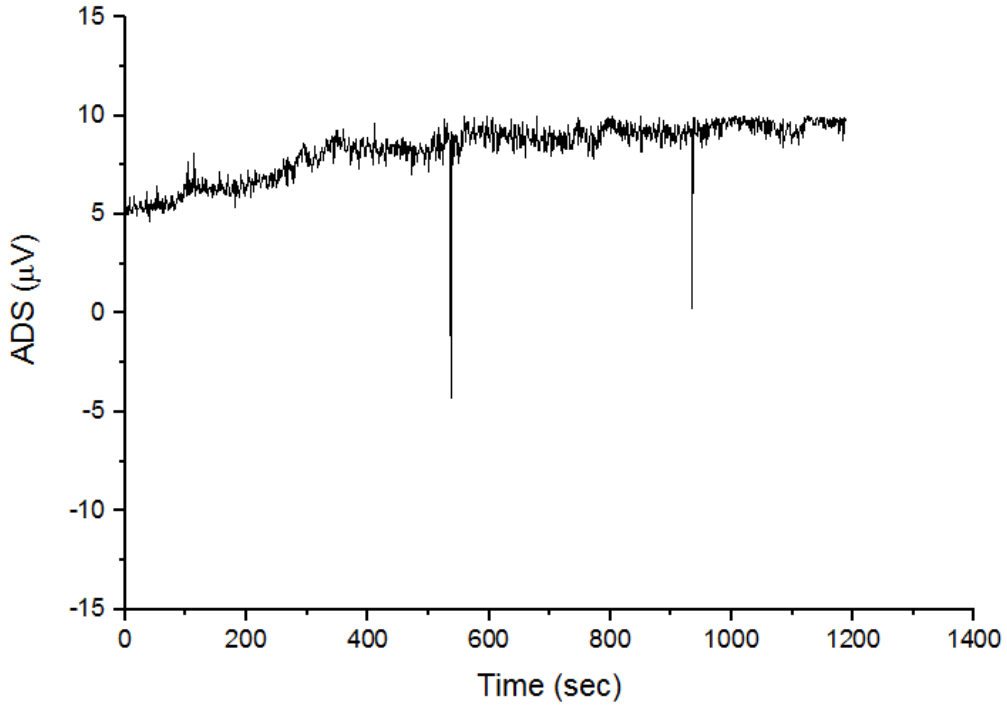
RESULTS

Amplitude – Time of DS

Before deformation



After deformation



Comparing the Amplitude -Time of the diagnostic signal before deformation with that obtained for the sample made up of steel after deformation

Conclusions

The results presented in this work considers the first official implementation of SCP in the Laboratory of Material testing in Jordan Atomic Energy Commission.

The study of early stages of micro-deformation is very important to control the homogeneity and deformation behavior in industrial faculties ,such as for monitoring and diagnostics of NPP equipment during operation ,to obtain information about the state of materials at an early stage

FWHM distribution histograms of contact potential differences were found to be lower after the tensile test.

It was observed that new micro-deformation peaks appeared in the histograms after the tensile test have been performed, which were not present before.

The potentiograms show clearly the moment of formation of micro-deformations within the internal structure of the specimen, due to the tensile strain it is exposed to, causing the detection of a structural level signal (SLS ≈5) which is equivalent to 10 μV.

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