The background image shows a close-up of a mechanical assembly. A metal threaded rod is visible, passing through a hole in a dark, possibly black, metal component. A ruler is placed vertically over the rod, with markings in millimeters and centimeters. The ruler shows numbers like 30, 40, 50, 60, 70, 80, 90, and 100. The scene is lit from the side, creating shadows and highlights on the metal surfaces.

Study of electrical resistance in simple cuprate superconductor systems by application of uniaxial pressure

Agnieszka Domalewska, Mateusz Gala, Wojciech Tabiś



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Vienna University of Technology



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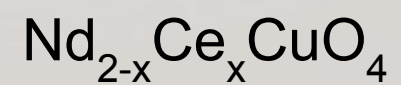
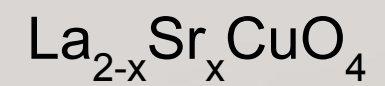
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SCOPE OF ACTIVITIES



ELECTRICAL RESISTANCE
MEASUREMENT IN TWO
SINGLE CRYSTALS:

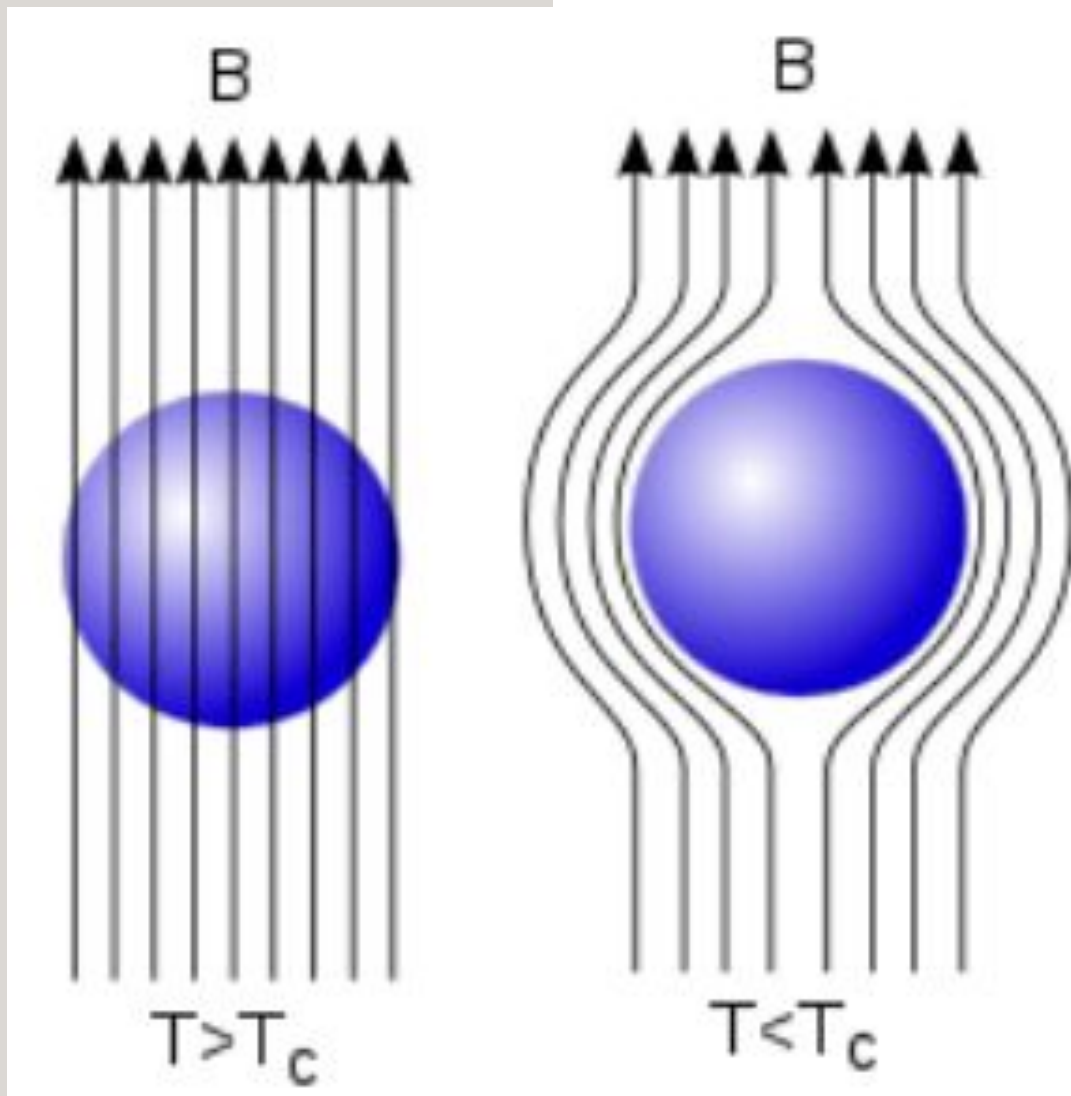
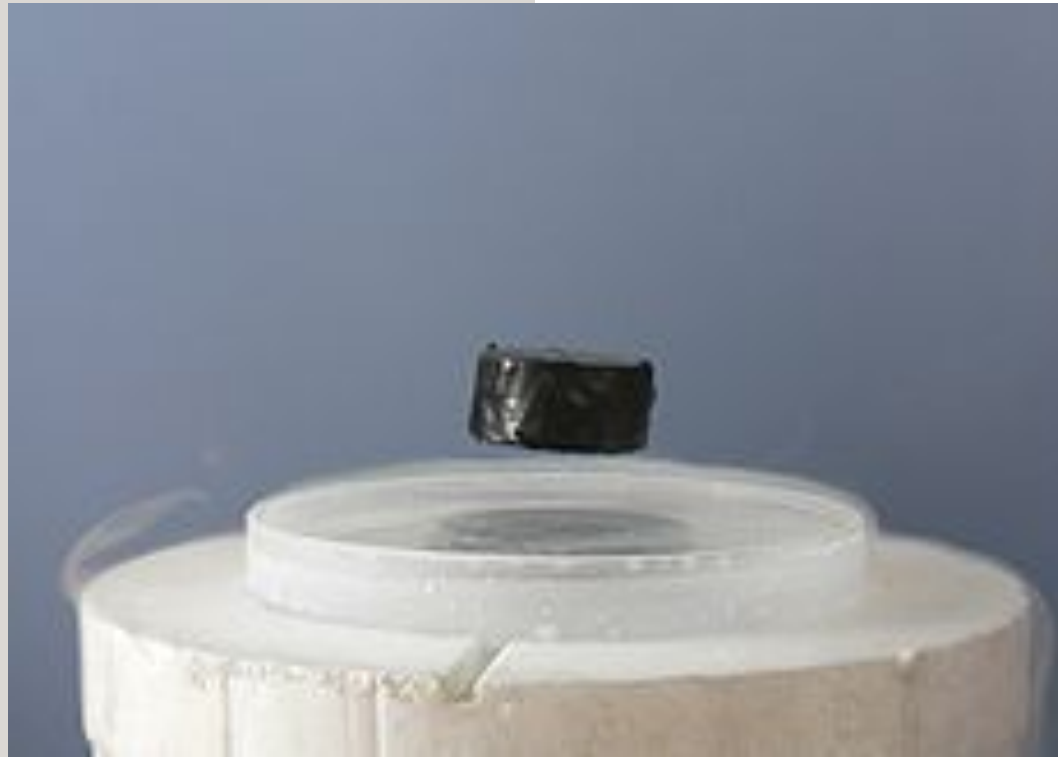


CHECK HOW THE
RESISTANCE OF THE
MATERIALS CHANGES
WITH THE PRESSURE.



GUIDANCE TO
FURTHER
RESEARCH AND
INNOVATION

INTRODUCTION

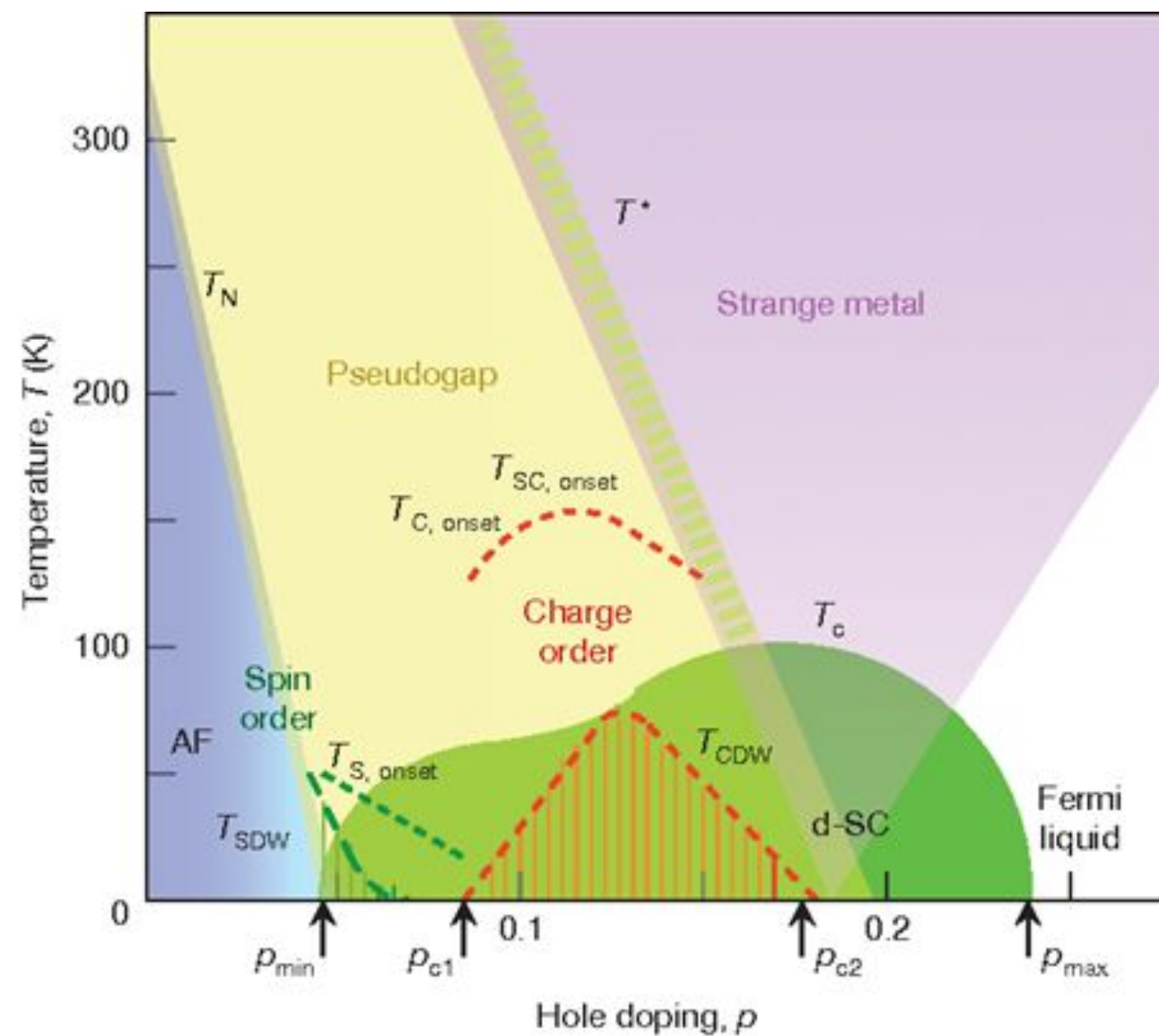
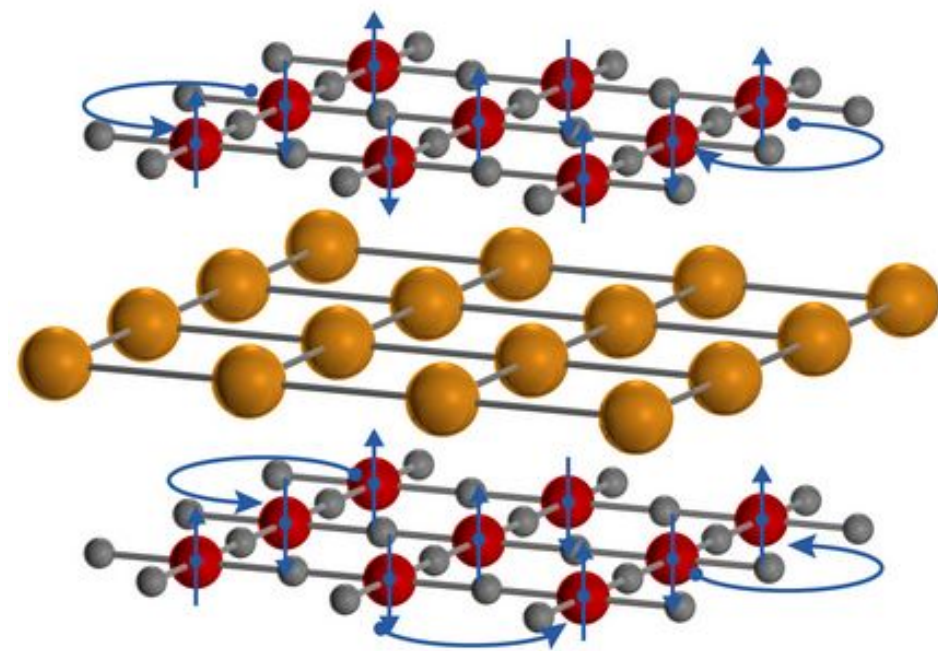


Usually one depicts classical superconductivity as the Meissner effect.

Many materials cooled to liquid nitrogen temperatures show superconducting properties and they repel magnetic fields. So such a superconductor put in a magnetic field will hover in its area, which looks spectacular.

The most promising materials, because of the highest achieved critical temperatures, are superconductors based on copper oxide, called cuprates.

Cuprates



01

high temperature superconductivity

02

layered structure

03

copper-oxide layers separated by charge reservoir buffers

04

antiferromagnetism

05

coping by adding or removing electrons
(electron or hole doped systems)

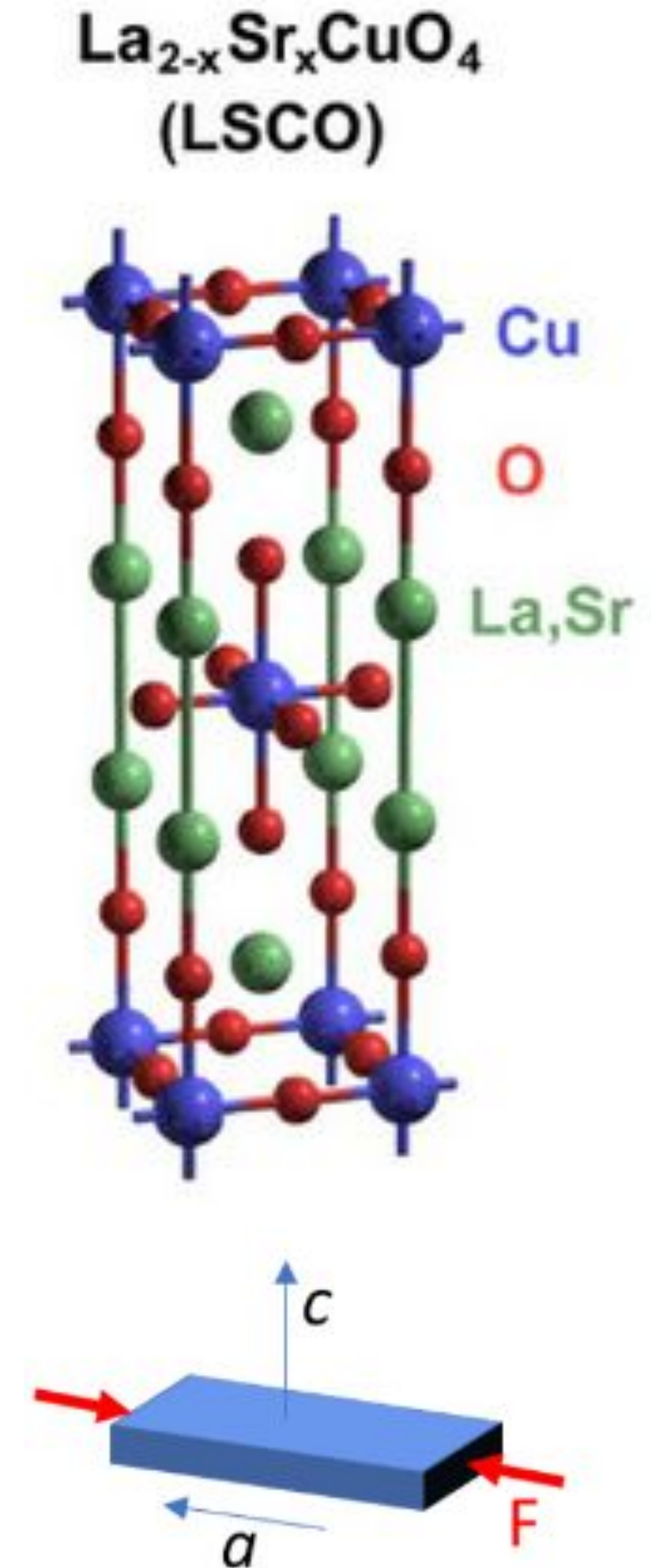
Studied materials

The tested materials were two single crystals:

$\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ (LSCO), hole doped

$\text{Nd}_{2-x}\text{Ce}_x\text{CuO}_4$ (NCCO), electron doped

The samples are grown in the Traveling Solvent Floating Zone Furnace, which is a zone-melting furnace.

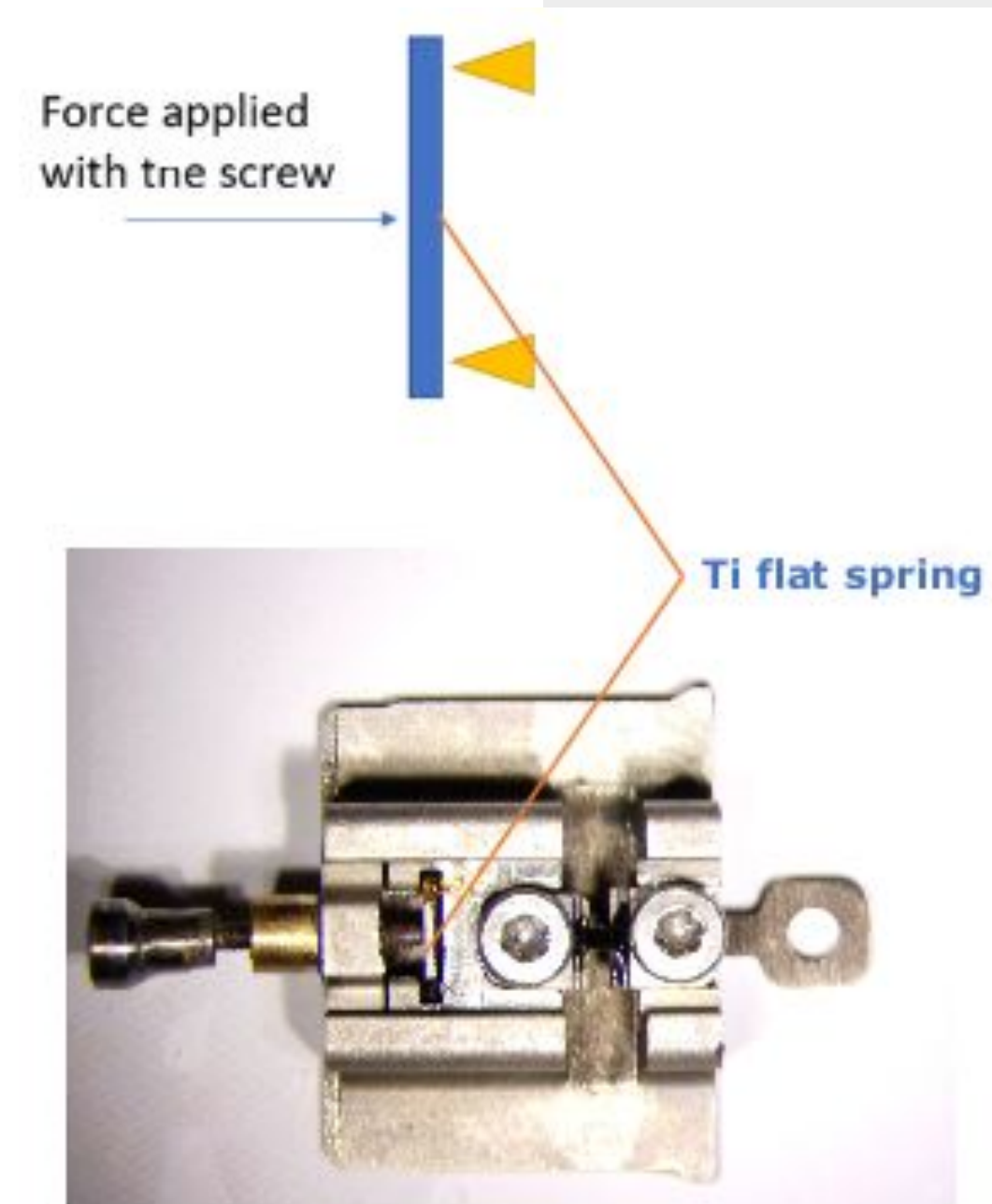
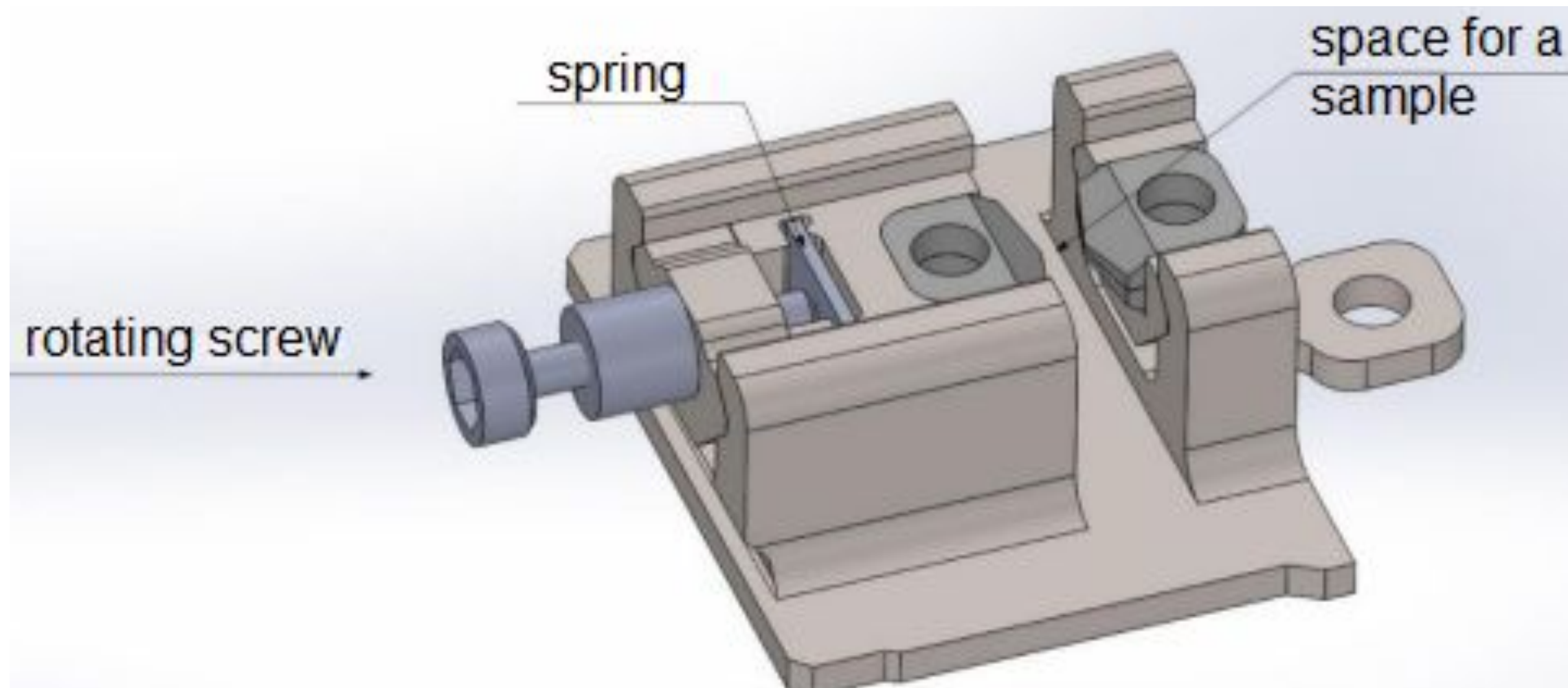


PREPARATION

The team has developed various methods to apply single-axis pressure.

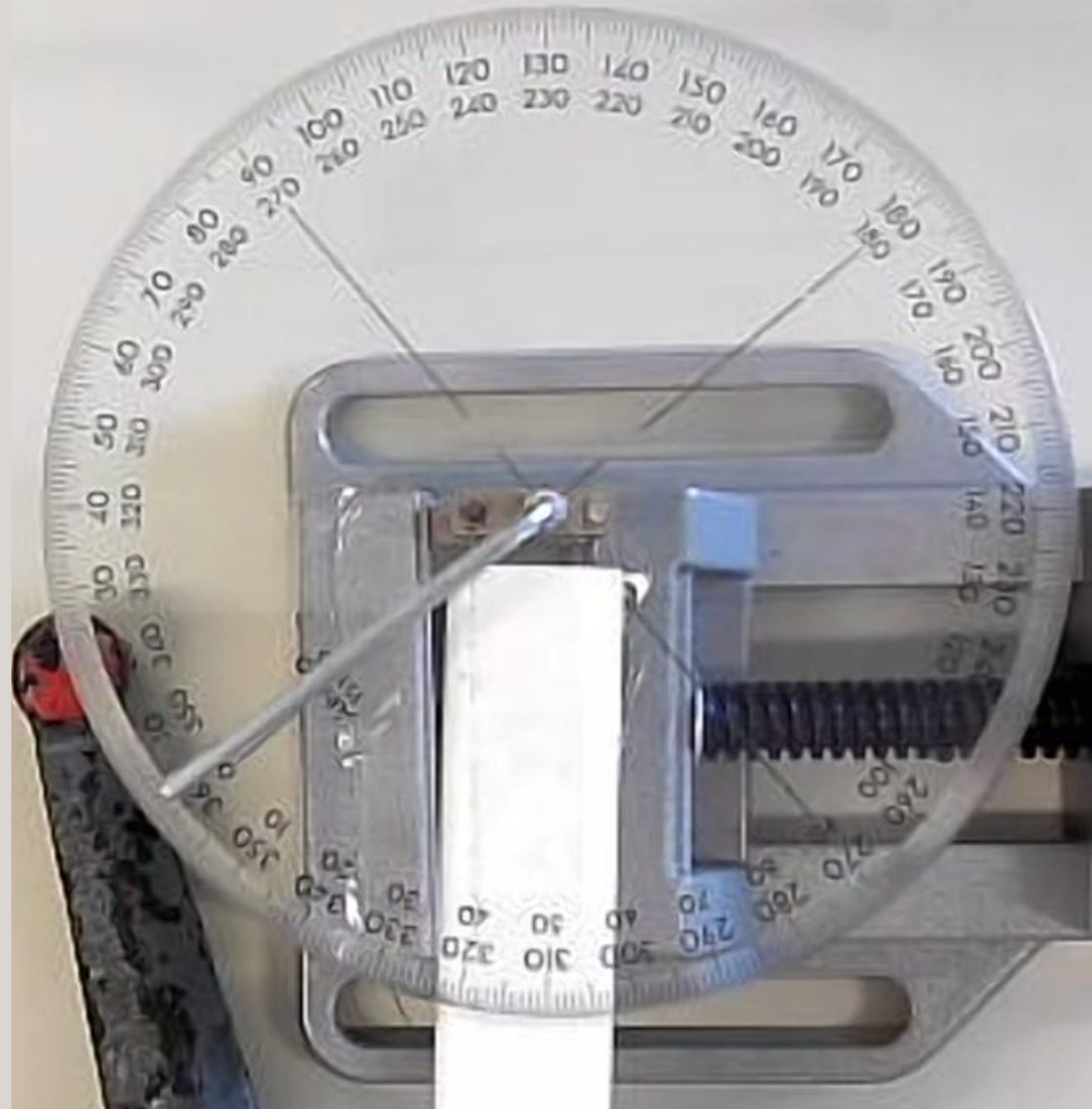
Here, the pressure is applied through elastic deformation of a flat titanium spring

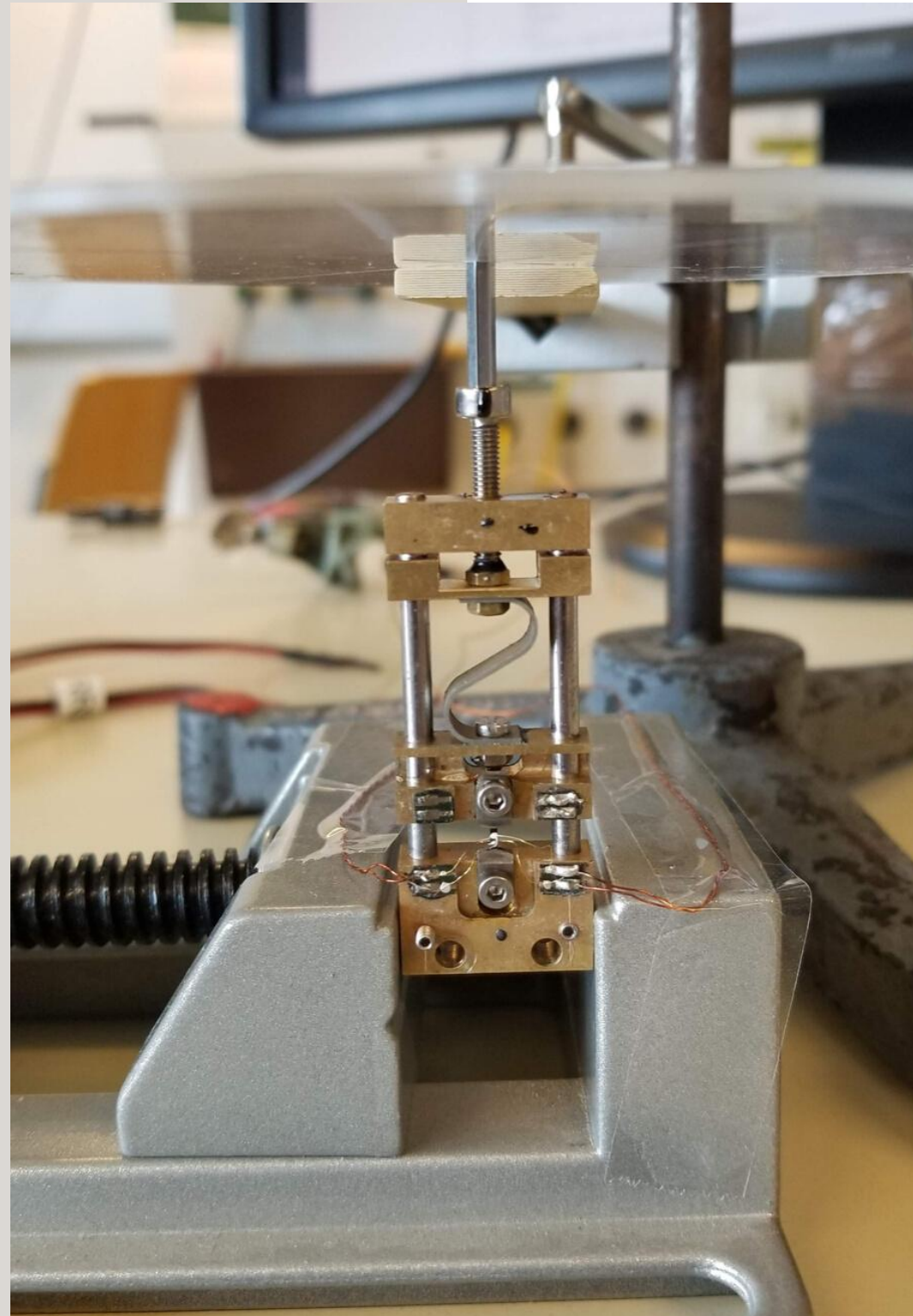
The force is regulated by the rotation of the screw by a certain angle.



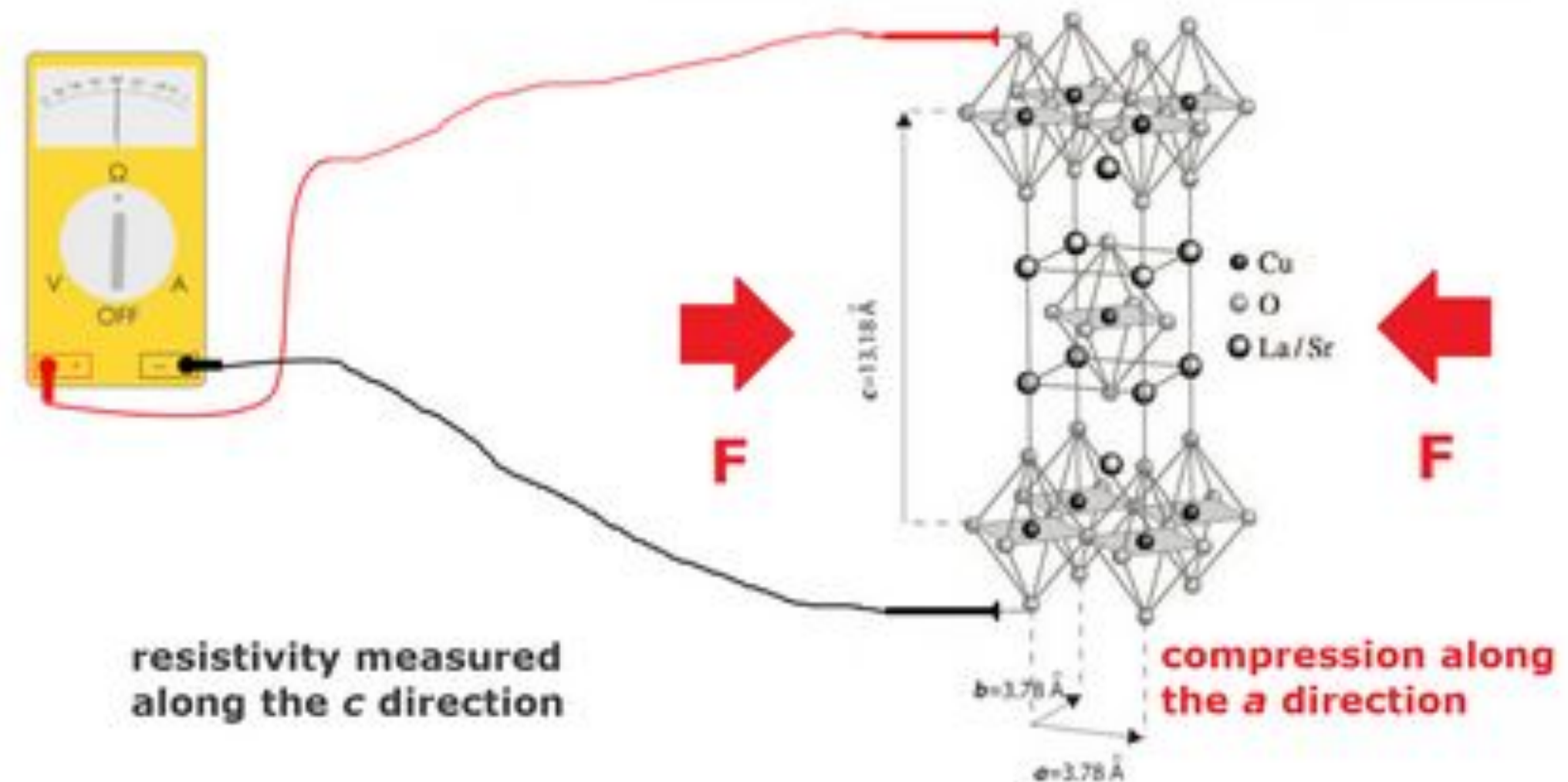
The angle by which the screw was rotated was measured with a protractor.

Measurements were taken at two equal intervals: 5 or 10 degrees.

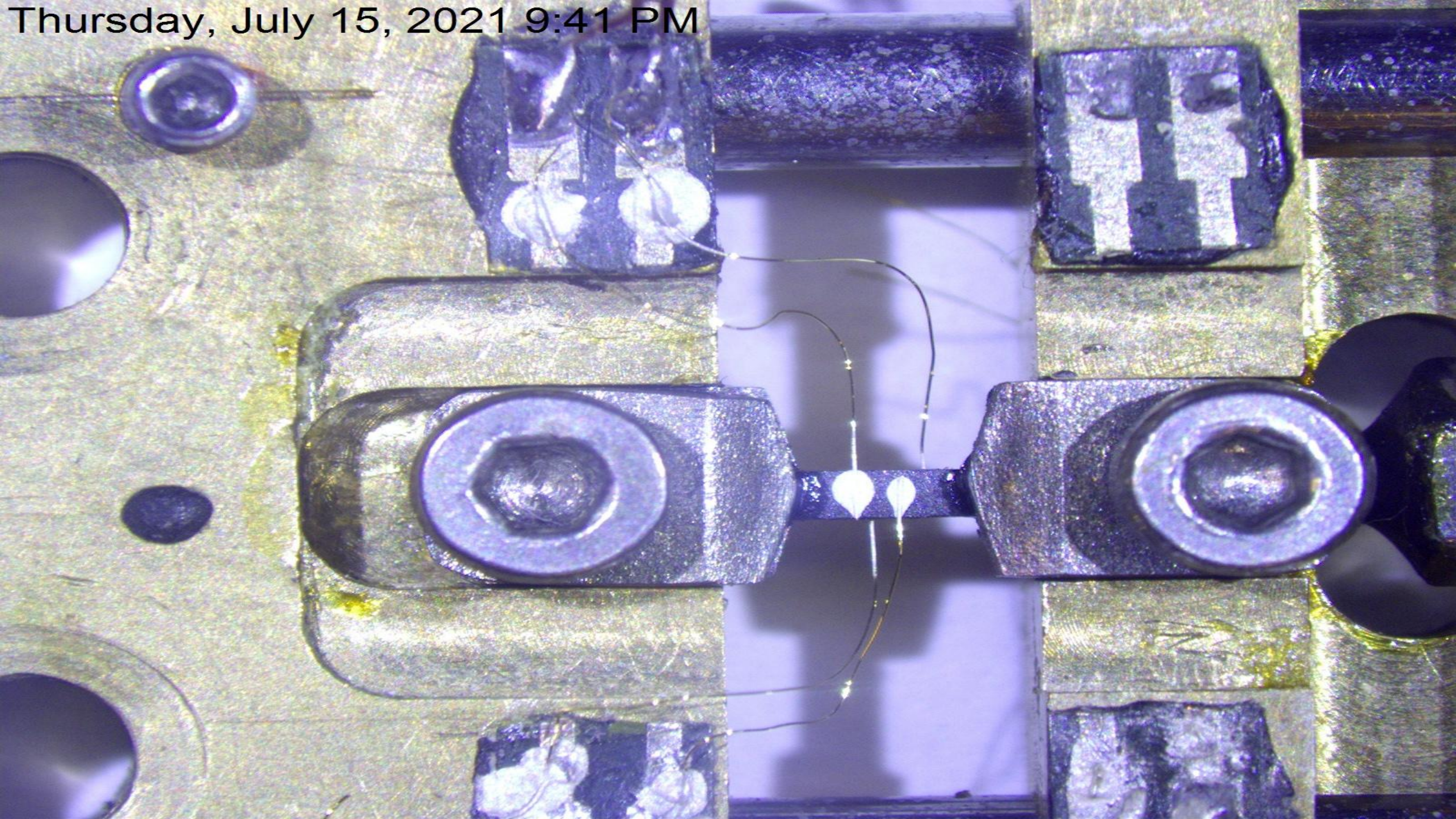




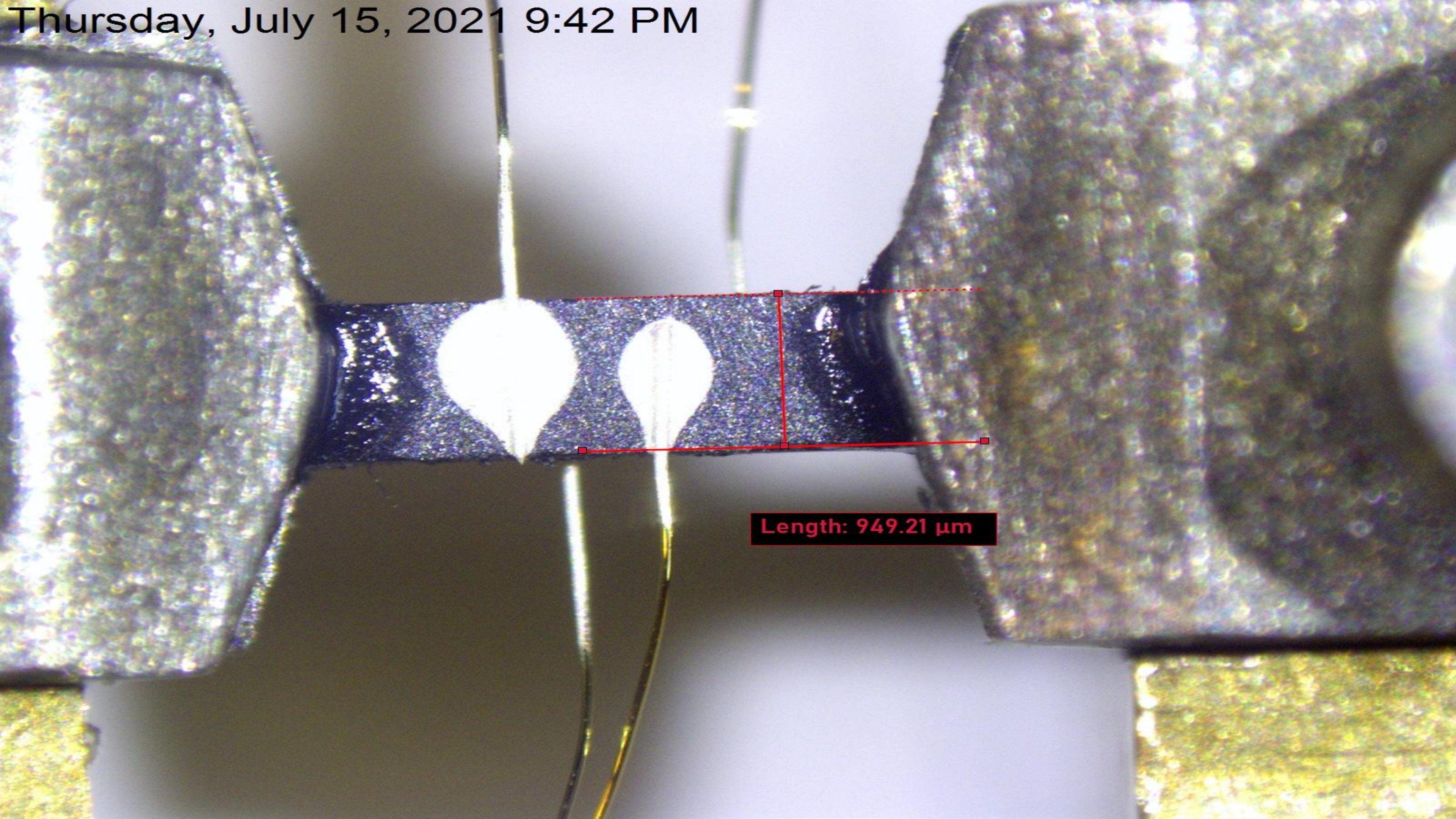
We chose the S-shaped springs because it will be the easiest to calculate the stress from strain of the spring.



Thursday, July 15, 2021 9:41 PM

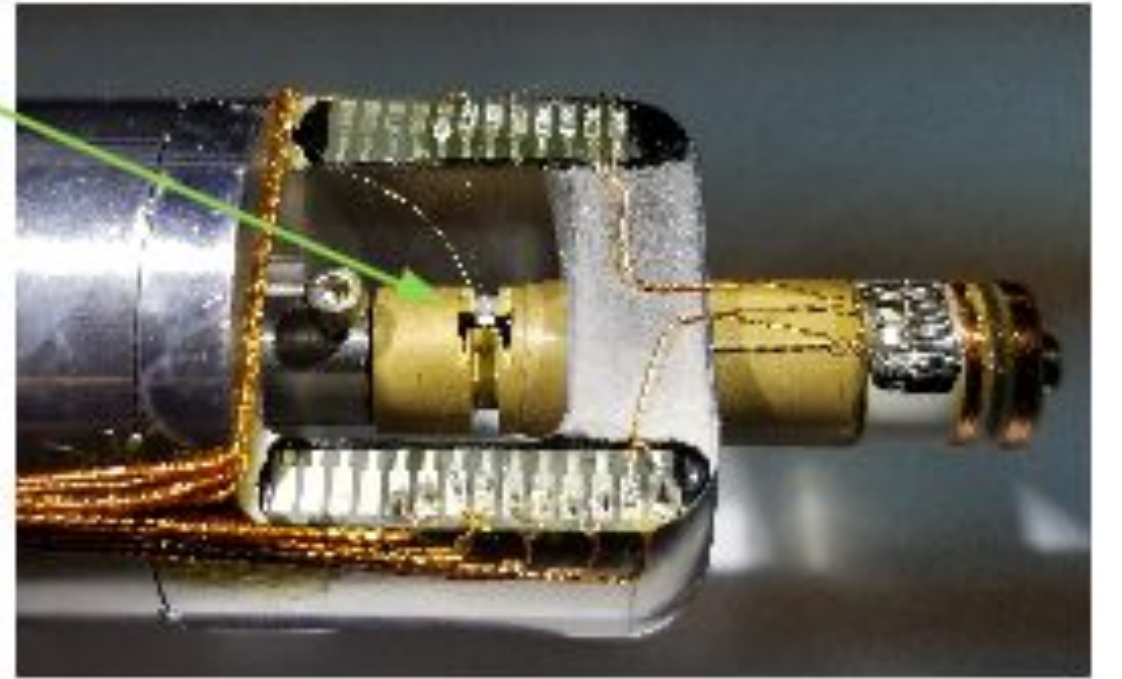
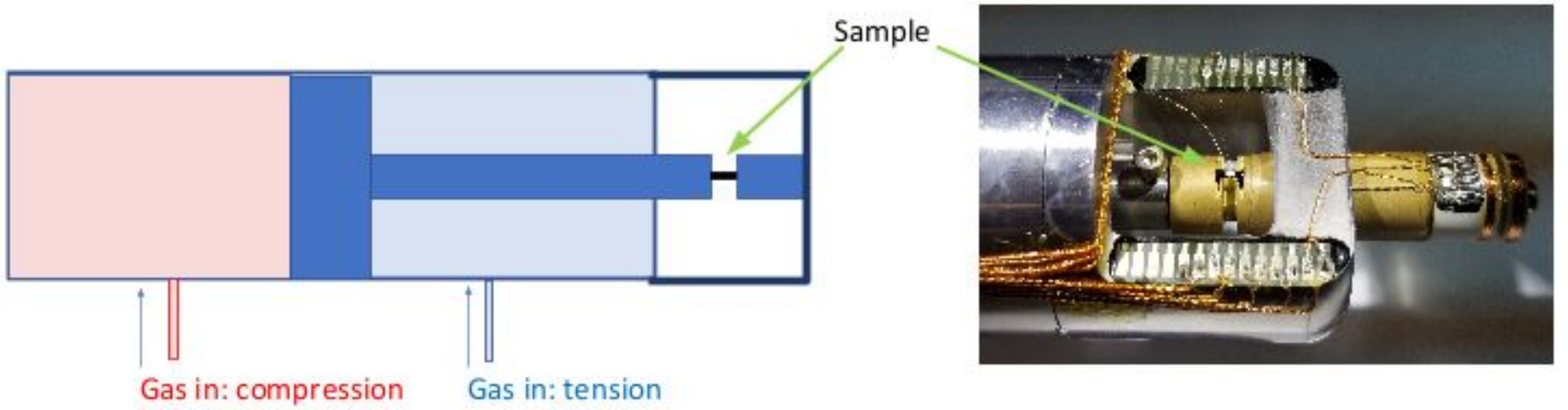


Thursday, July 15, 2021 9:42 PM



Length: 949.21 μm

TECHNOLOGY TO MEASURE SINGLE-AXIS
PRESSURE USING COMPRESSED GAS



TECHNOLOGY TO MEASURE SINGLE-AXIS
PRESSURE USING COMPRESSED GAS

Pressure
control

Sample dilatation
measurement

Sample resistance
measurement



Tension

Compression



DATA ANALYSIS AND RESULTS



The electrical resistance of the single crystal was measured.



The sample was placed in the right place along the appropriate axis.



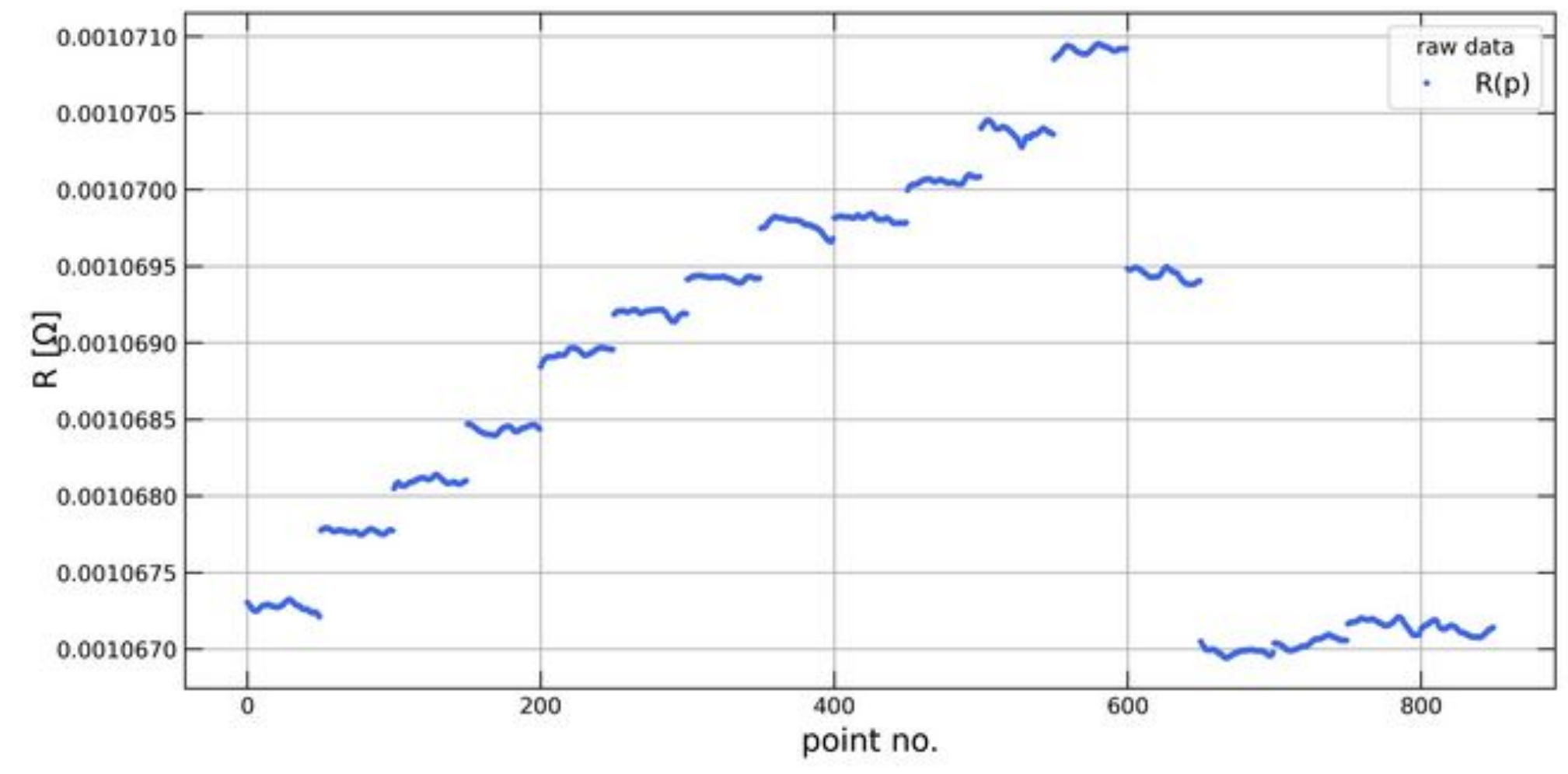
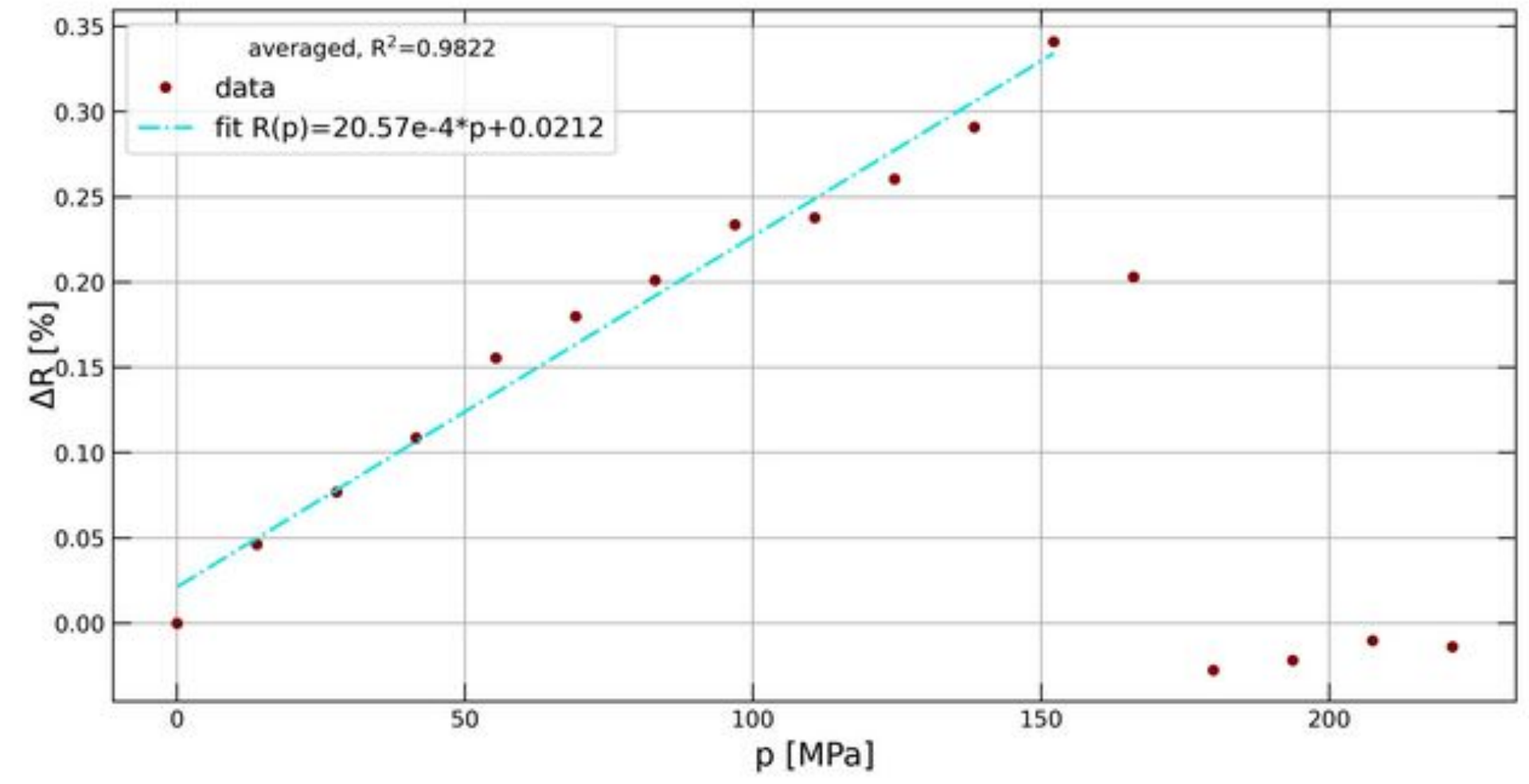
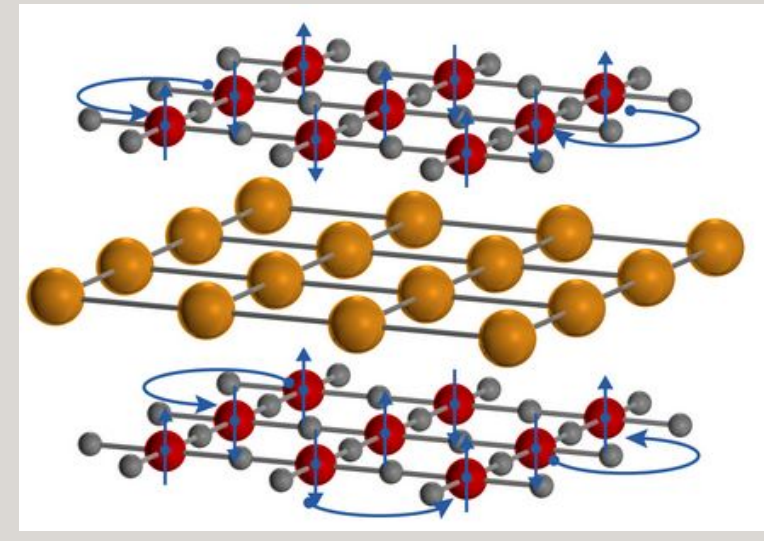
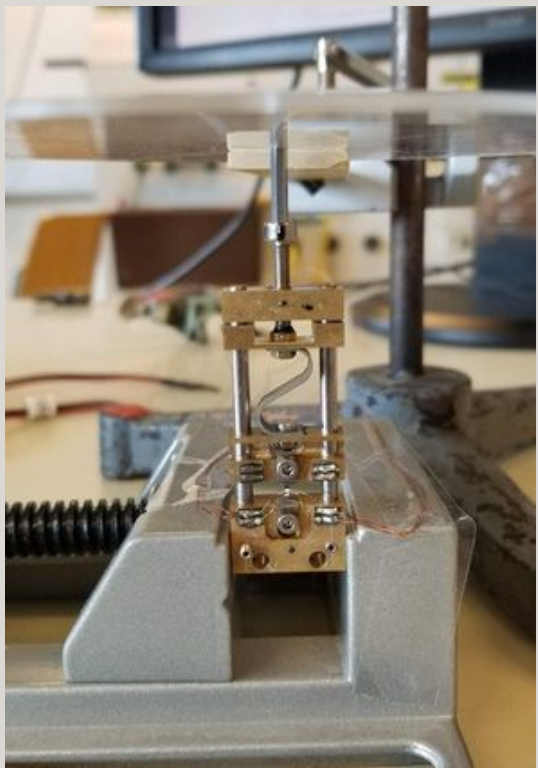
Several measurements were performed, and the results were compared.

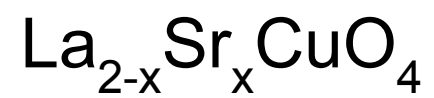
Data Analysis and Results



up to 50 degrees,
every 5 degrees

$k = 2.767 \text{ MPa/deg}$

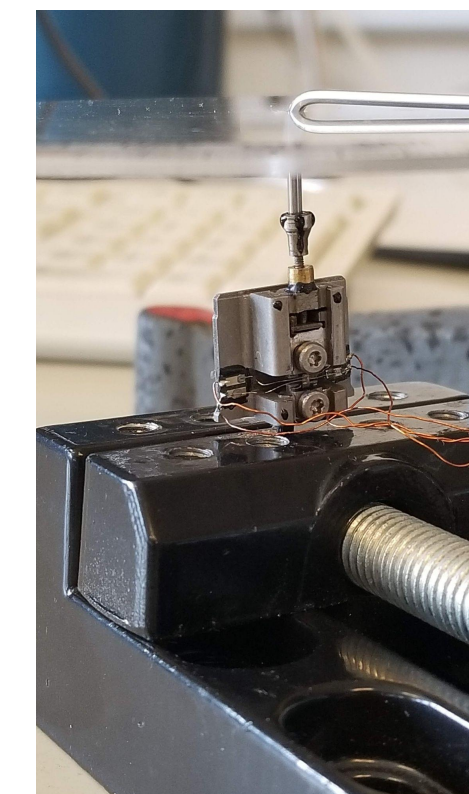
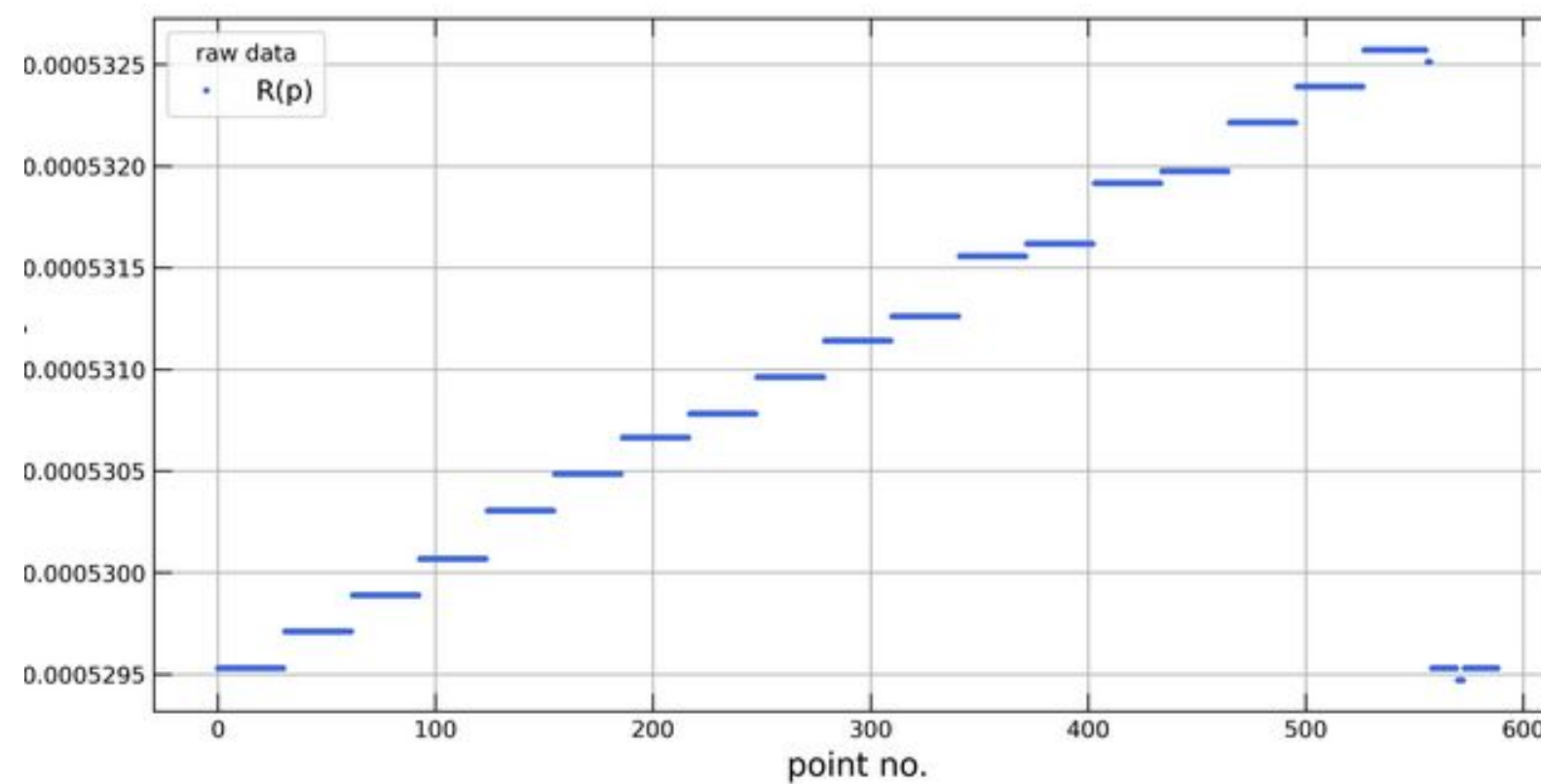
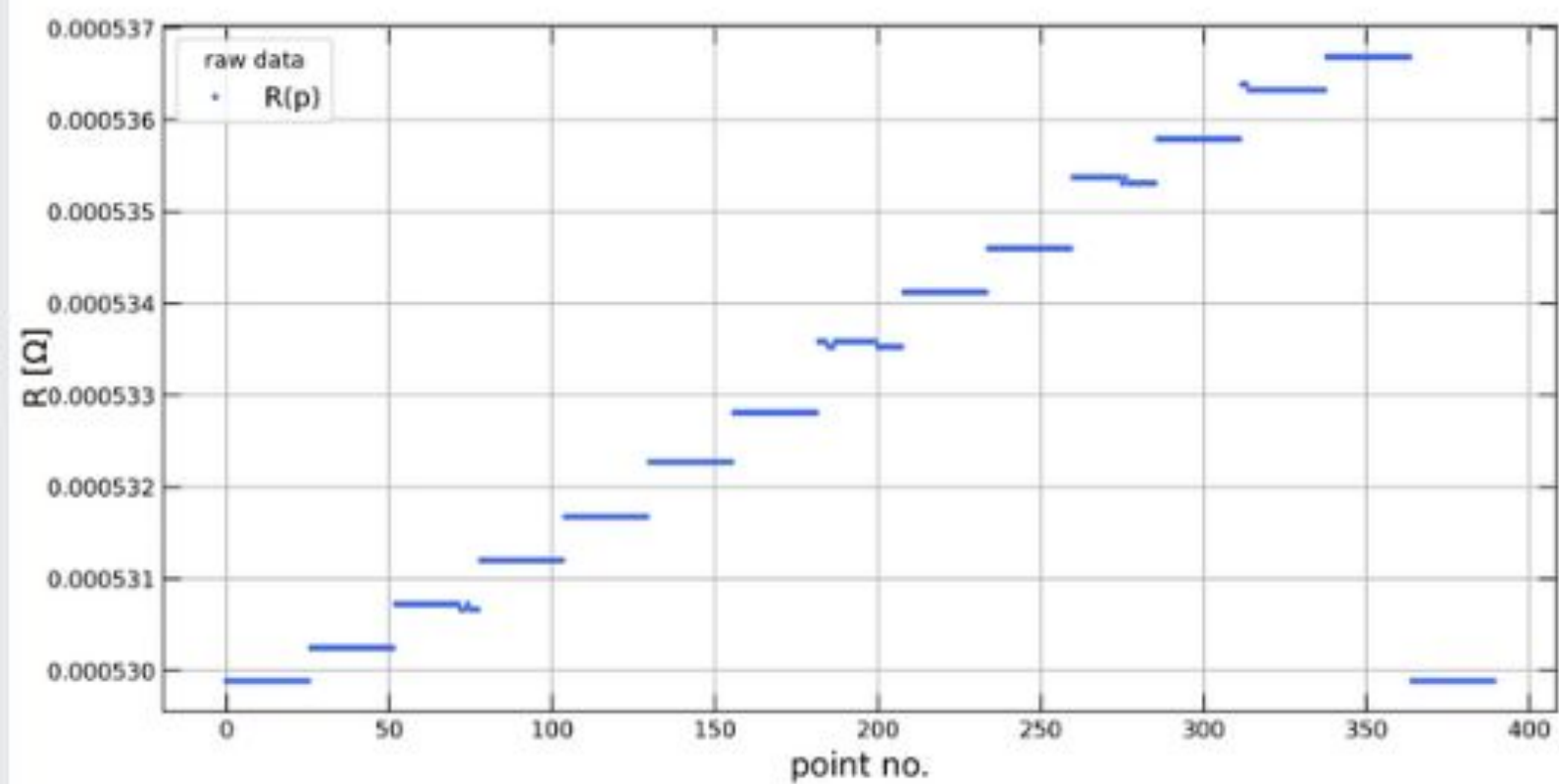
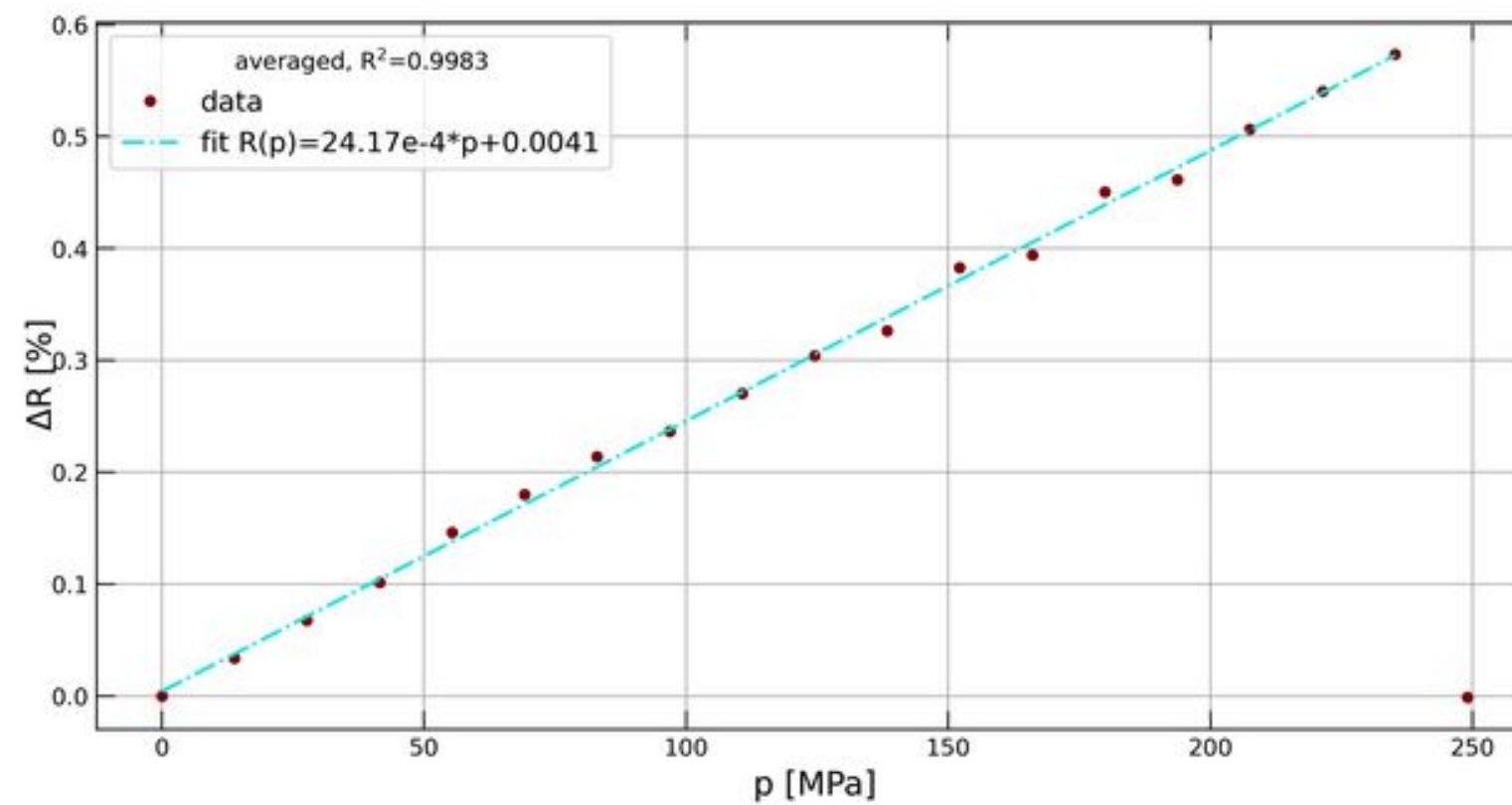
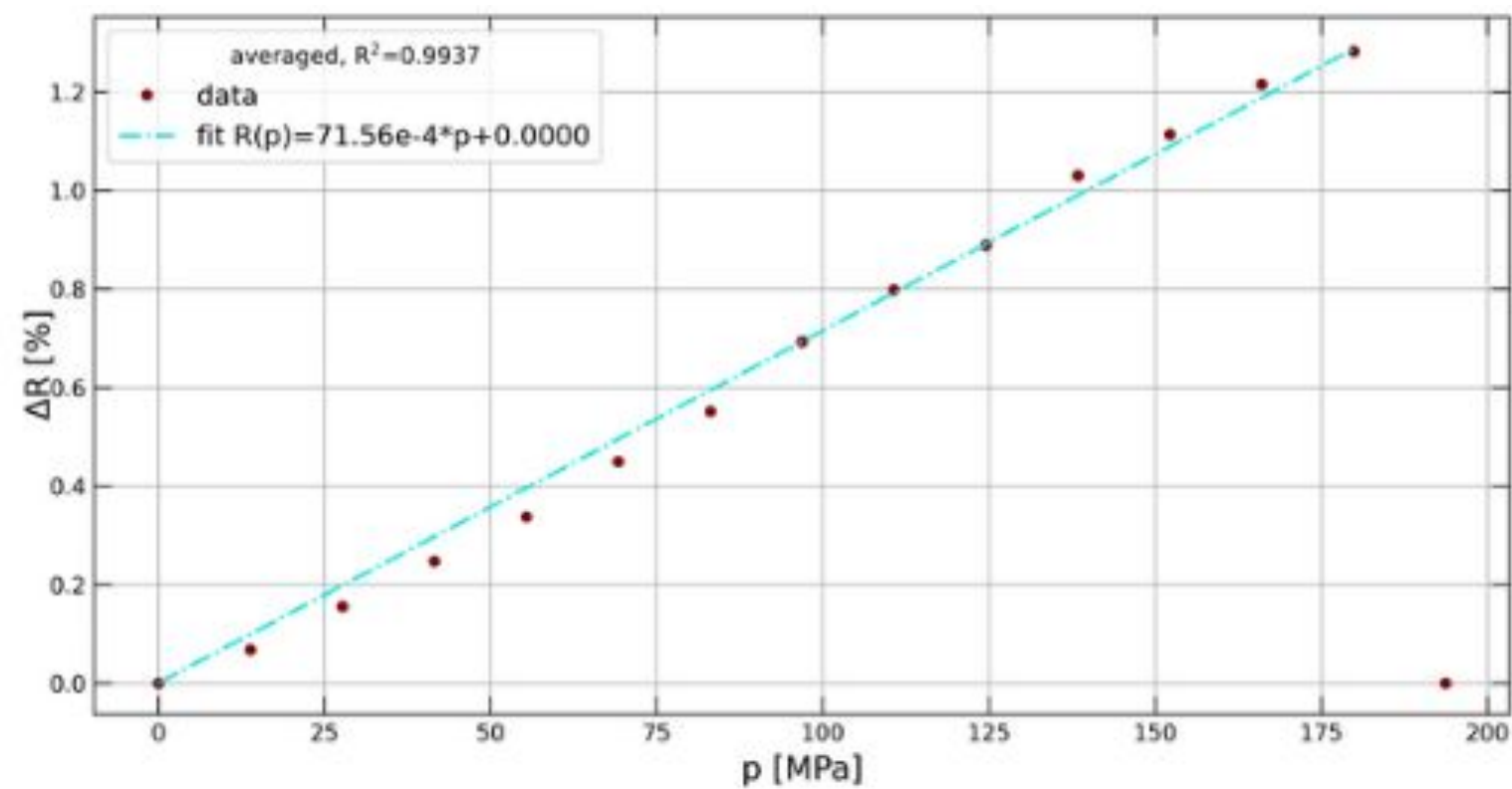




$k = 2.767 \text{ MPa/deg}$

up to 75 degrees

every 5 degrees

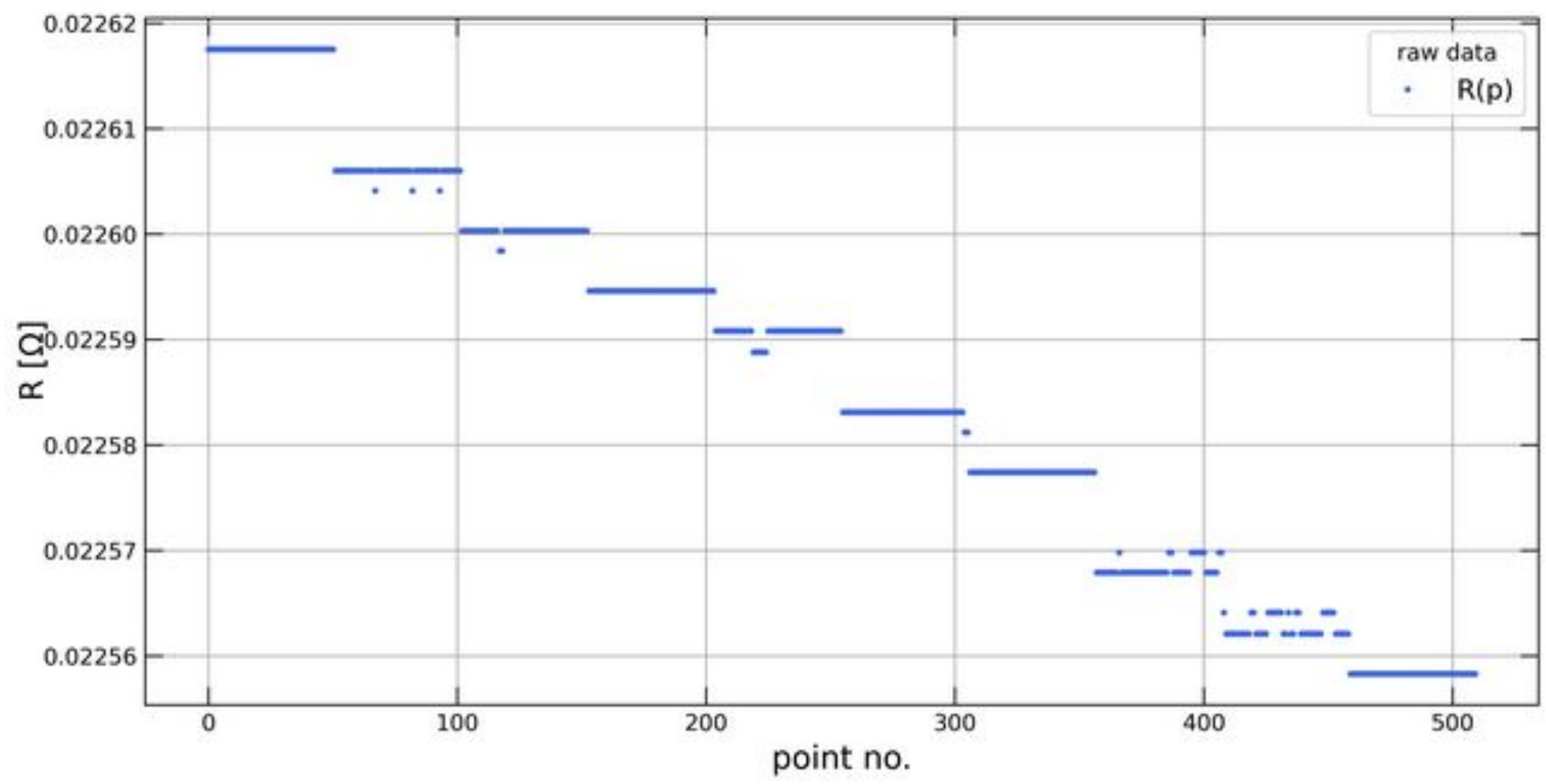
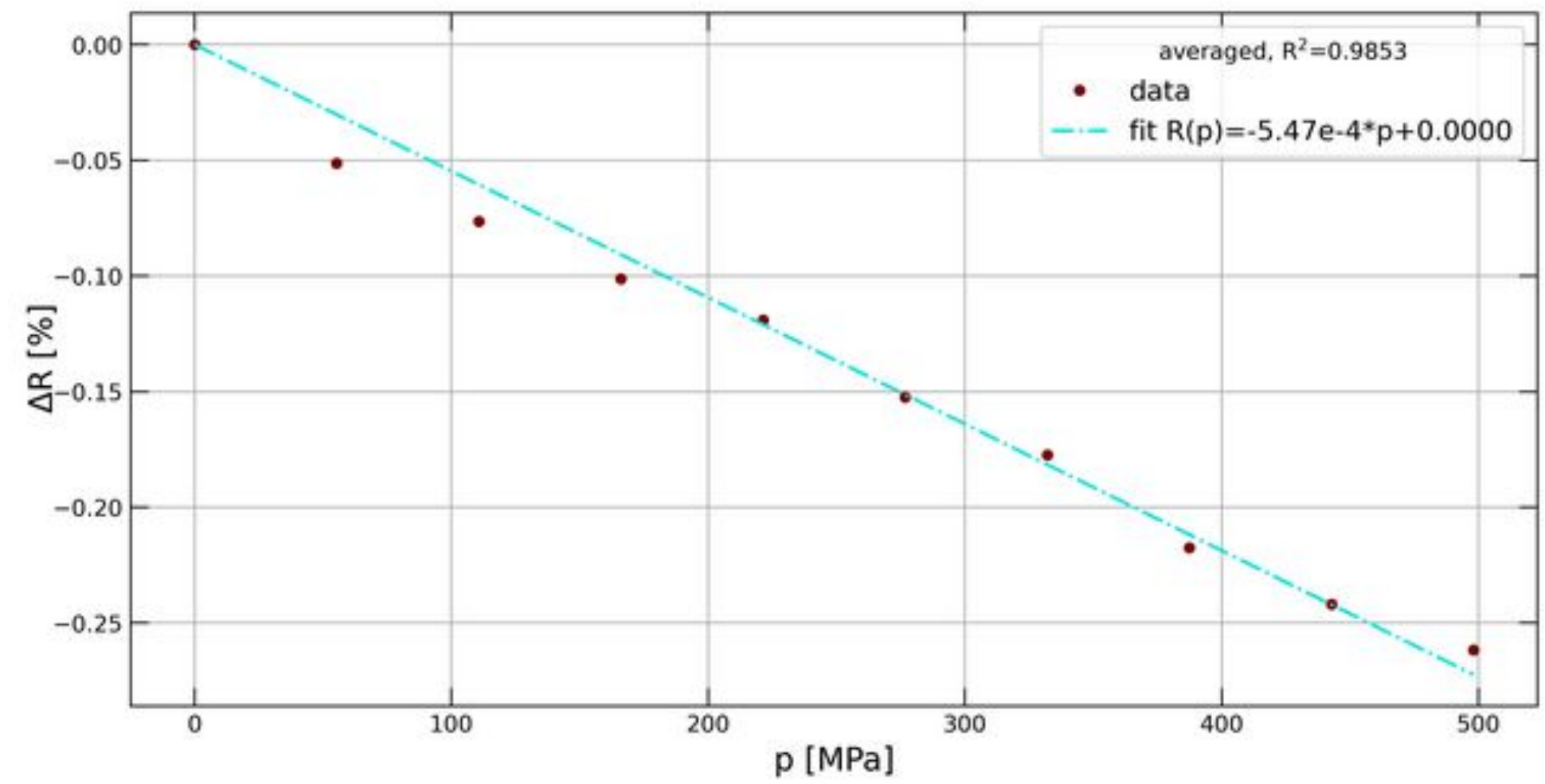
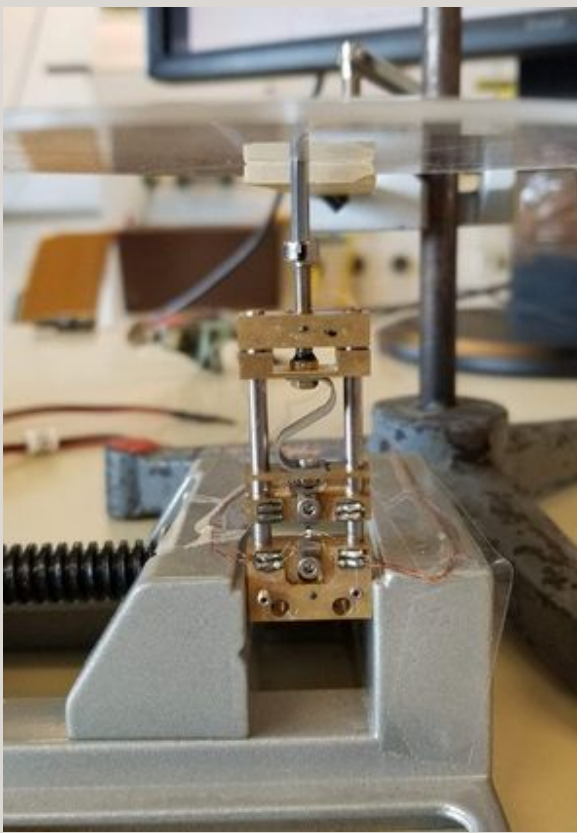


Data Analysis and Results

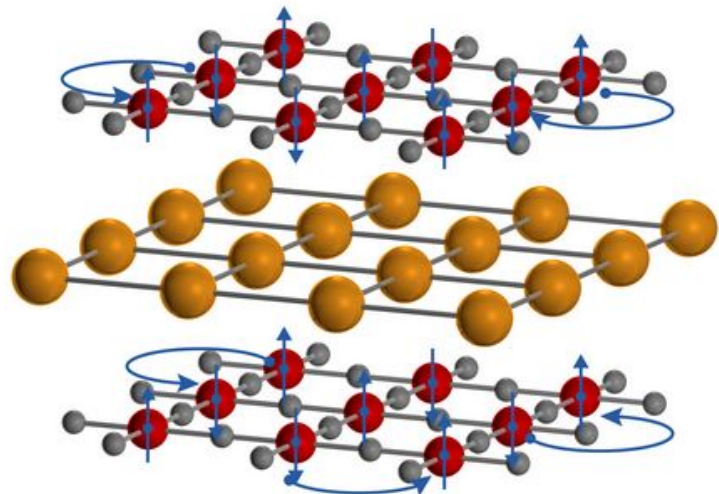
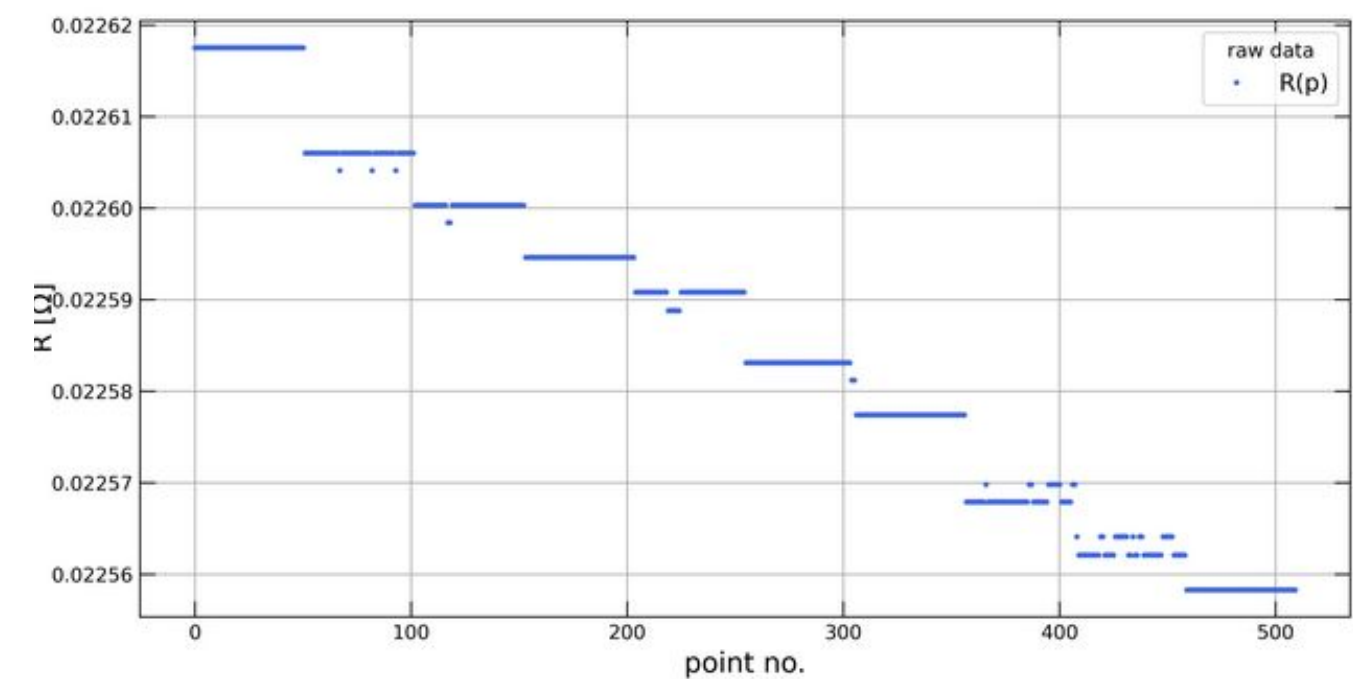
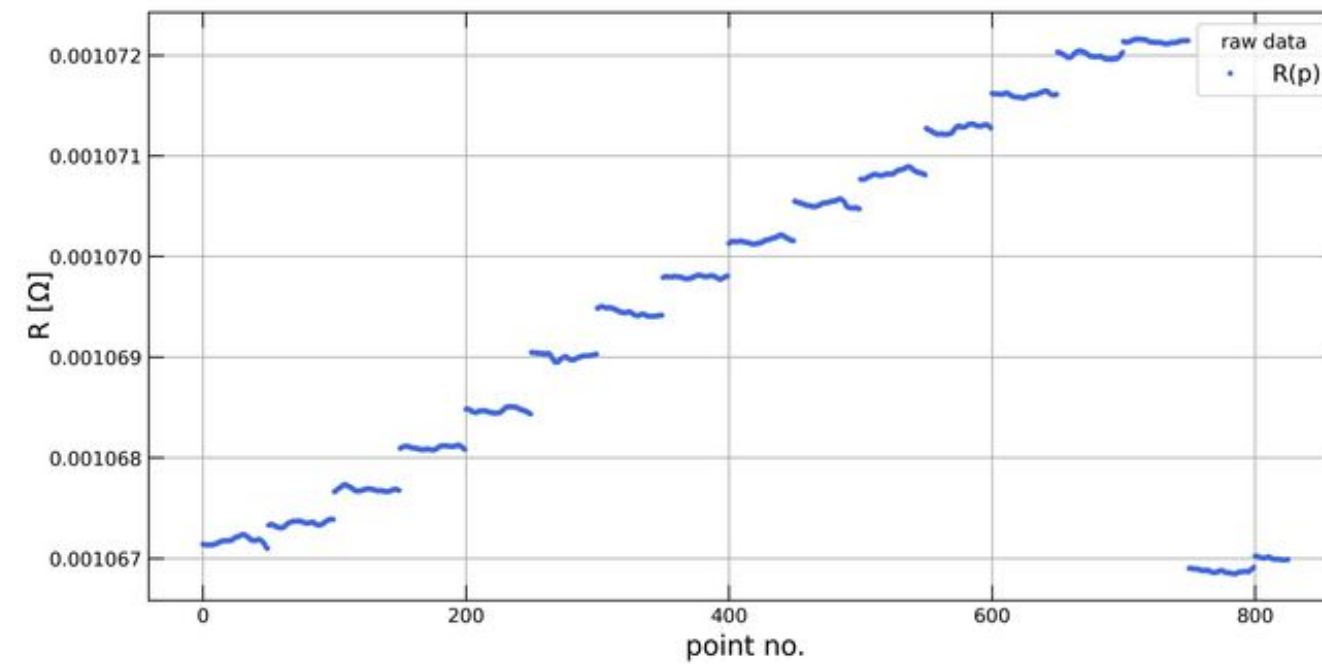
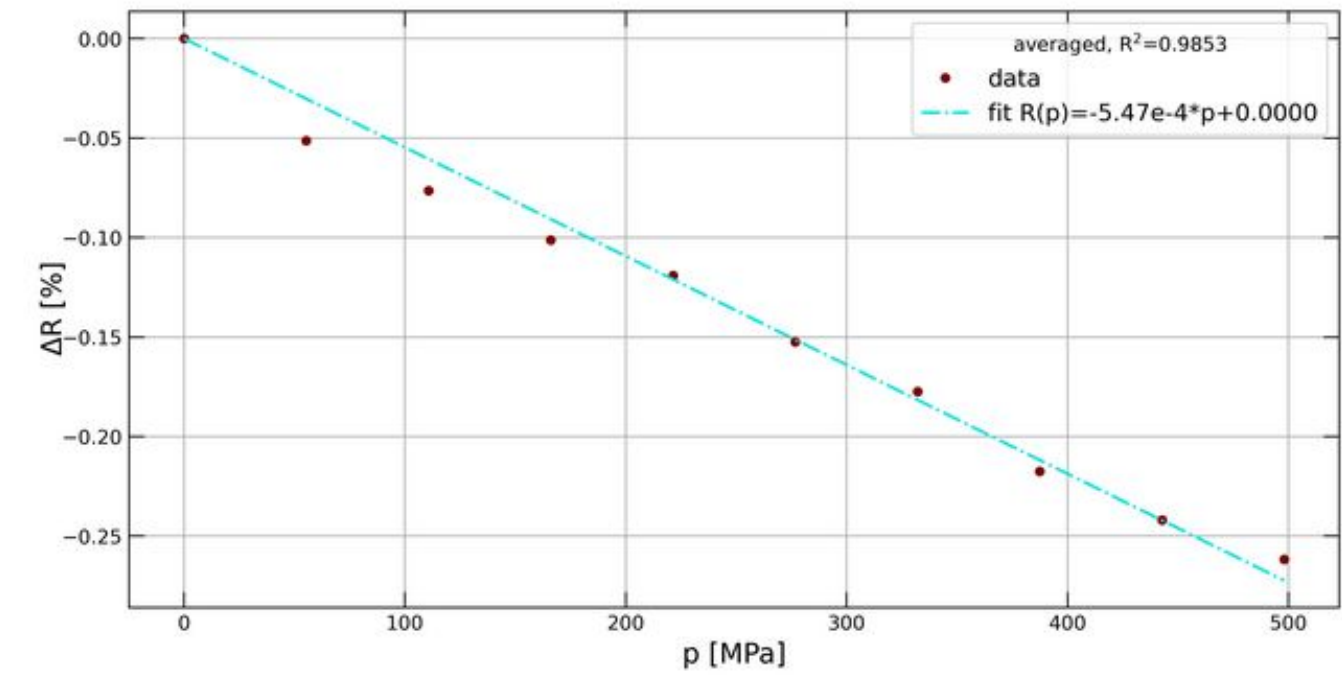
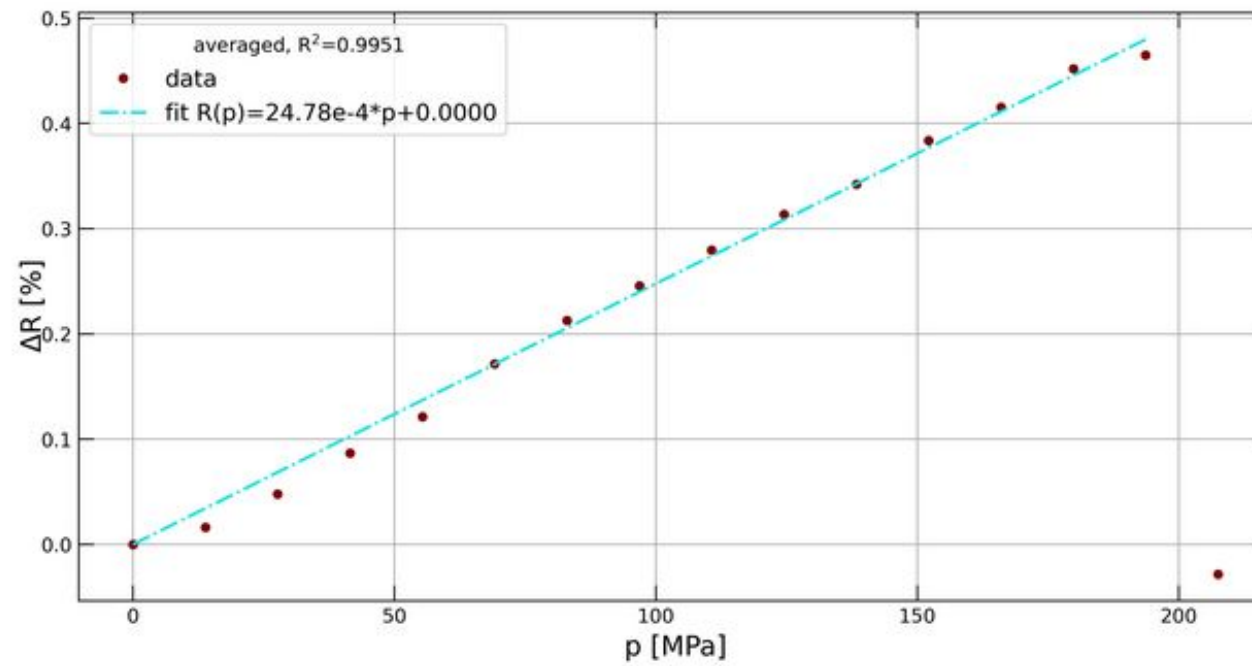


up to 180 degrees,
every 20 degrees

$k = 2.767 \text{ MPa/deg}$



SUMMARY



Cuprates with the same defects, when subjected to compression and expansion, generate completely different results.

The obtained results illustrate the influence of symmetry breaking on electronic properties.

The background image shows a close-up of a metal plate with several circular holes. A clear plastic ruler is placed vertically on the right side of the plate, with markings in centimeters and millimeters. A silver-colored bolt is positioned horizontally across the ruler, with its head on the right and its threaded shaft extending to the left. The text "Thank you!" is overlaid on a semi-transparent grey rectangular box in the center-left of the image.

Thank you!