



Manufacture of nanopositioners for scientific and industrial applications

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Objective

- ▶ Manufacture a nanopositioner with innovative design at a low cost, that besides being able to position samples in 3 dimensions with high resolution, can act in conditions of low temperature and ultra high vacuum.

What is a nanopositioner?

- ▶ Piezoelectric nanopositioners consist of a mechanical structure moved by a piezoelectric ceramic.
- ▶ This effect is due to an electric voltage capable of generate the movement.

Applications

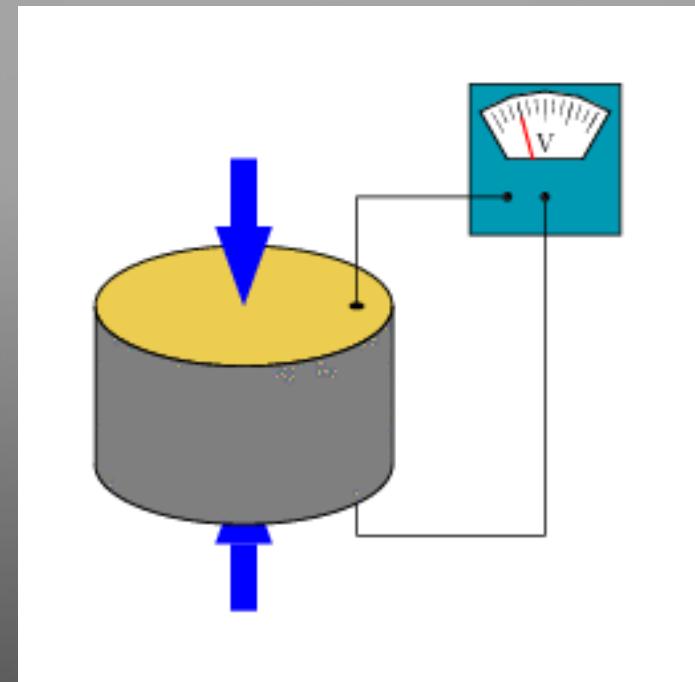
- ▶ tip microscope (atomic force, tunneling).
- ▶ Confocal microscope (study of biological systems).
- ▶ Optical tweezers, nanofabrication, study of the mechanical properties of nanowires (promising applications).

Piezoelectricity

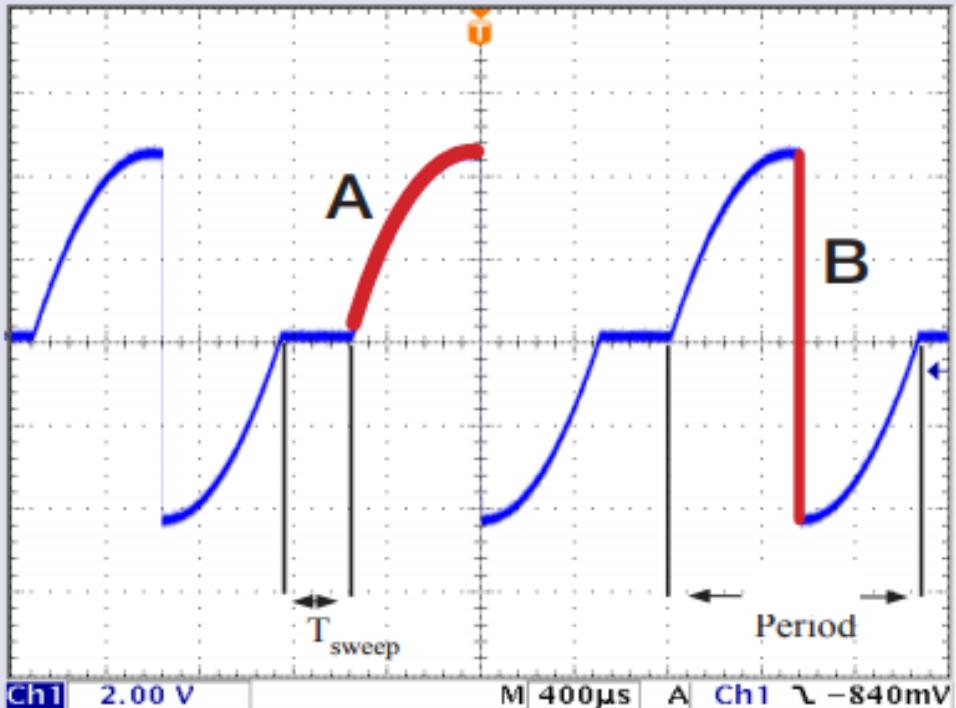
- ▶ The ability of a crystal to generate electrical voltage with in response to a mechanical stress.

Can be:

- ▶ Direct
- ▶ Reverse

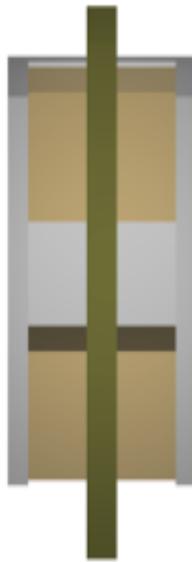


Operation principle



- ▶ A
Gradual increase
of tension (piezo
expands)
- ▶ B
Rapid change in
tension (piezo
contraction)

Operation principle



(1)



(2)



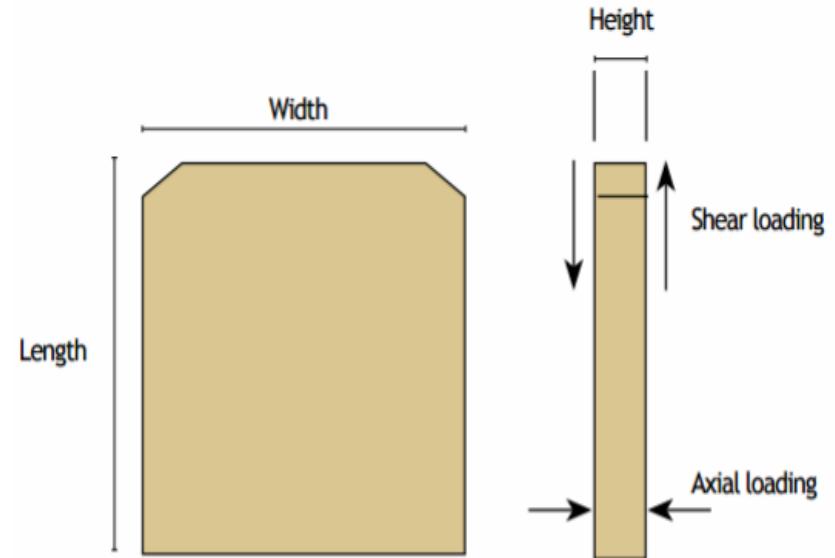
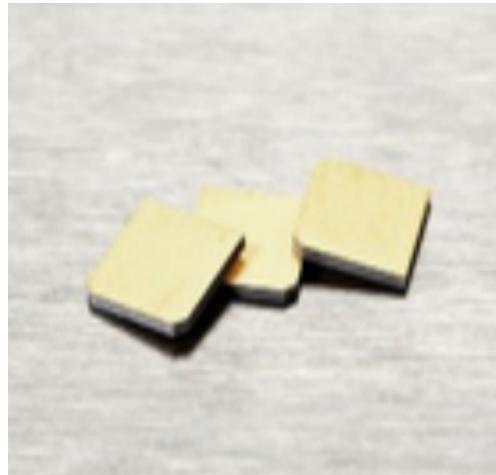
(3)

In “1” piezo is in relaxed form.

In “2” piezo is deforming.

In “3” piezo returns to relaxed form..

The Shearpiezo



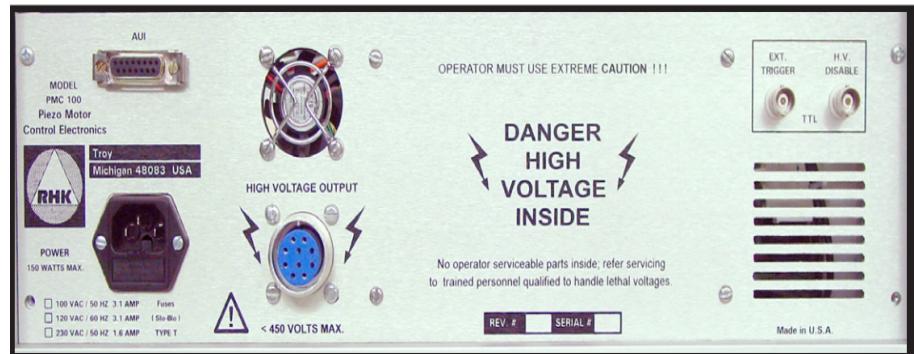
Shearpiezo CSAP03
of Noliac with dimensions
10x10x0,5 mm and provides a
free stroke of 1.5 μm and a
capacitance of 3321 pF.



Methodology

- ▶ Design a functional and workable design.
- ▶ Manufacture the positioner in the machine manufectury.
- ▶ Couple the piezos and ceramics.
- ▶ Perform calibration and testing.
- ▶ Test in the microscope STM.

Methodology



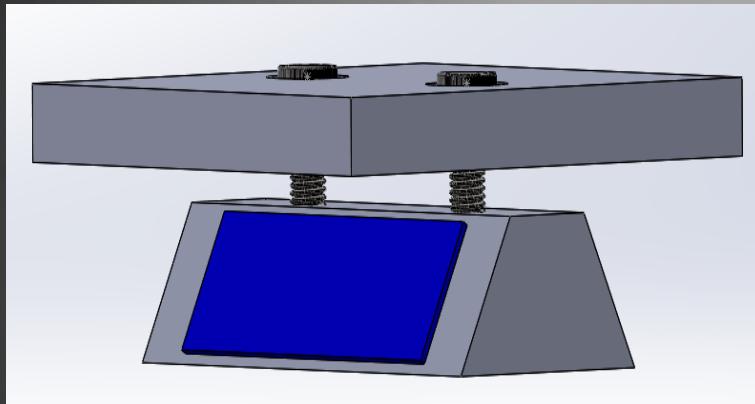
(Eletronic)

Methodology

optical microscope

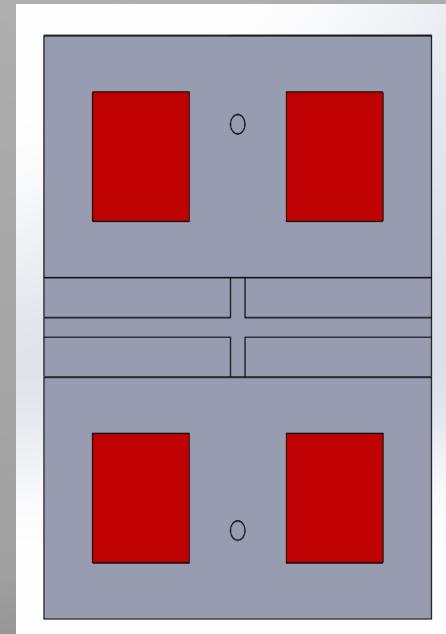
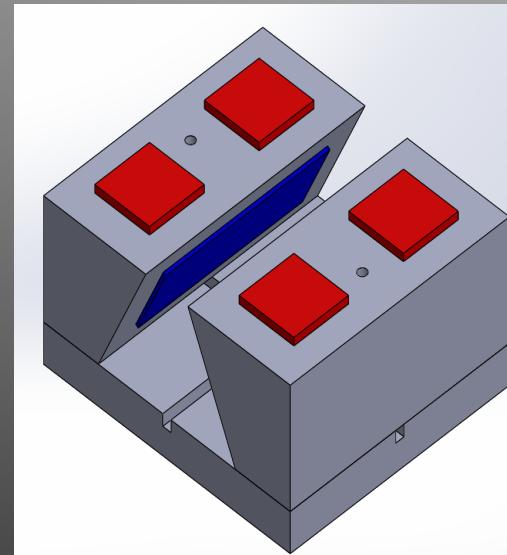


RESULTS

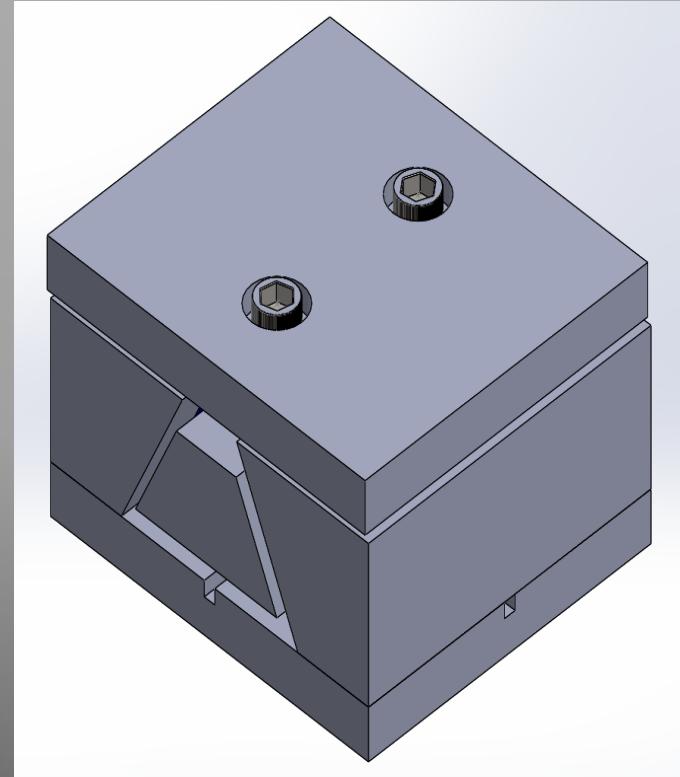
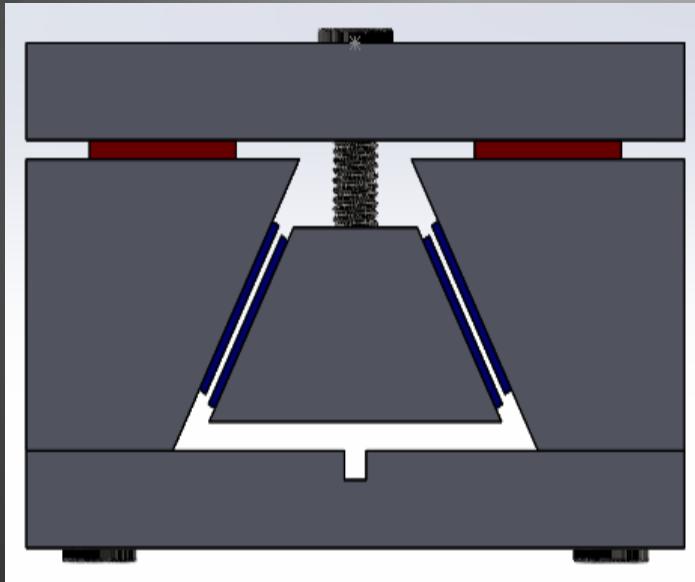


In blue- ceramic

In red- piezo



RESULTS



Conclusion

- ▶ In the first step, a design capable of moving samples in one dimension or up to 3 dimensions(when two or more positioners are coupled), was generated.
- ▶ The positioner is in the process of manufacturing, and is expected to be finalized in 2017.

Perspectives

- ▶ Finish production and all tests by March 2018.
- ▶ Two prototype designs of other designs are ready and being evaluated.
- ▶ The goal would be to reduce the overall weight and measures of the device, when operated in more dimensions.