

Calibration Of Nano- And Pico- Meter Range Displacement Measures With Static Measures

Authors: P. Luskinovich, V. Zhabotinsky, S. Rudas, A. Dikov, A. Shavykin.

Introduction

Displacement measures are based on high-voltage driven lithium niobate (LiNbO_3) monocrystals. Material is known to show a linear behavior without significant drift and is considered to be largely hysteresis-free when voltage ramps are applied.

Available both vertical and horizontal (expansion in one lateral direction).

No need in additional sensors: compact design that fits most installations. May function as a metrological tool for calibration of various equipment



Displacement measure

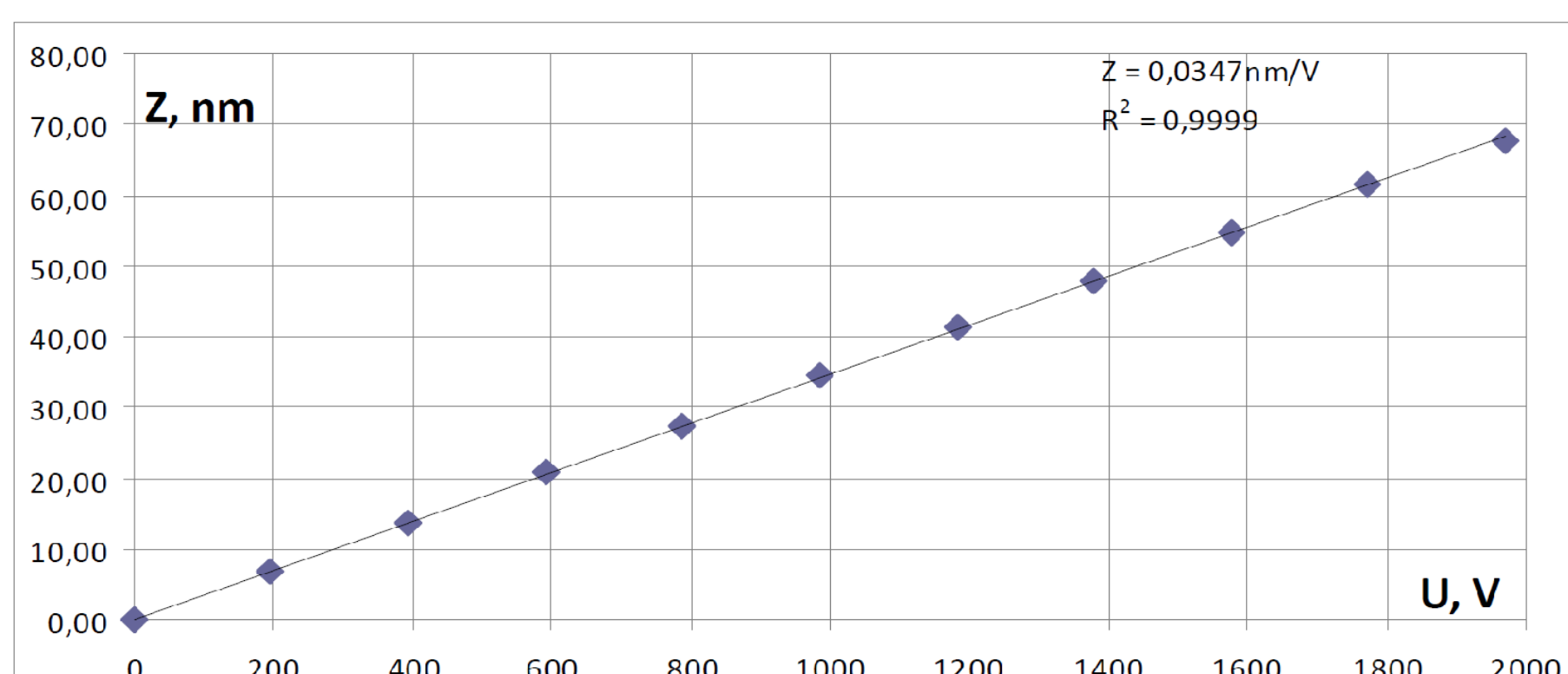


Electronic control system

Depending on the amount or direction of displacement required, measures are made by assembling one or several crystals.

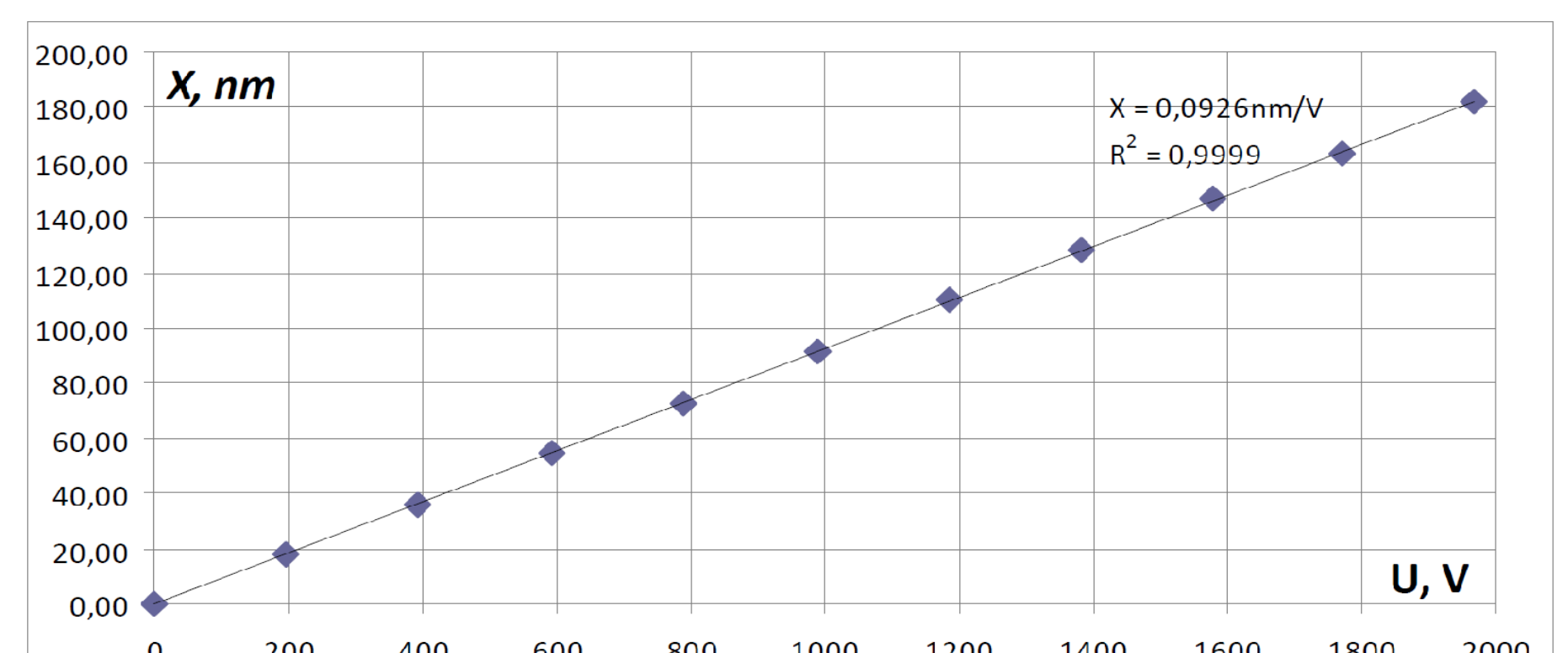
Durability to external mechanical and climatic influences allows usage in different external conditions, including outside vacuum systems and clean rooms.

Characterization of vertical measures

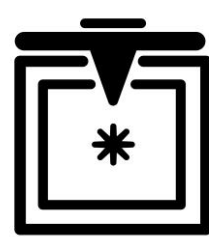


Displacements in vertical direction up to 120 nm
 Linear regression coefficient: $R = 0.99980$ to 0.99999

Characterization of horizontal measures

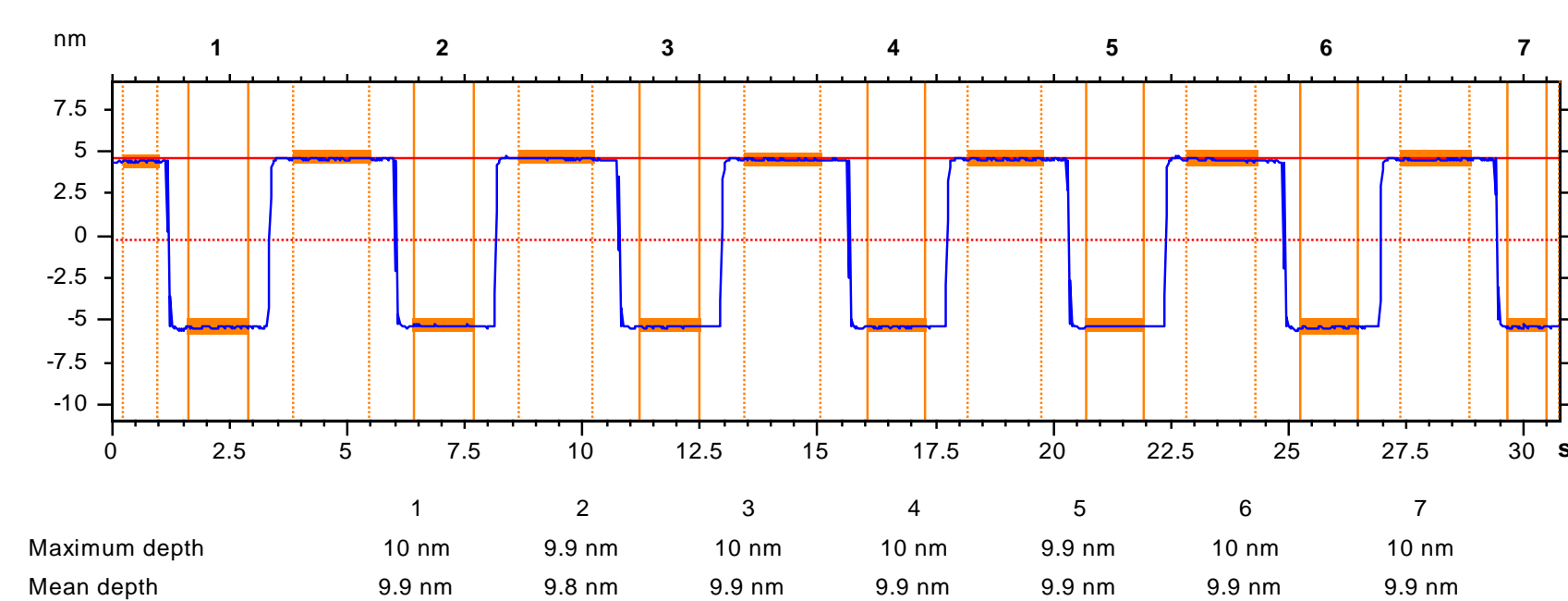


Displacements in horizontal direction up to 600 nm
 Linear regression coefficient: $R = 0.99900$ to 0.99994

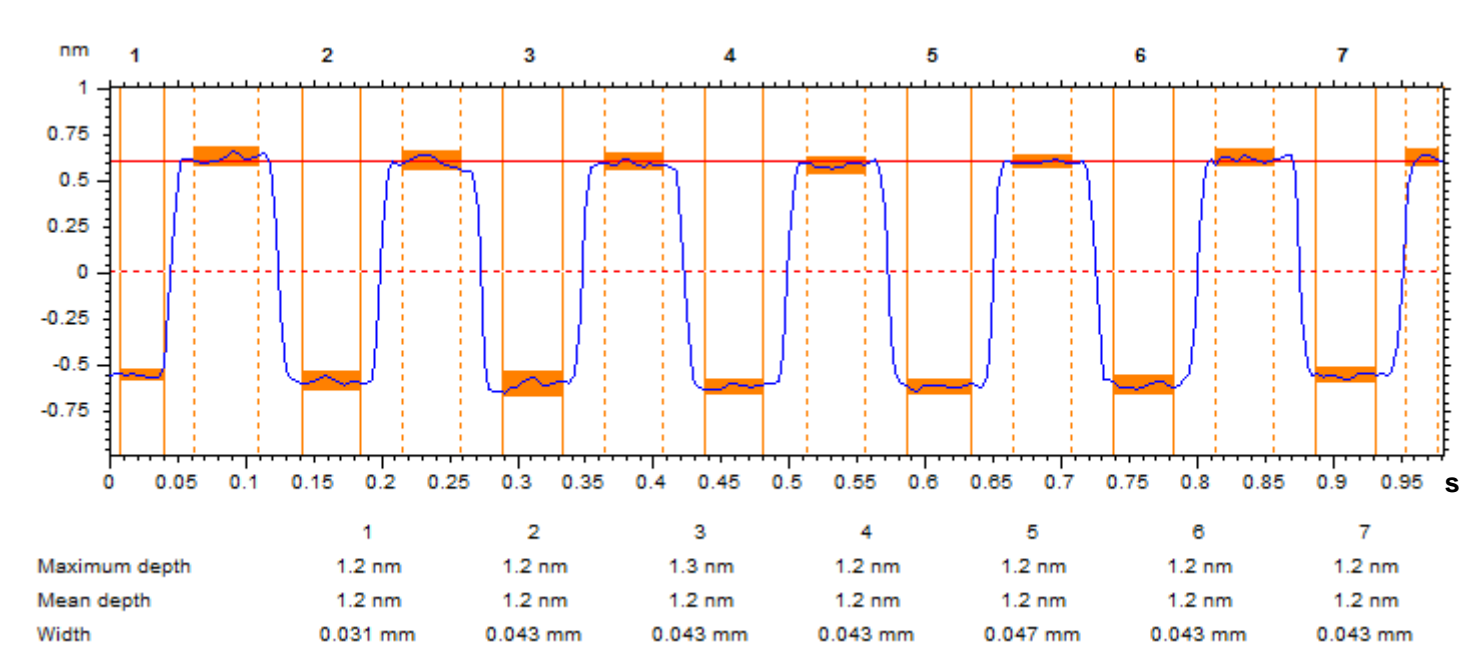


Measuring results

10 nm

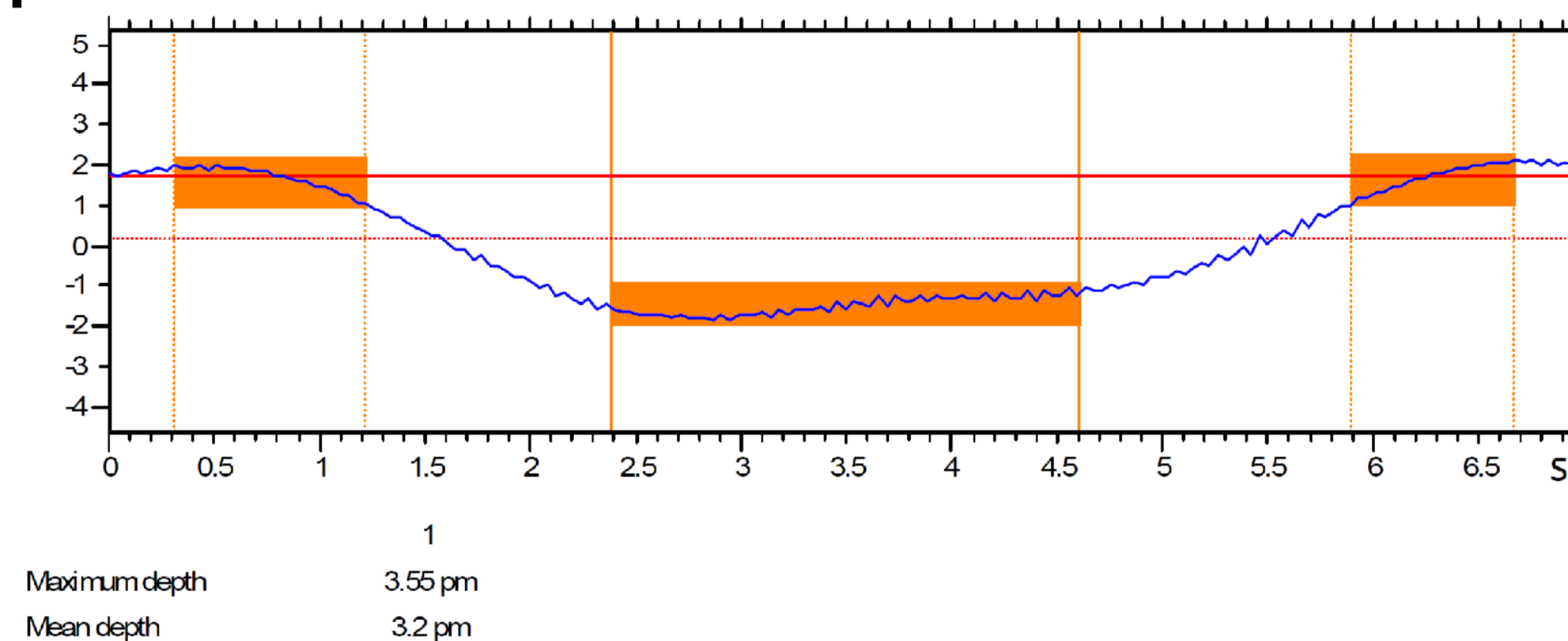


1 nm

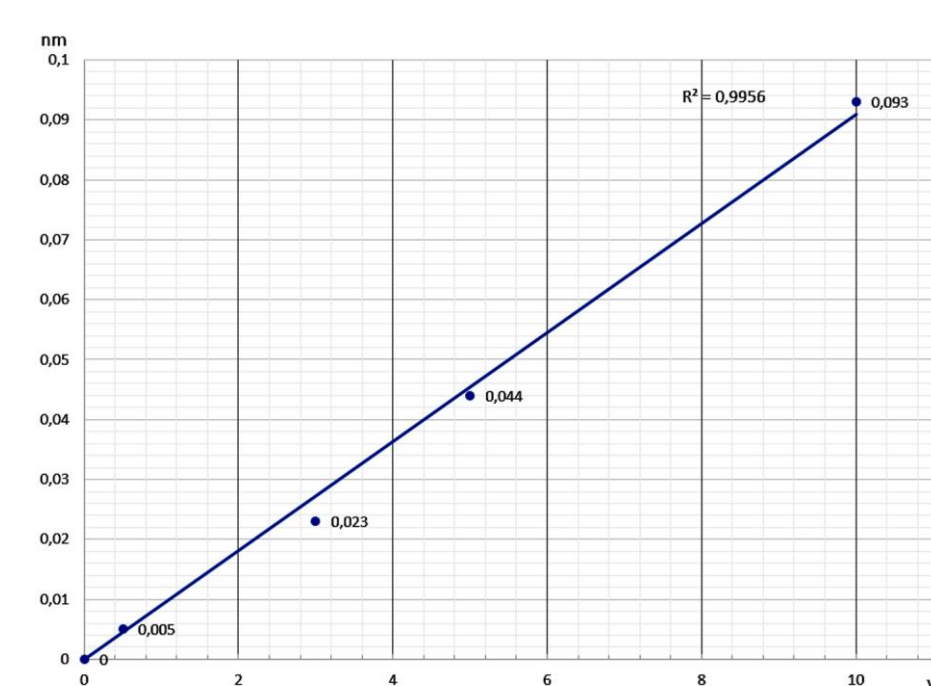


Displacements with amplitude of 3.2 picometers,
achieved by method of averaging

pm

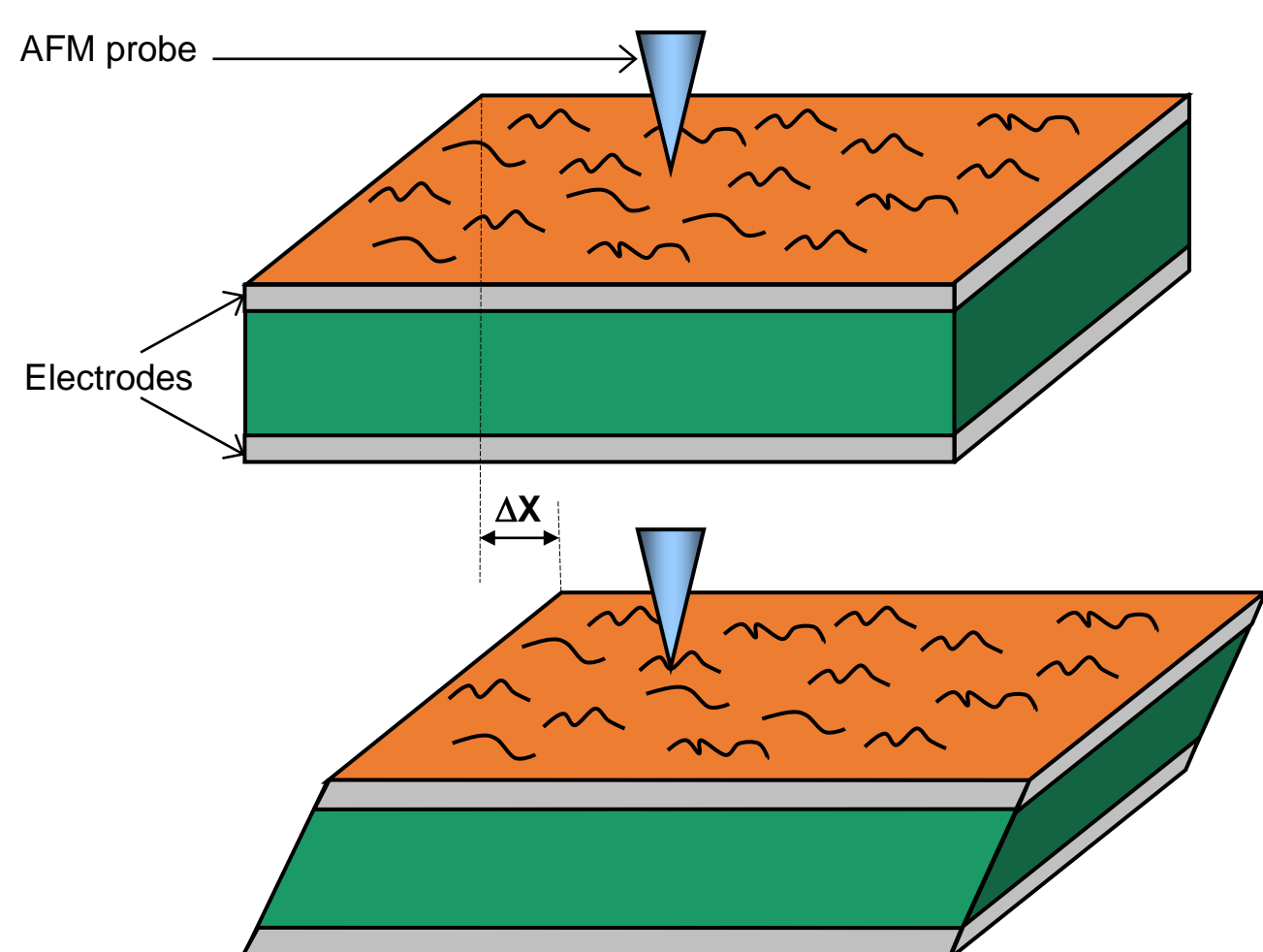


Experimental results of measuring the linear
dependence in picometer range

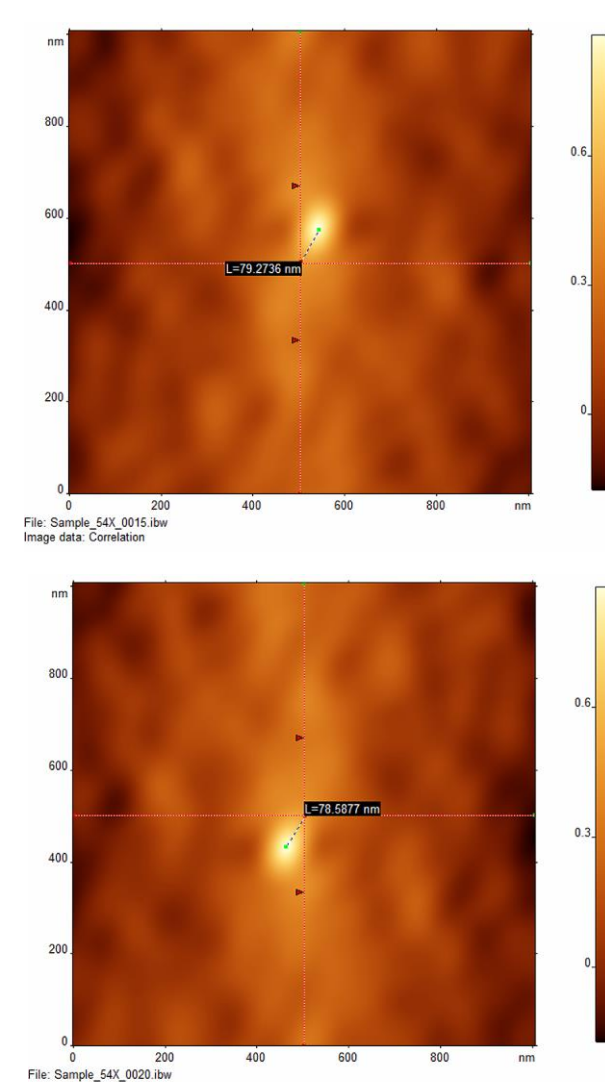


Calibration of displacement measures with static measures

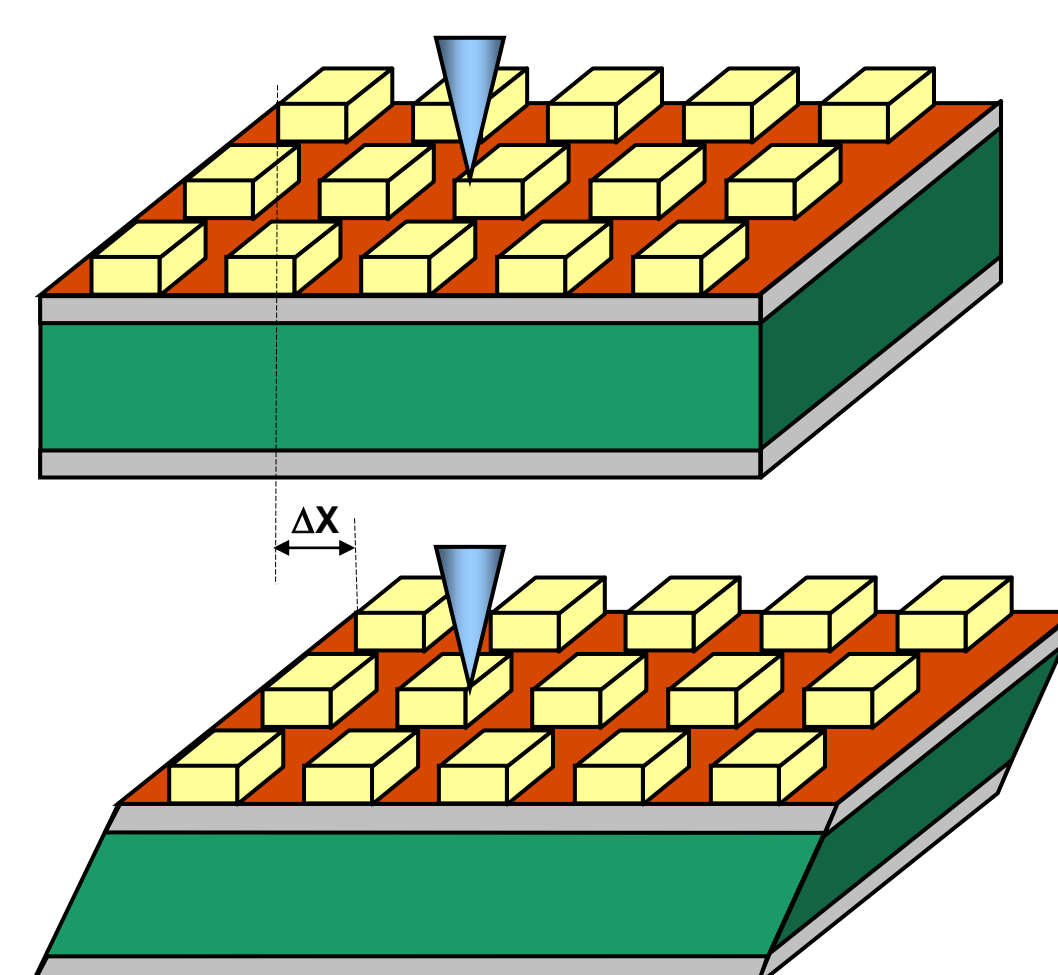
Rough surface



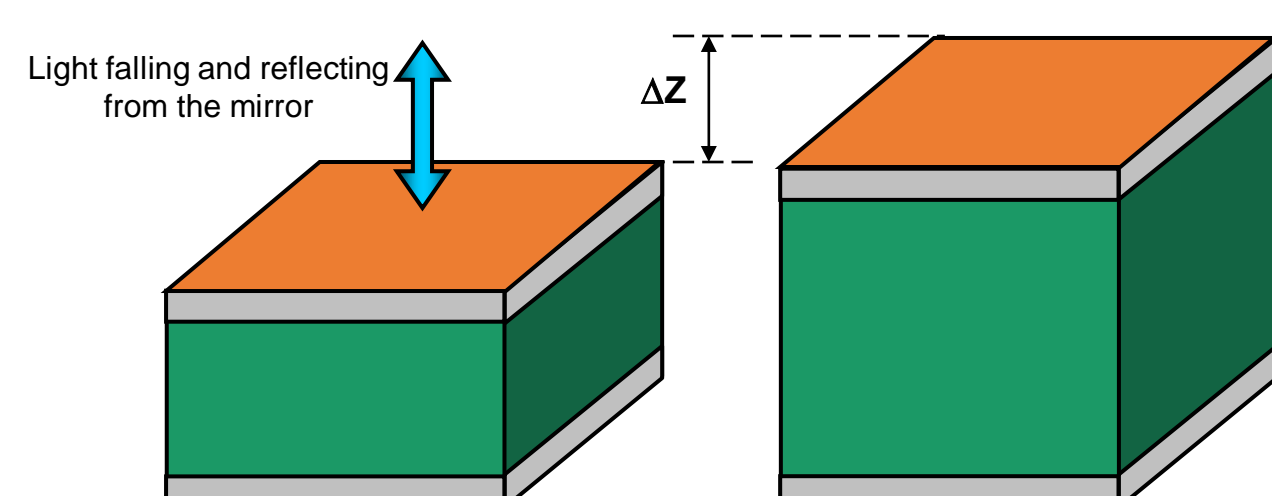
Rough surface displacement



Calibrated surface displacement



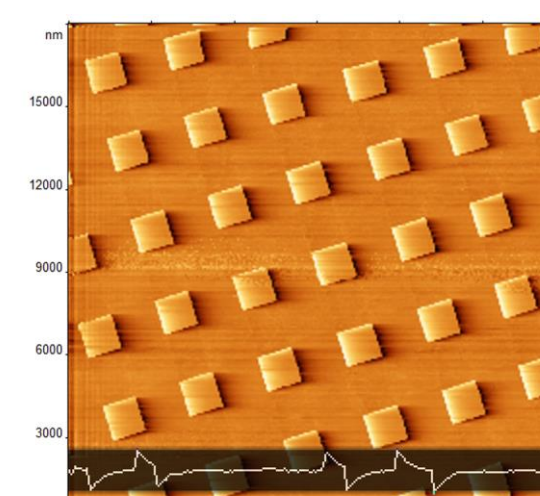
Flat surface displacement



Flat surface in case



Standard calibrated surface



Conclusions

The presence of displacement measures and static measures makes it possible to calibrate displacement measures without interacting metrological centers and provides their unlimited lifespan.