Увидеть невидимое

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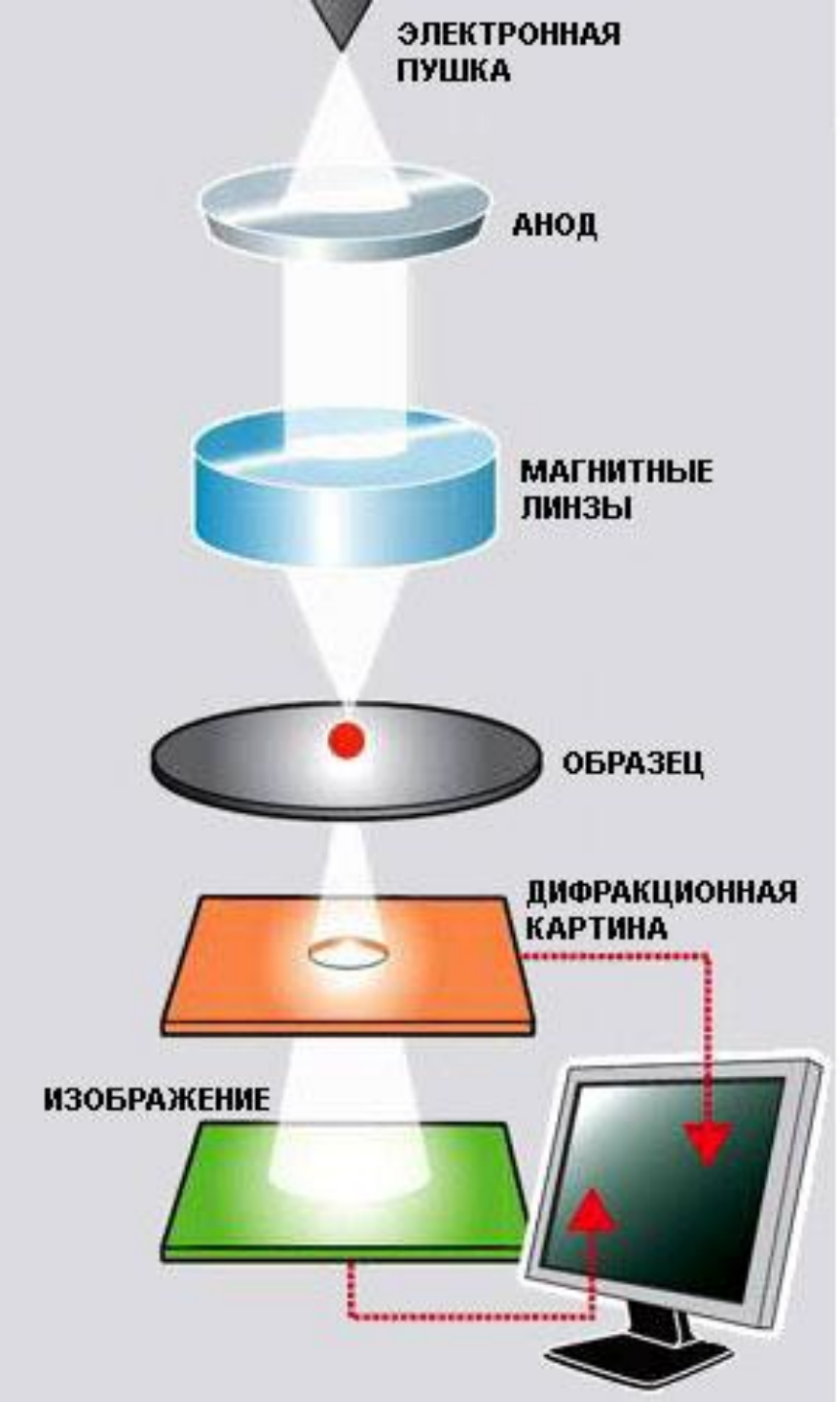
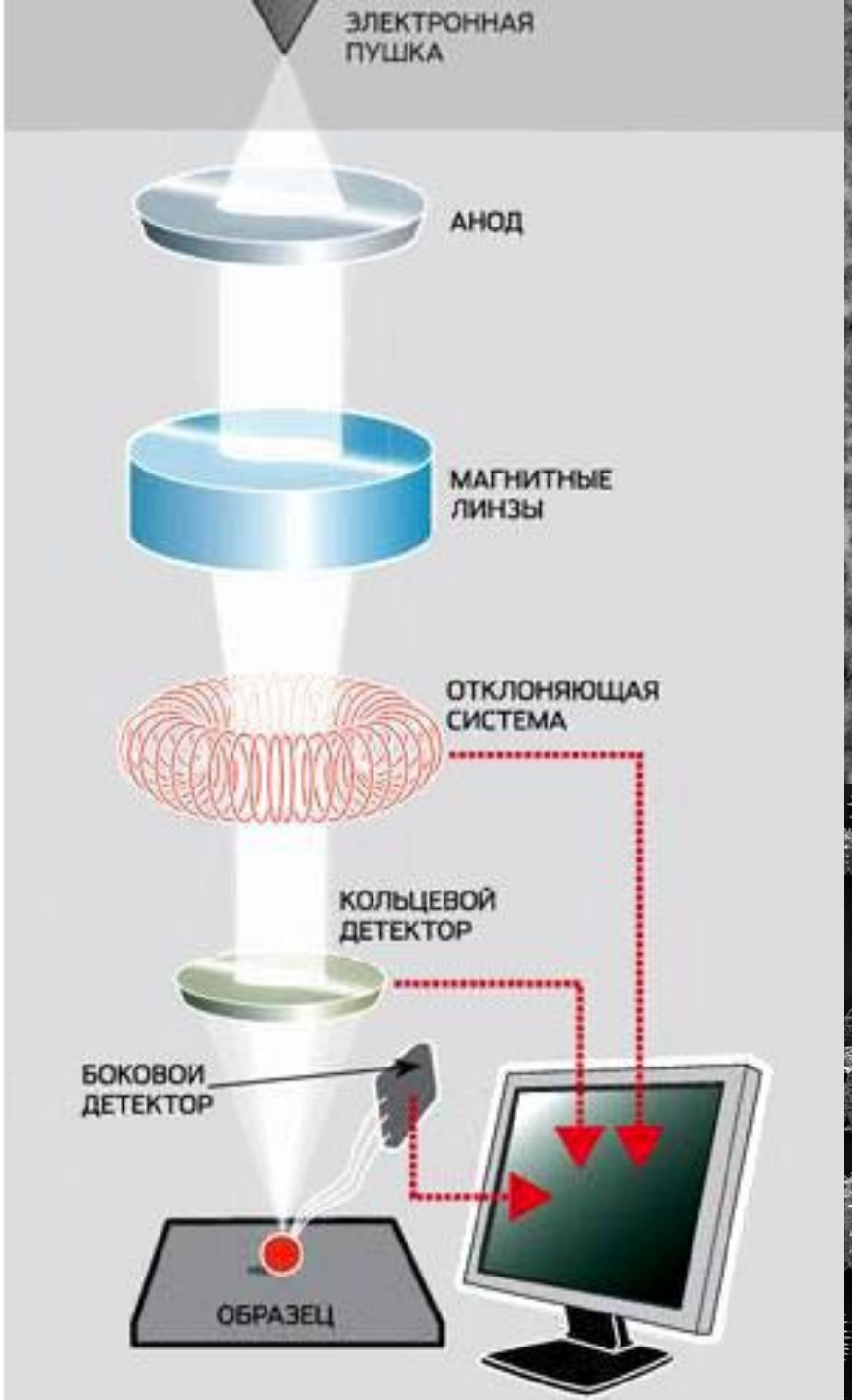
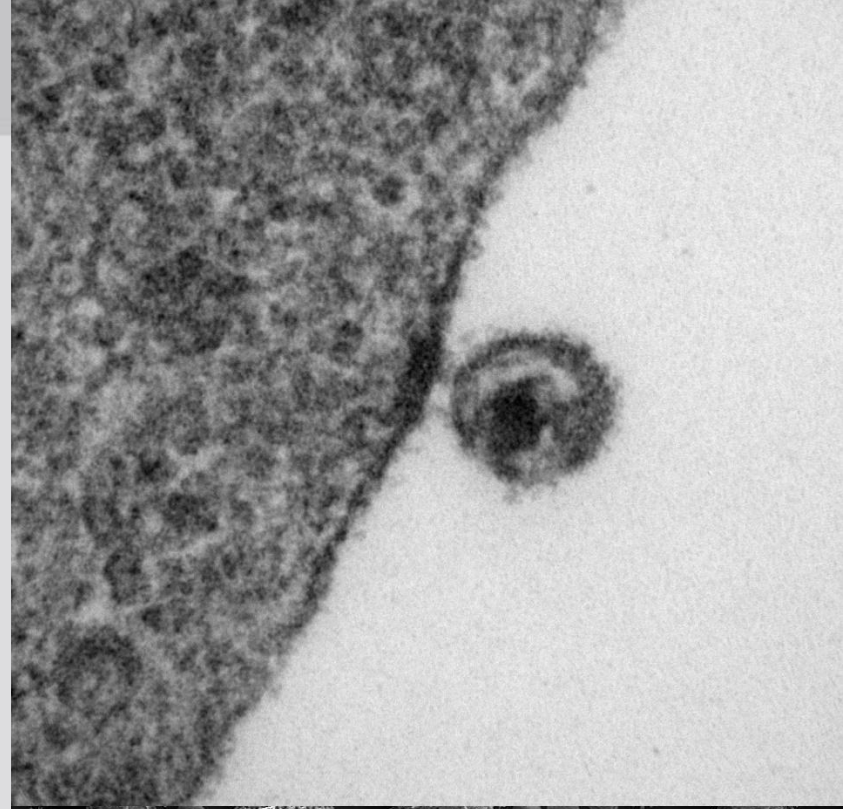
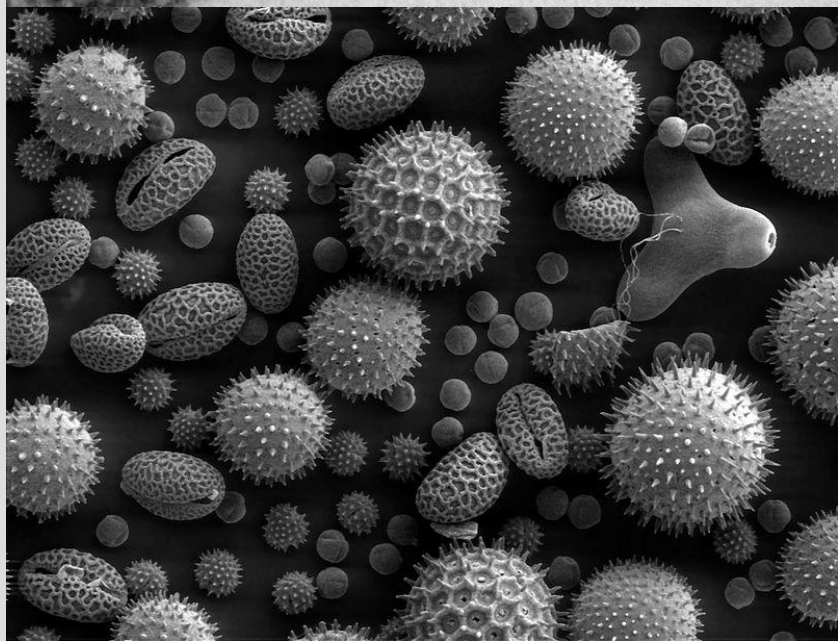
Увидеть невидимое

- Как можно увидеть, что происходит внутри живого
- Как можно увидеть бактерии, вирусы, отдельные белки
- Как работают биомолекулы

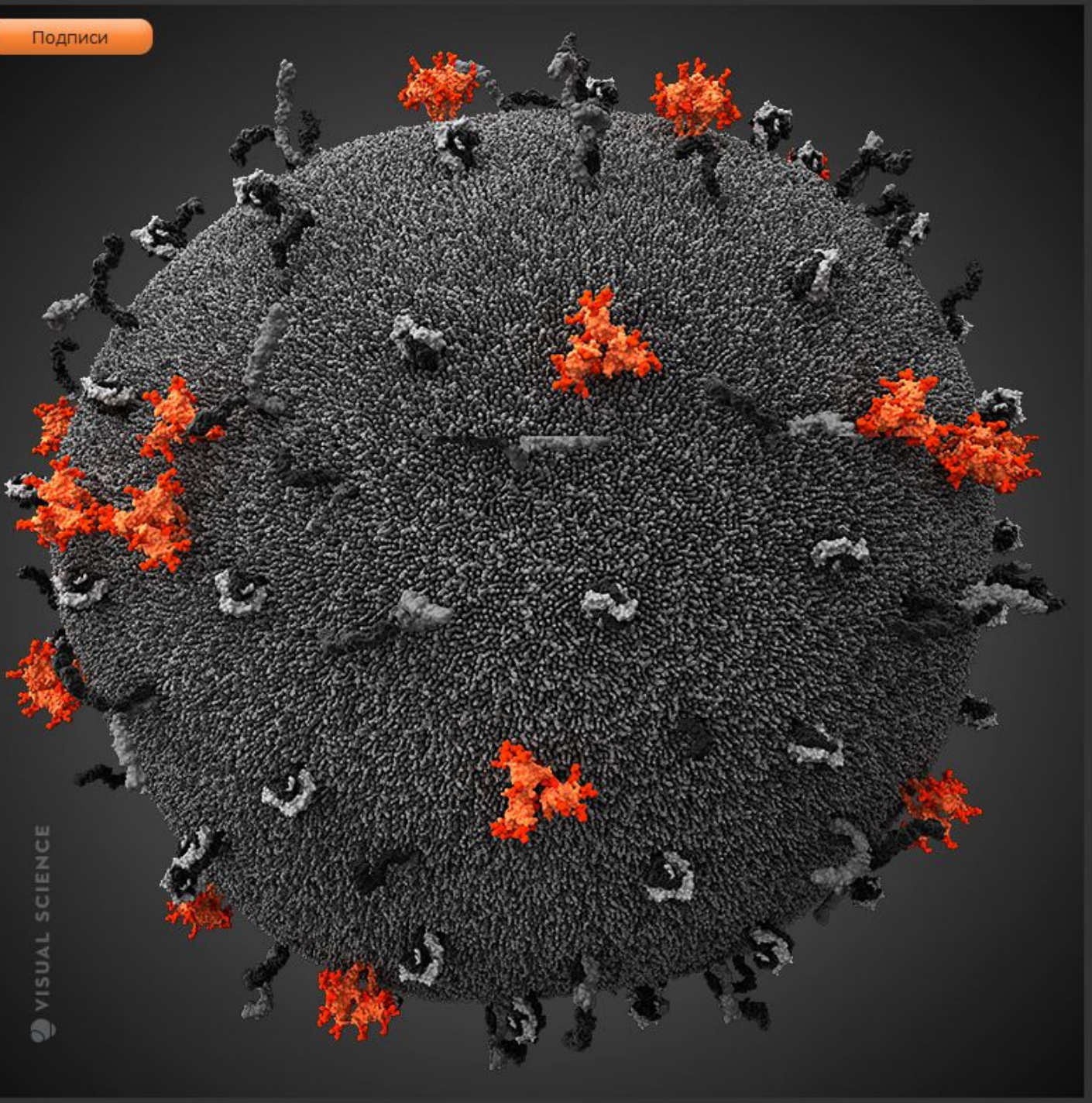

ЭЛЕКТРОННАЯ ПУШКА
АНОД
МАГНИТНЫЕ ЛИНЗЫ
ОБРАЗЕЦ
ДИФРАКЦИОННАЯ КАРТИНА
ИЗОБРАЖЕНИЕ

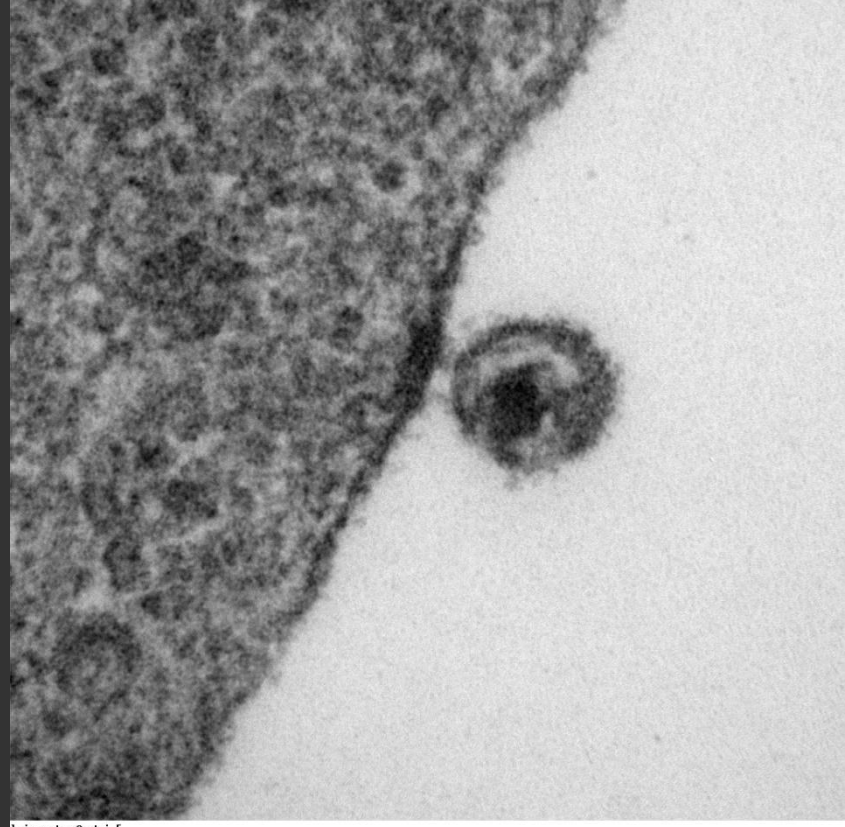

ЭЛЕКТРОННАЯ ПУШКА
АНОД
МАГНИТНЫЕ ЛИНЗЫ
ОТКЛОНЯЮЩАЯ СИСТЕМА
КОЛЬЦЕВОЙ ДЕТЕКТОР
БОКОВОЙ ДЕТЕКТОР
ОБРАЗЕЦ





Подписи



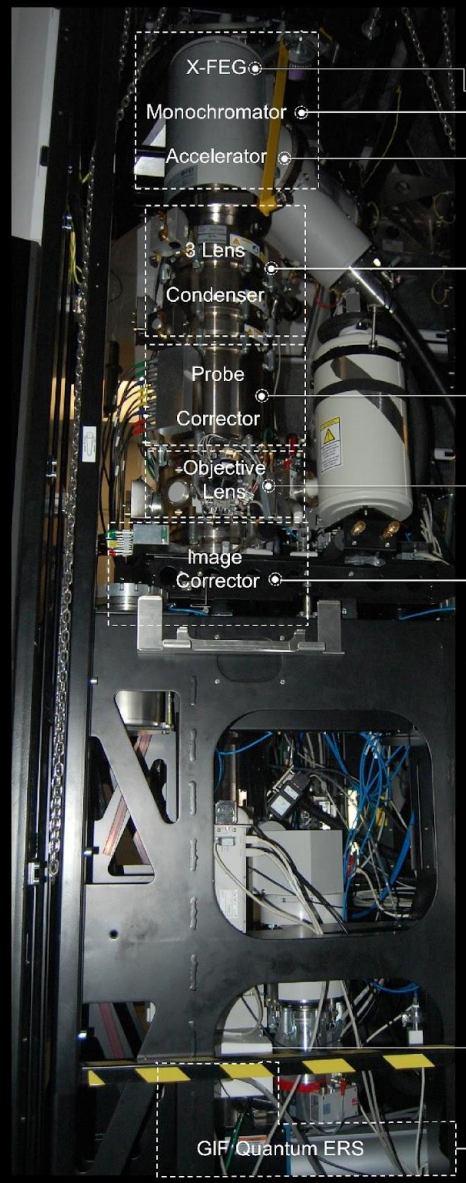


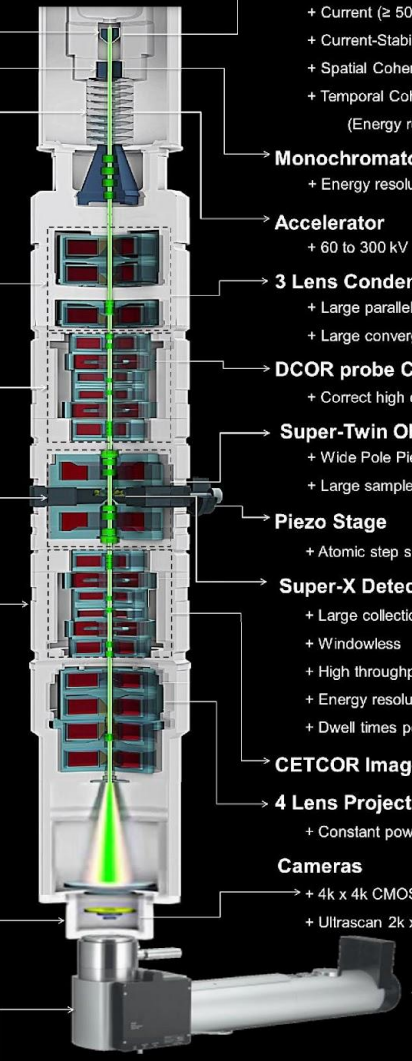
hiv-tc2.tif
HIV-TC145kXtecnai20
bio46
Print Mag: 224000x @ 7.0 in
16:14 10/31/06
Microscopist: Louisa

100 nm
HV=100kV
Direct Mag: 145000x
X:174.603 Y: 32.357 T:0.01
AMT Camera System

Aberration Corrected (Scanning) Transmission Electron Microscope (S/TEM)

FEI Titan Themis^3





Extreme Field Emission Gun (X-FEG)
- + Brightness (≥ 7×10^7 A/m^2 sr V)
- + Current (≥ 50 nA before monochromator)
- + Current-Stability (≤ 1 % over 7 days)
- + Spatial Coherency
- + Temporal Coherency

(Energy resolution at 300 kV without monochromator ≤ 0.8 eV)

Monochromator
- + Energy resolution at 300 kV ≤ 0.2 eV

Accelerator
- + 60 to 300 kV

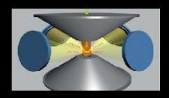
3 Lens Condenser
- + Large parallel illumination range in TEM (from nm to µm)
- + Large convergence angle range in STEM

DCOR probe Cs corrector
- + Correct high order aberrations (3rd, 4th and 5th order aberrations)

Super-Twin Objective Lens
- + Wide Pole Piece Gap (5 mm)
- + Large sample tilt range (± 70°)

Piezo Stage
- + Atomic step size in x,y,z (20 pm)

Super-X Detector (4 Silicon Drift Detectors)
- + Large collection angle (0.9 srad)
- + Windowless
- + High throughput rate (> 240 kcps)
- + Energy resolution (< 136 eV)
- + Dwell times per pixel down to 10 µs



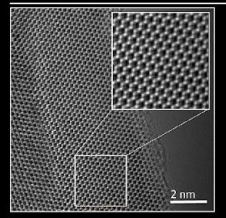
CETCOR Image Cs corrector

4 Lens Projector system
- + Constant power (high stability)

Cameras
- + 4k x 4k CMOS-based CETA camera
- + Ultrascan 2k x 2k CCD

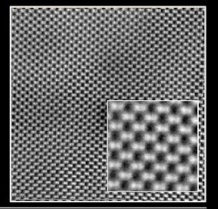
Gatan Image Filter Quantum ERS
- + High speed (1000 spectra per second)
- + Large EELS range (2000 eV)

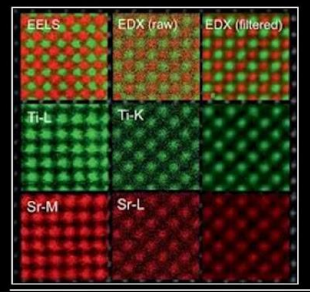
Application Highlights:



Atomic resolution TEM image of WSe_2 sheet at 80 kV.

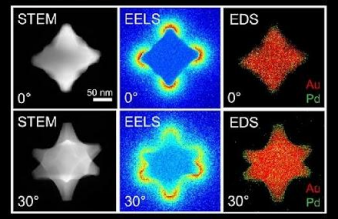
Atomic resolution STEM image of GaN in [112] orientation showing separation of GaN dumbells at 63 pm.

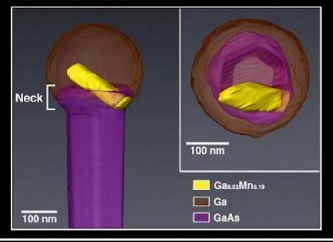




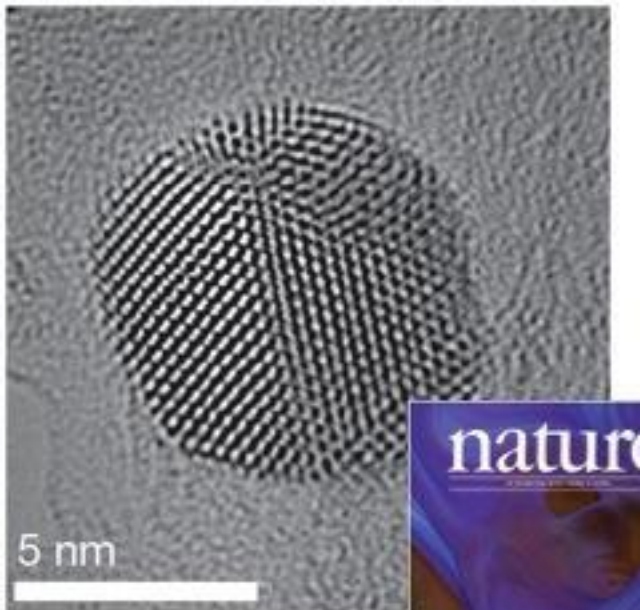
Atomic resolution chemical maps of $SrTiO_3$. Raw EELS and EDX data are shown in the first two columns for comparison.

STEM-EDX-EELS plasmonic study of Au/Pd octopods at different orientations.



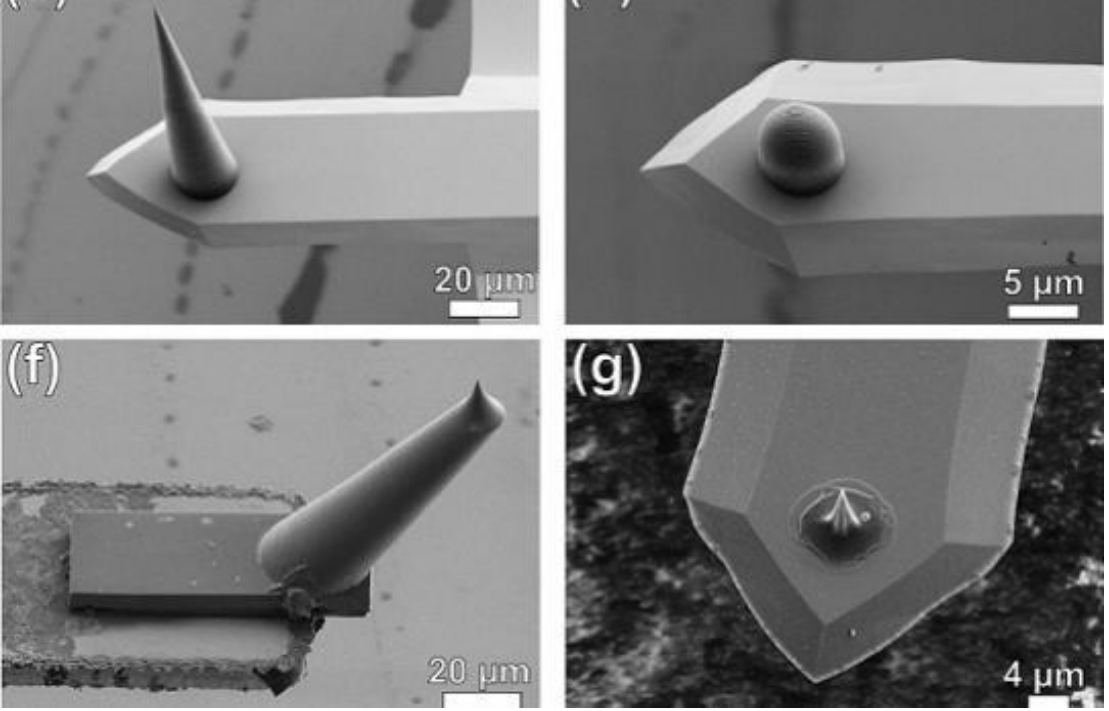


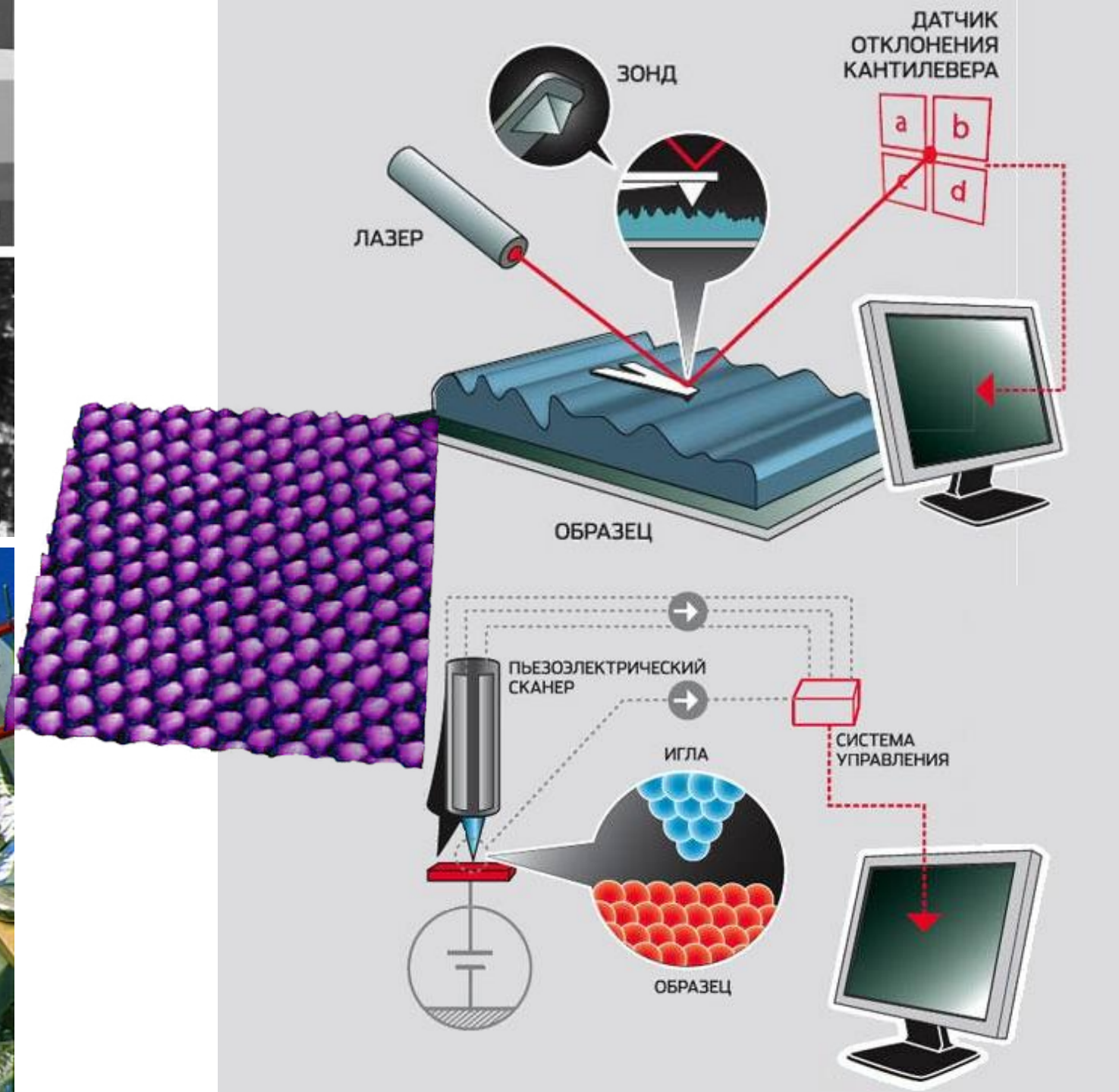
Isosurface visualization of an electron tomographic reconstruction of GaMnAs nanowire.

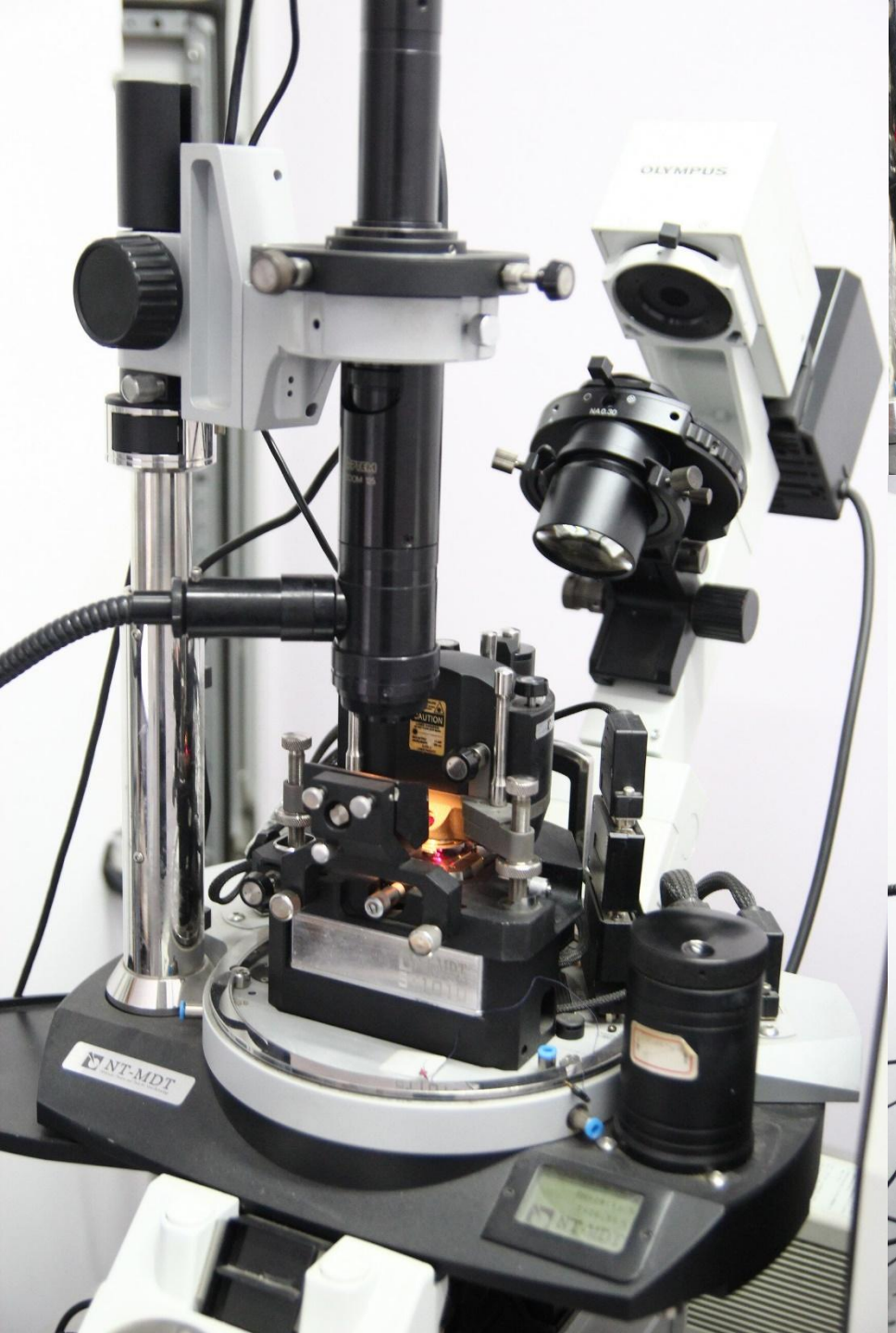


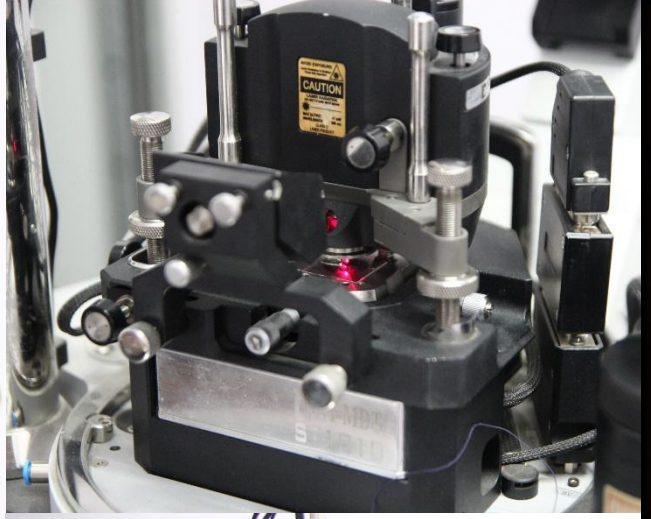
Rice University, Brockman Hall for physics, Room B05

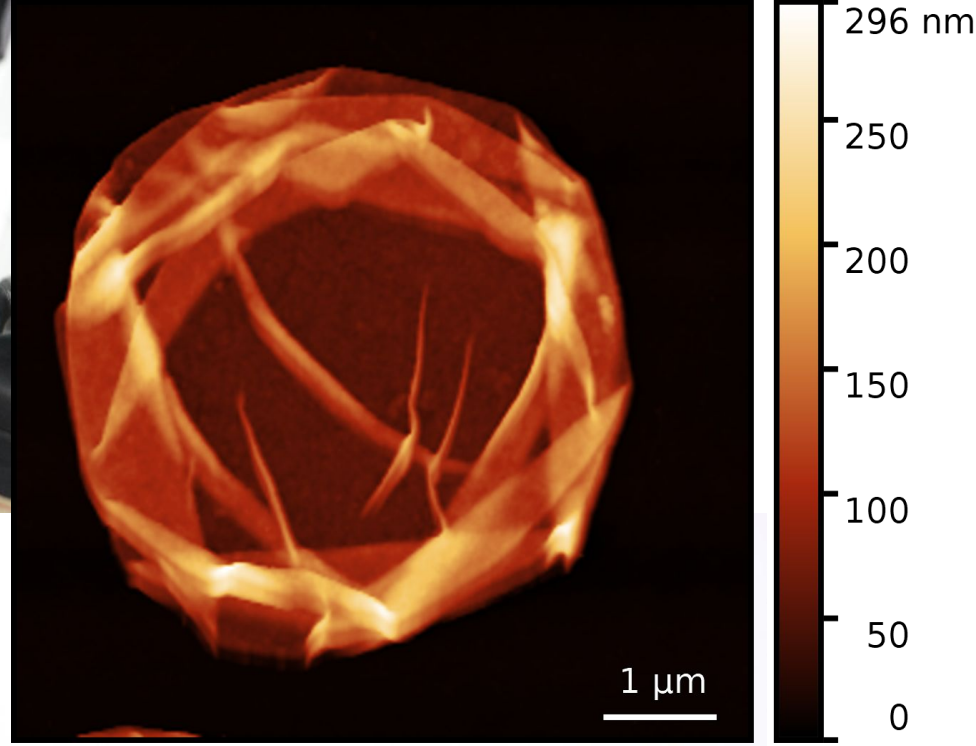
Email: sadegh.yazdi@rice.edu

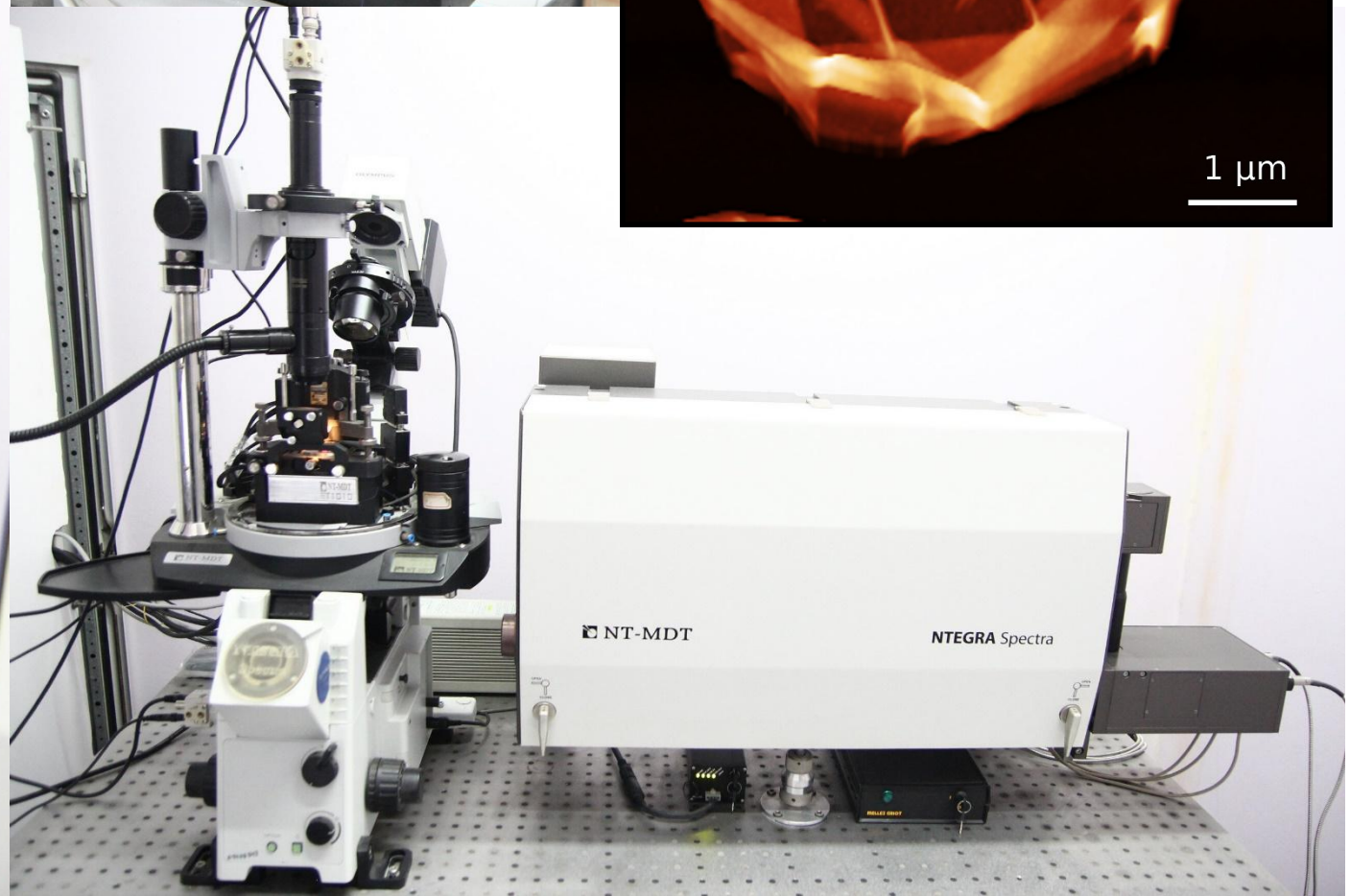

20 µm
5 µm
(f)
20 µm
(g)
4 µm

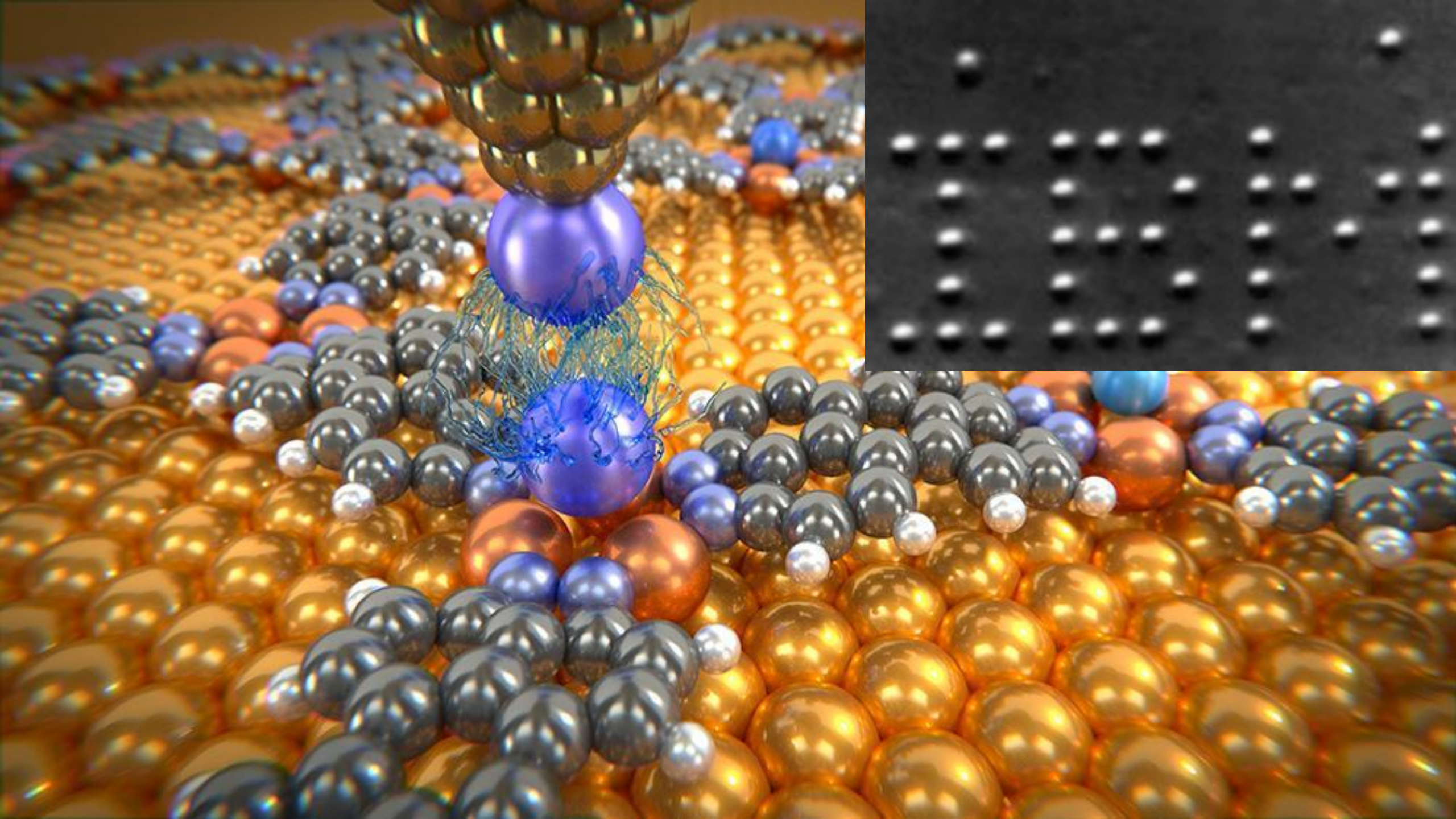

ДАТЧИК ОТКЛОНЕНИЯ КАНТИЛЕВЕРА
ЗОНД
a
b
c
d
ЛАЗЕР
ОБРАЗЕЦ
ПЬЕЗОЭЛЕКТРИЧЕСКИЙ СКАНЕР
СИСТЕМА УПРАВЛЕНИЯ
ИГЛА
ОБРАЗЕЦ


OLYMPUS
NT-MDT


CAUTION

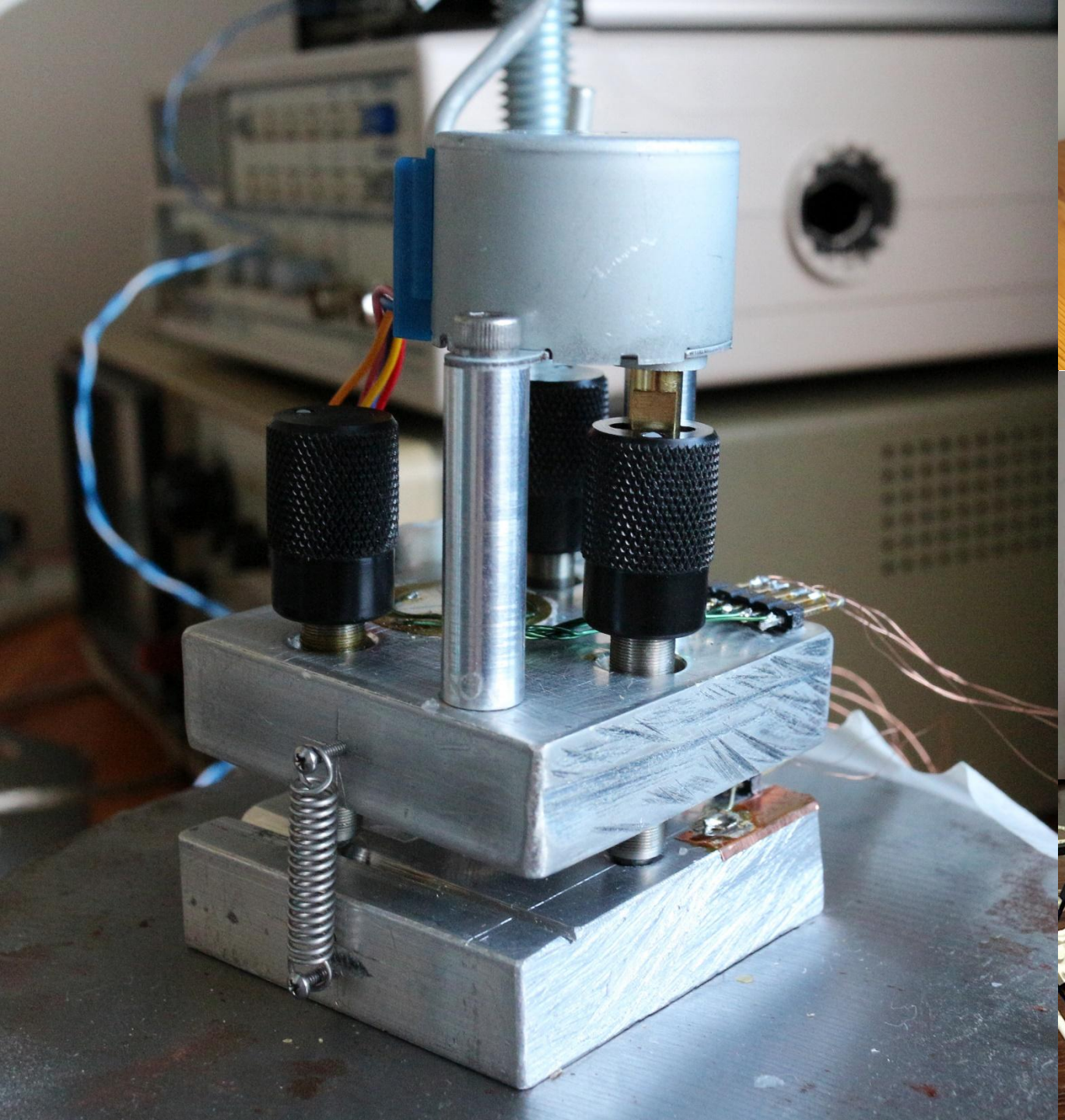

1 µm
296 nm
250
200
150
100
50
0

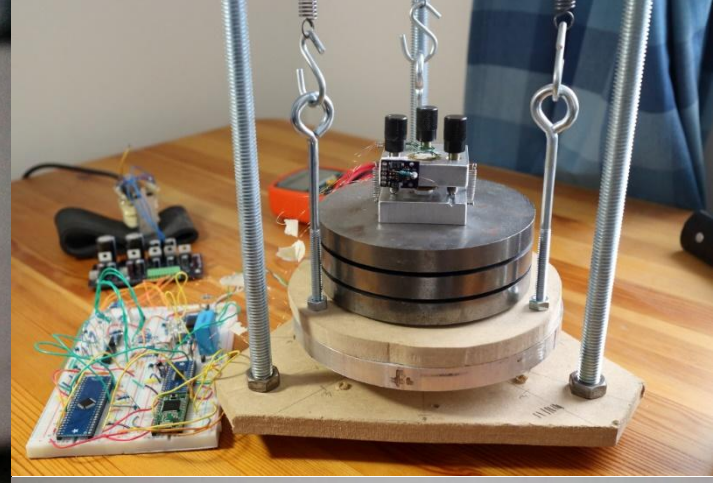

NT-MDT
NTEGRA Spectra

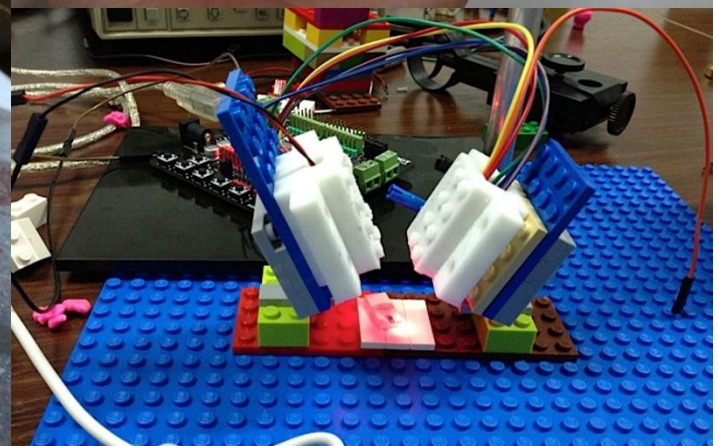


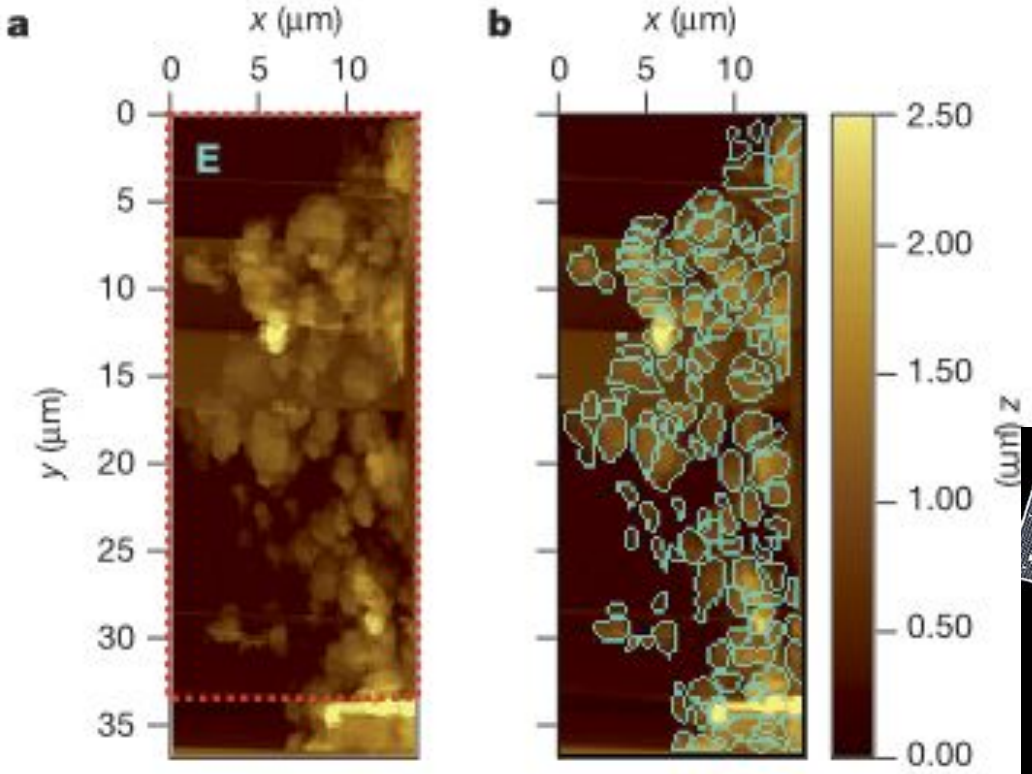
A Boy And His Atom: The World's Smallest Movie
ПОКАЗАТЬ ДРУГИЕ ВИДЕО
0:38 / 1:33
YouTube

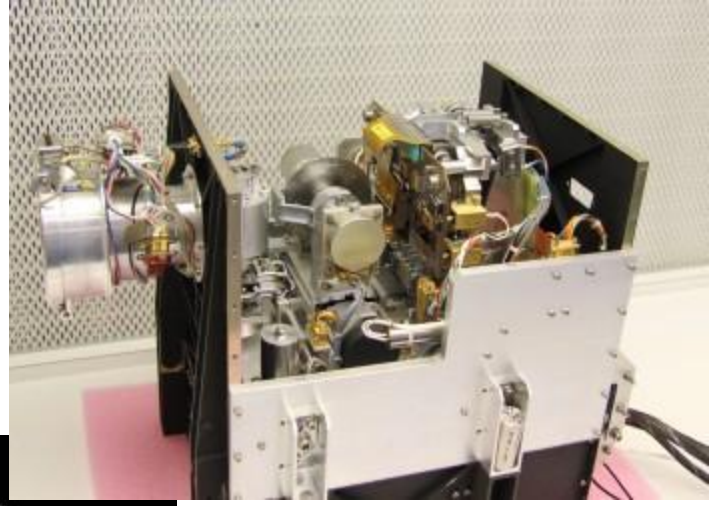
Moving Atoms: Making The World's Smallest Movie
ПОКАЗАТЬ ДРУГИЕ ВИДЕО
3:23 / 4:55
YouTube

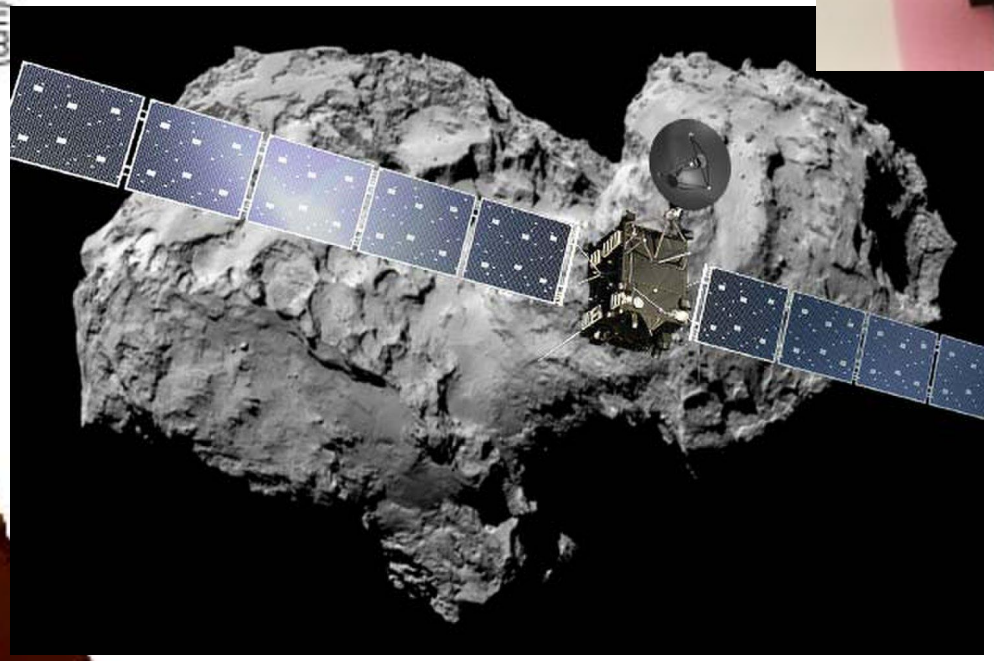


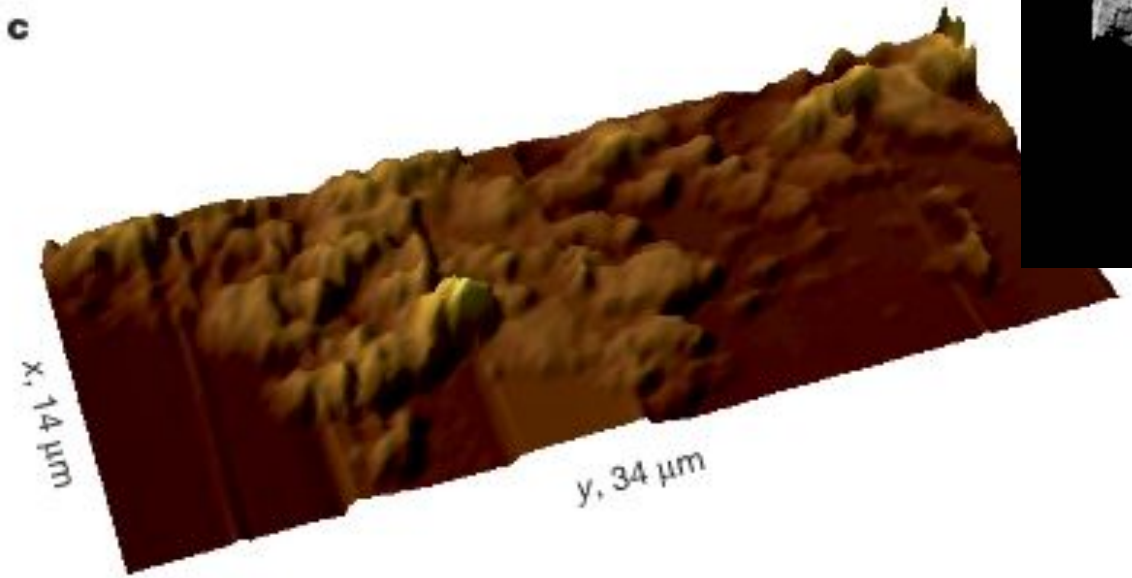


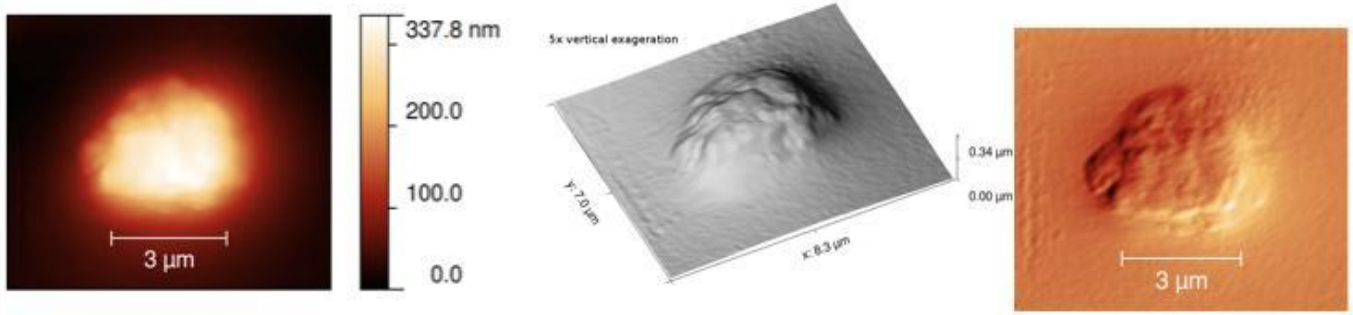


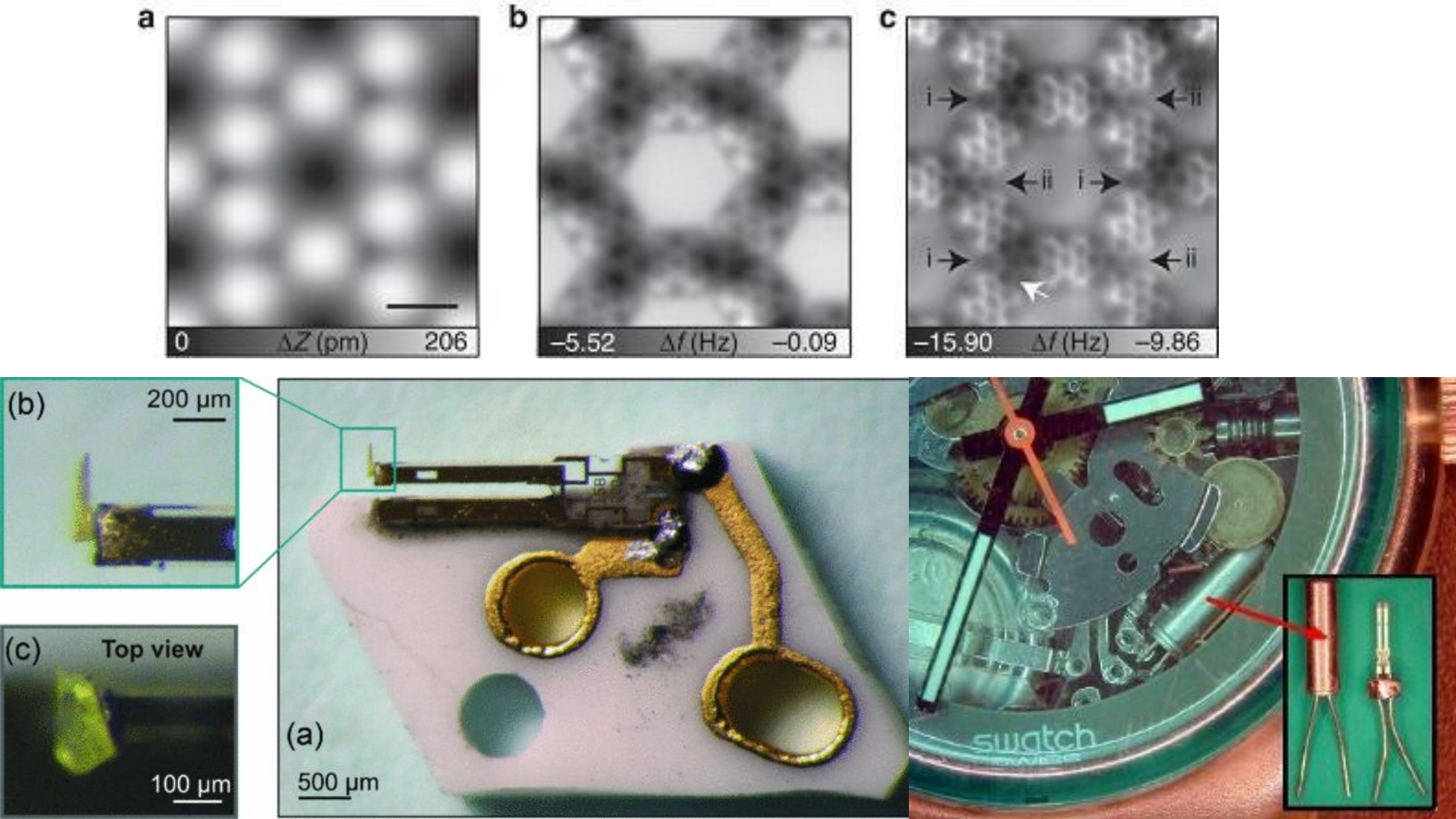

a
x (µm)
0
5
10
E
y (µm)
0
5
10
15
20
25
30
35
b
x (µm)
0
5
10
2.50
2.00
1.50
1.00
0.50
0.00
z (µm)

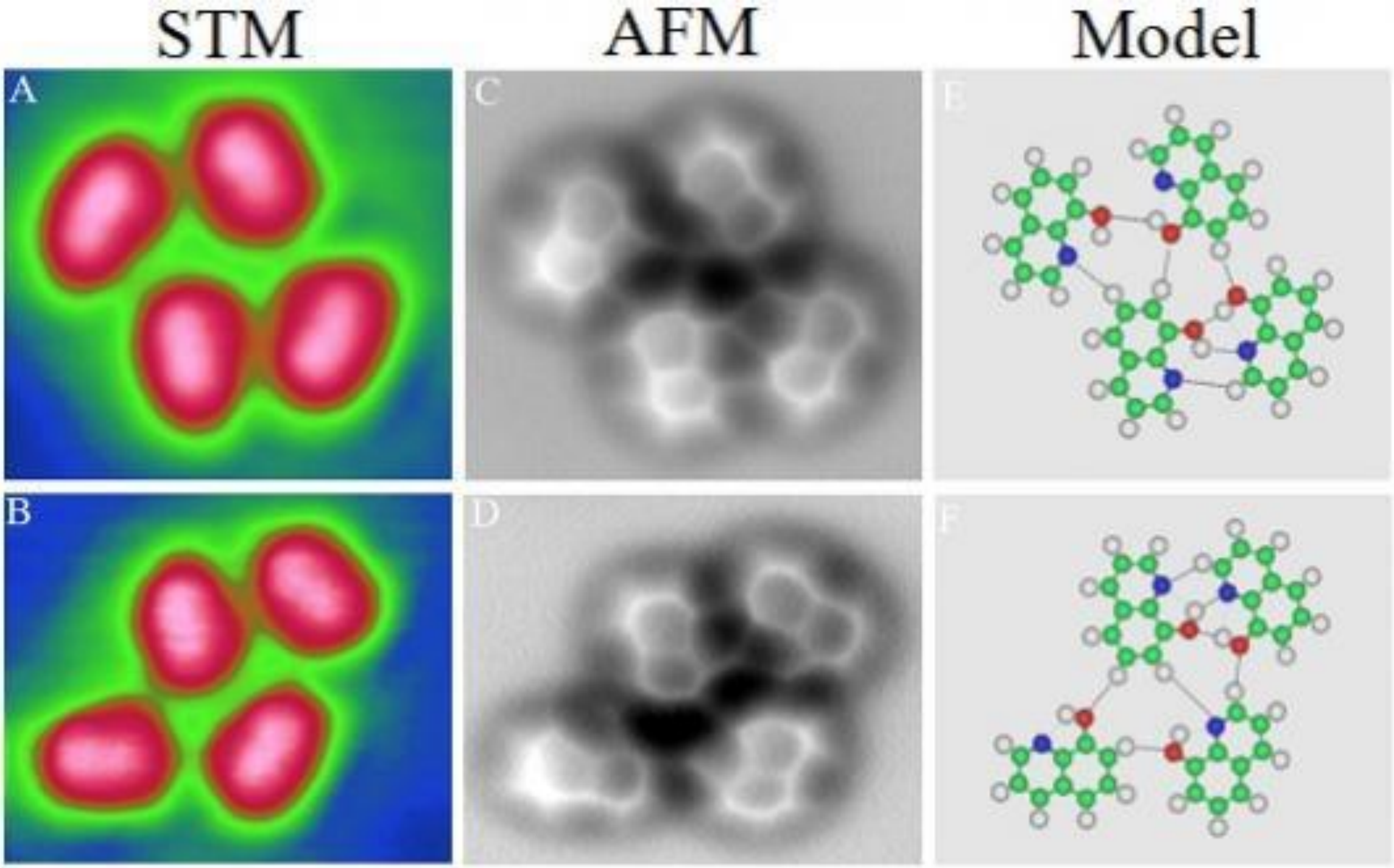


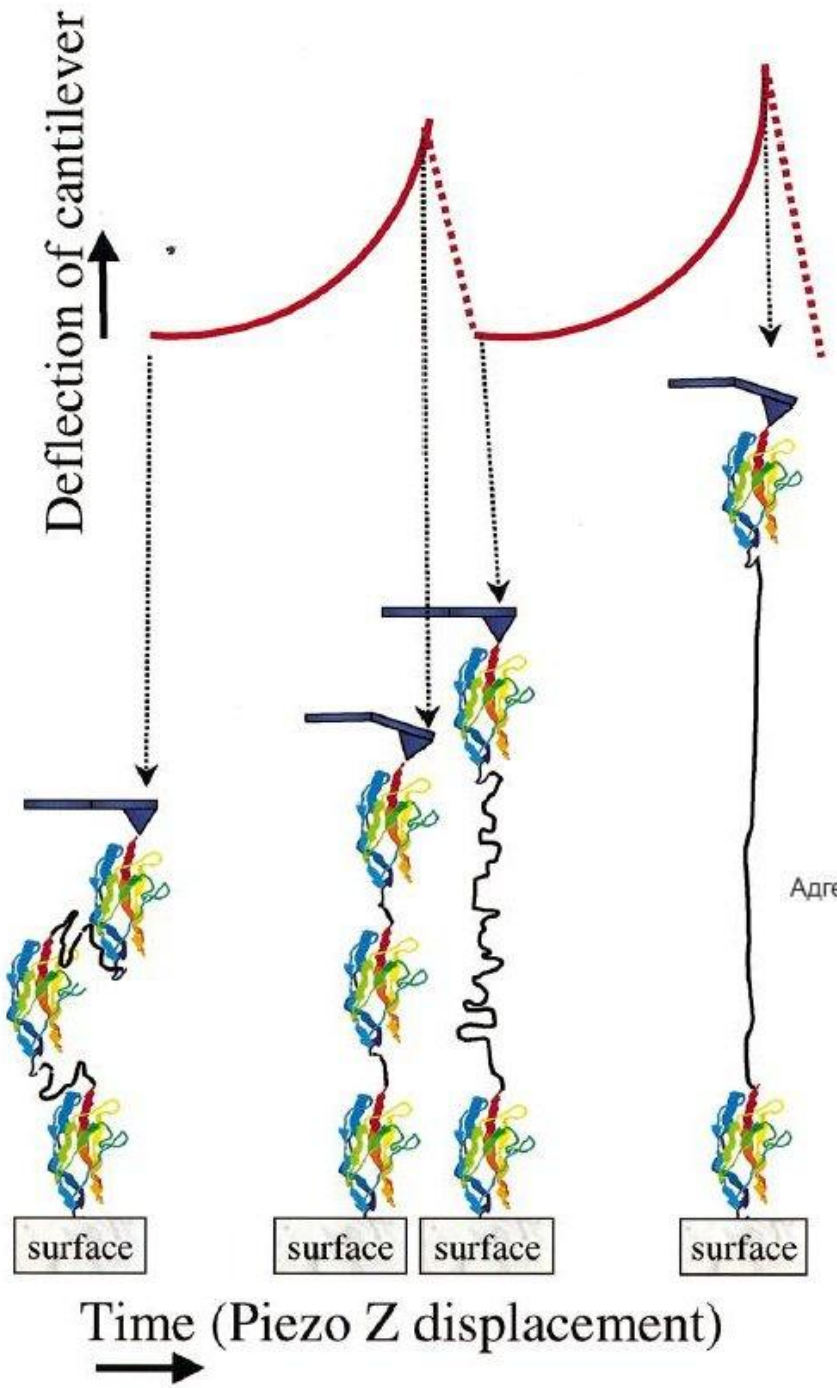


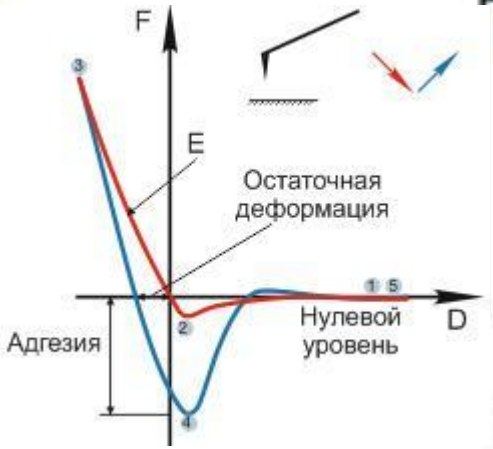

c
x, 14 µm
y, 34 µm

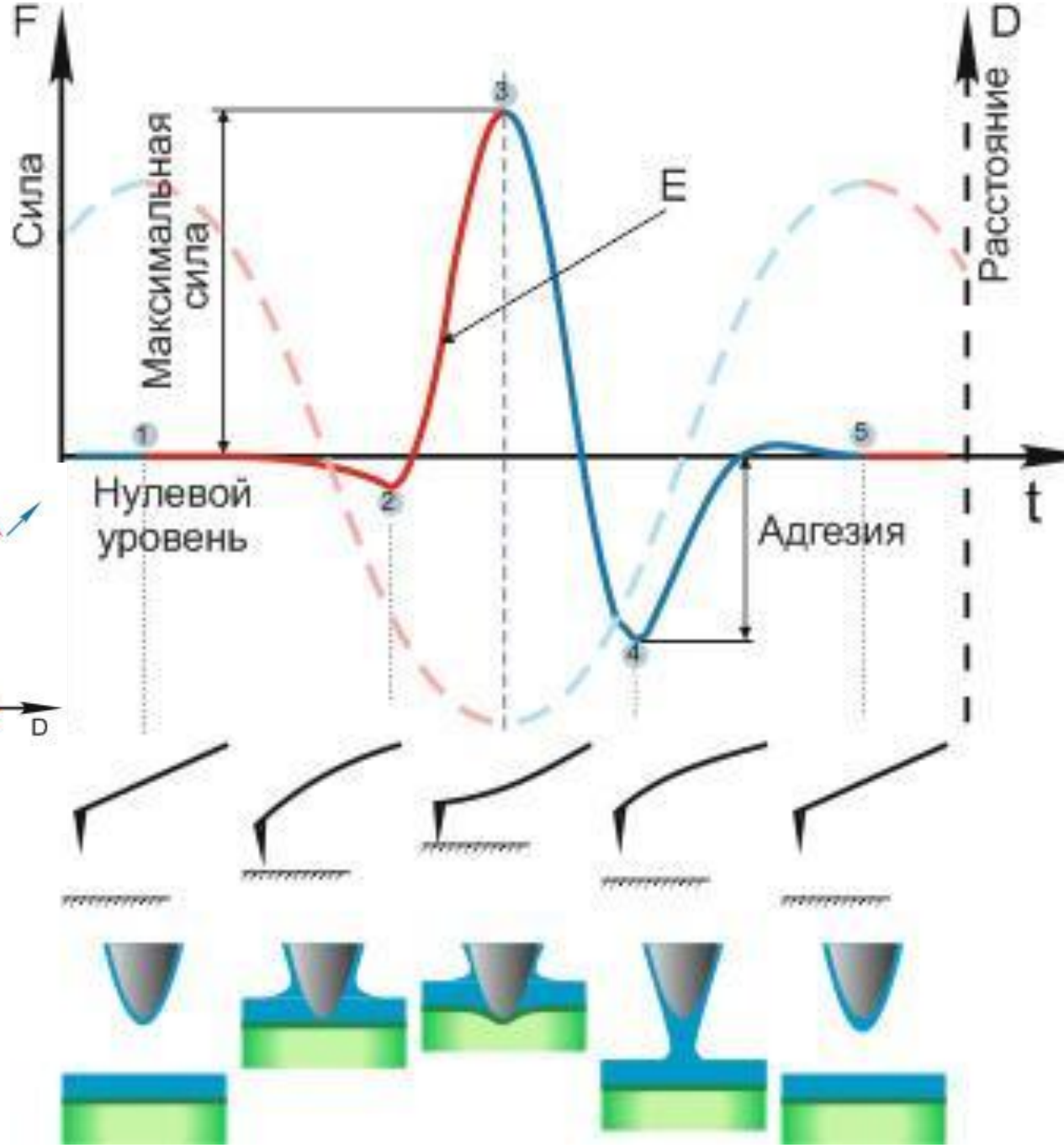

3 µm
337.8 nm
200.0
100.0
0.0
5x vertical exageration
0.34 µm
0.00 µm
3 µm

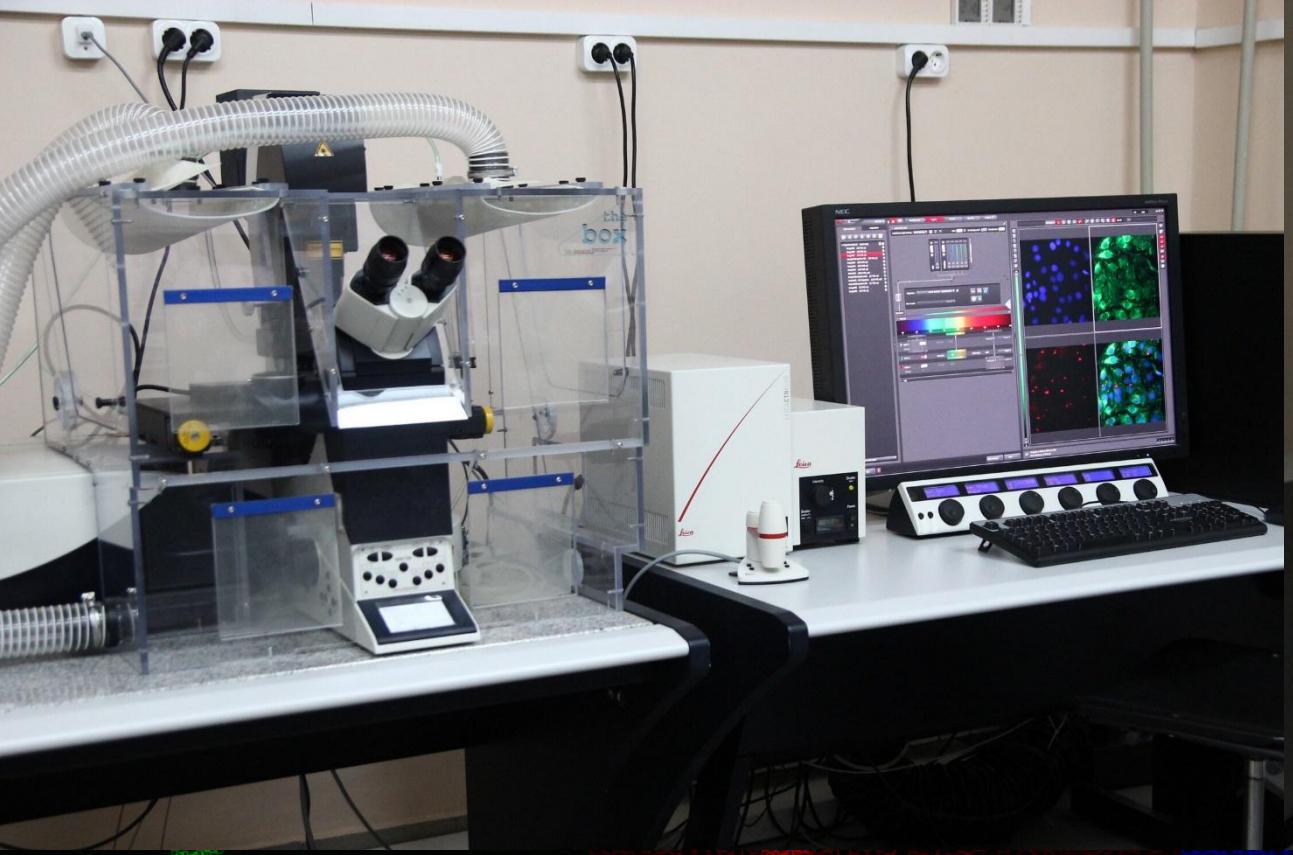

a
0
ΔZ (pm)
206
b
−5.52
Δf (Hz)
−0.09
c
i
ii
i
ii
i
ii
−15.90
Δf (Hz)
−9.86
(b)
200 μm
(c)
Top view
100 μm
(a)
500 μm
swatch


STM
AFM
Model
A
C
E
B
D
F

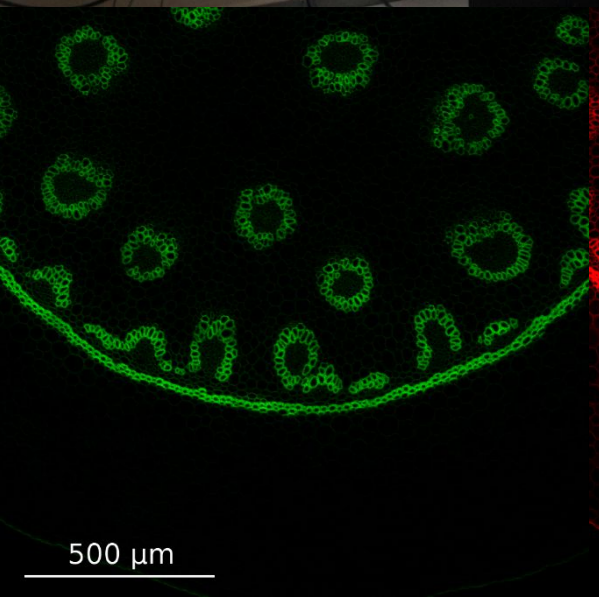

Deflection of cantilever
surface
surface
surface
surface
Time (Piezo Z displacement)

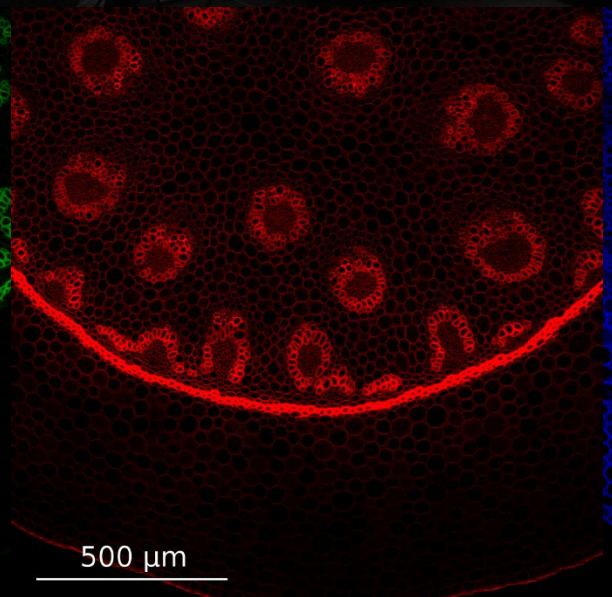

F
E
Остаточная деформация
Адгезия
Нулевой уровень
D

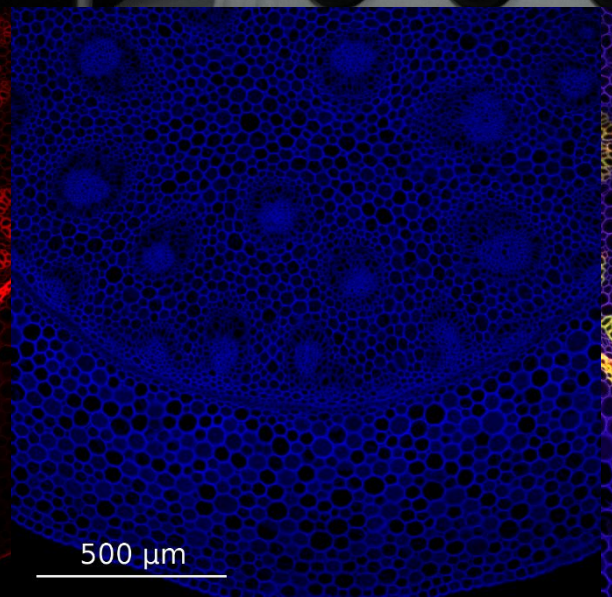

F
D
Сила
Расстояние
Максимальная сила
E
Нулевой уровень
Адгезия
t

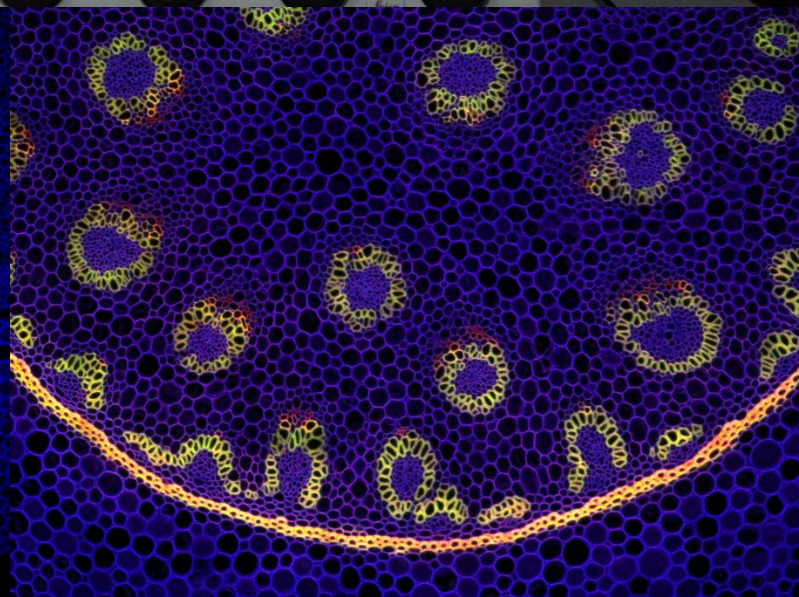


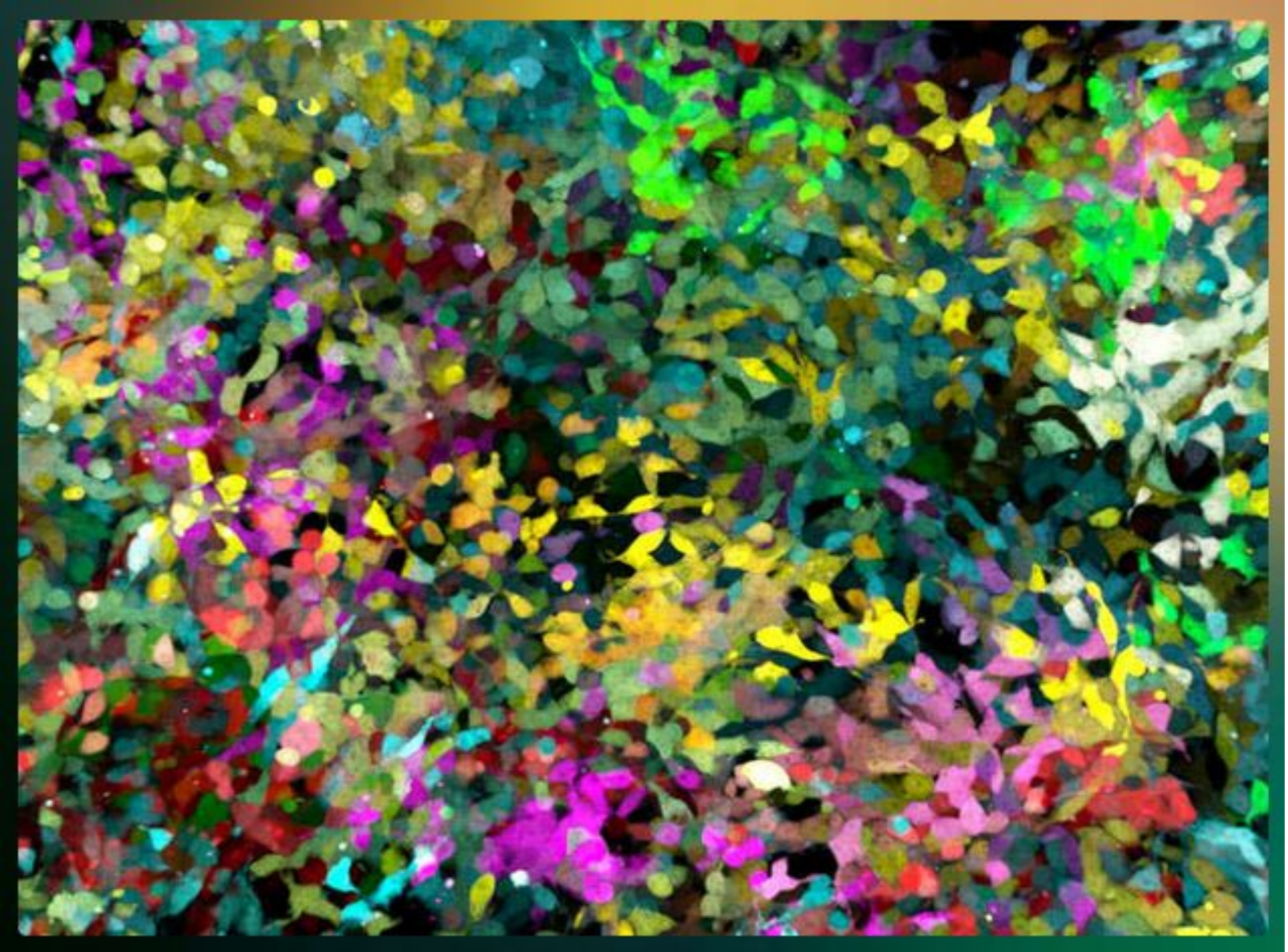
NEC
Smart Gain (HyD)
10.0 %
Smart Offset
disabled
Scan Field Rotat
0.0 °
Pinhole
1.00 AU
Zoom
1.00
Z Position
-0.00 µm


500 µm


500 µm

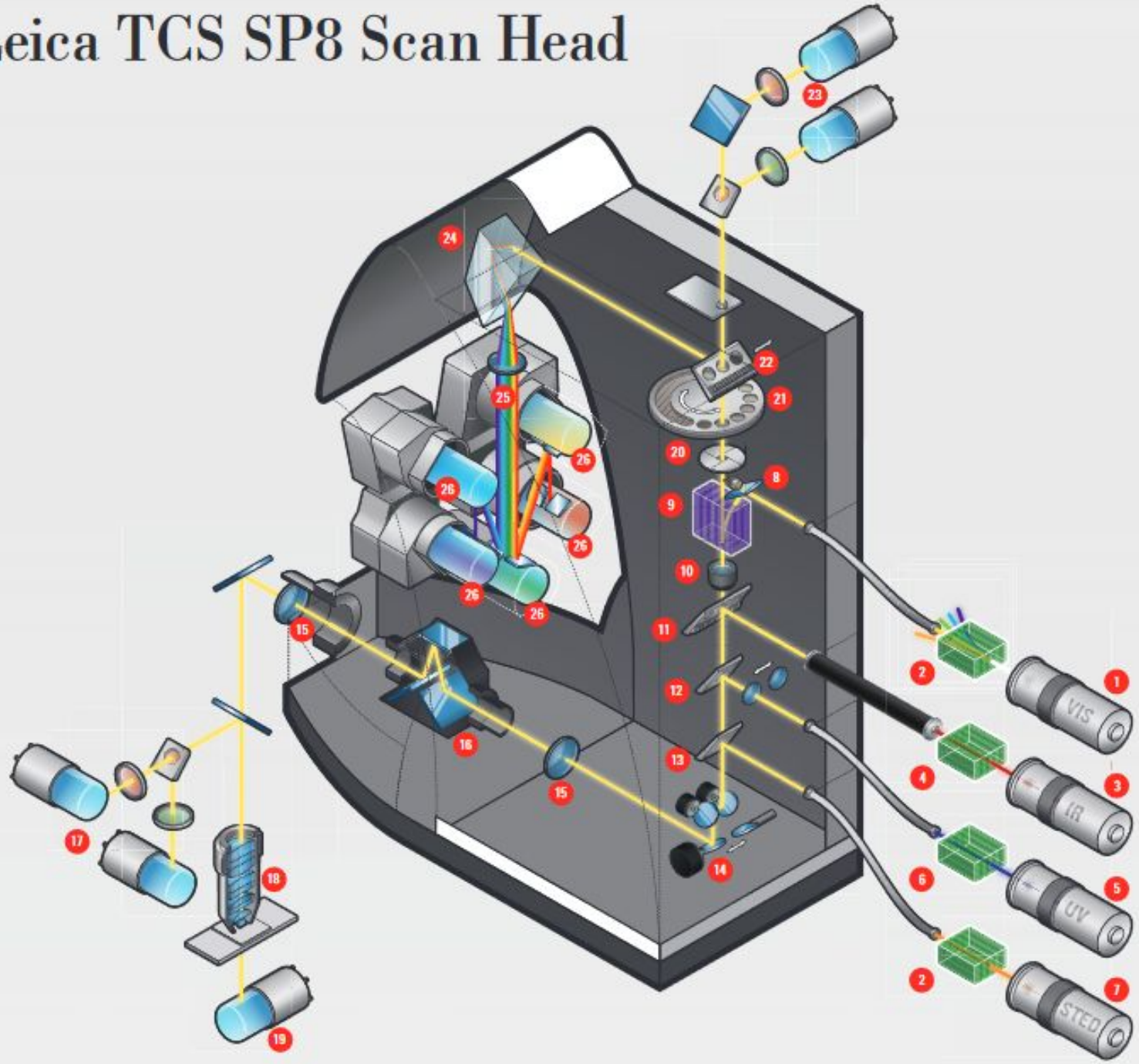

500 µm

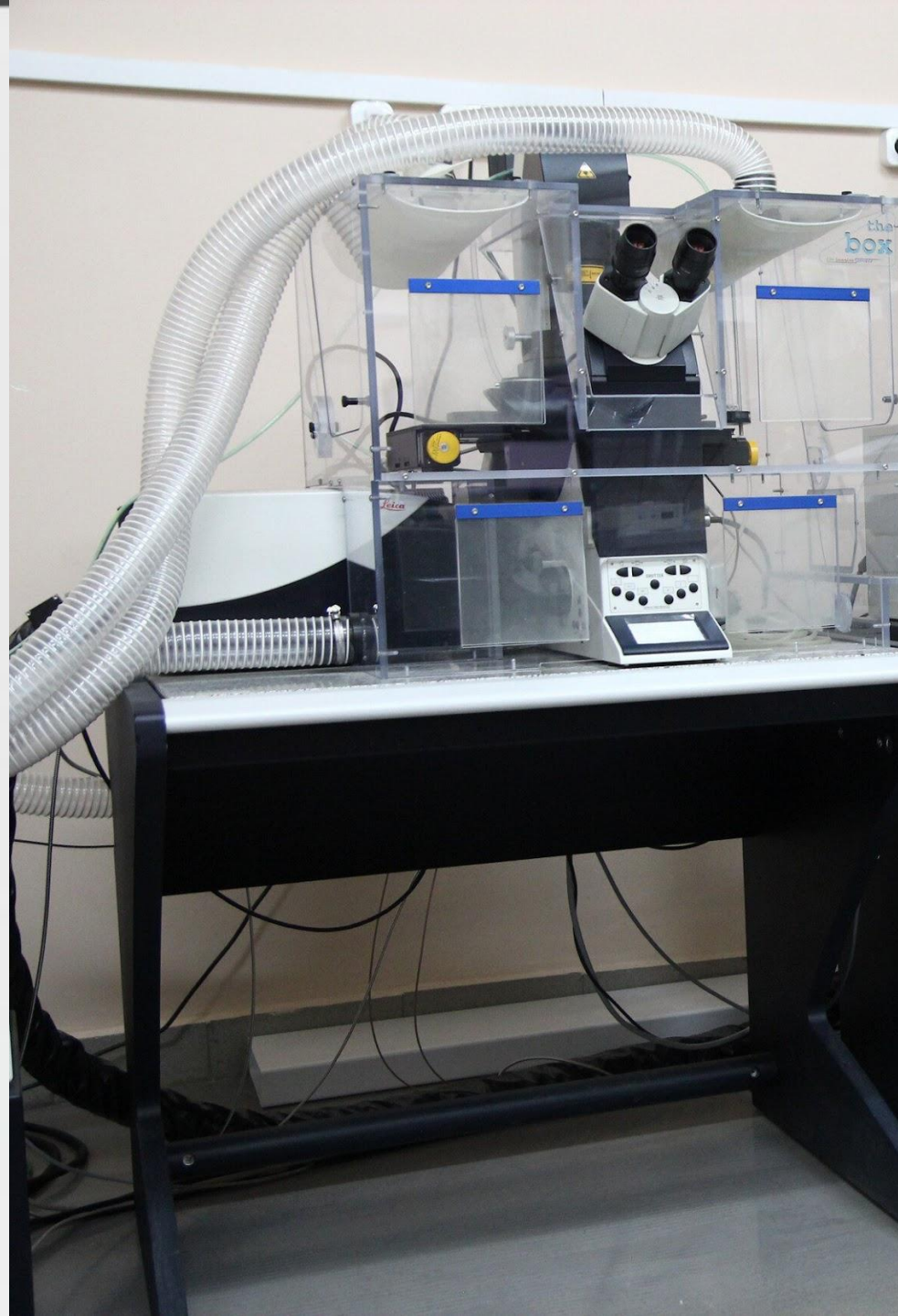


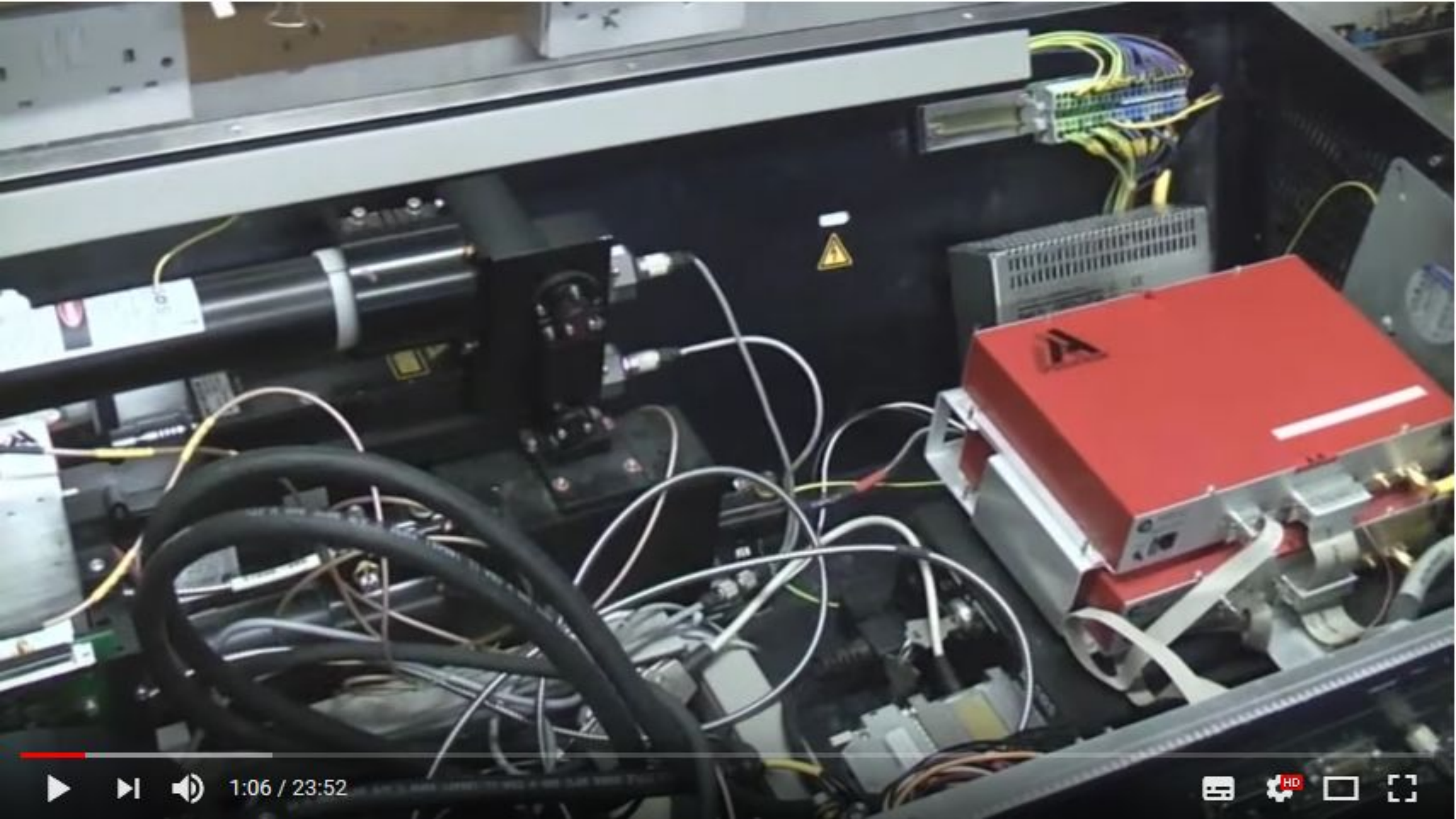


NIH3T3 cells transduced with five individual fluorescent protein (FP) vectors. FPs: Cerulean, EGFP, Venus, tdTomato and mCherry. Each FP was visible only in the cells transduced with the corresponding vector. Courtesy of Daniela Malide, NIH Bethesda, MD USA

Leica TCS SP8 Scan Head



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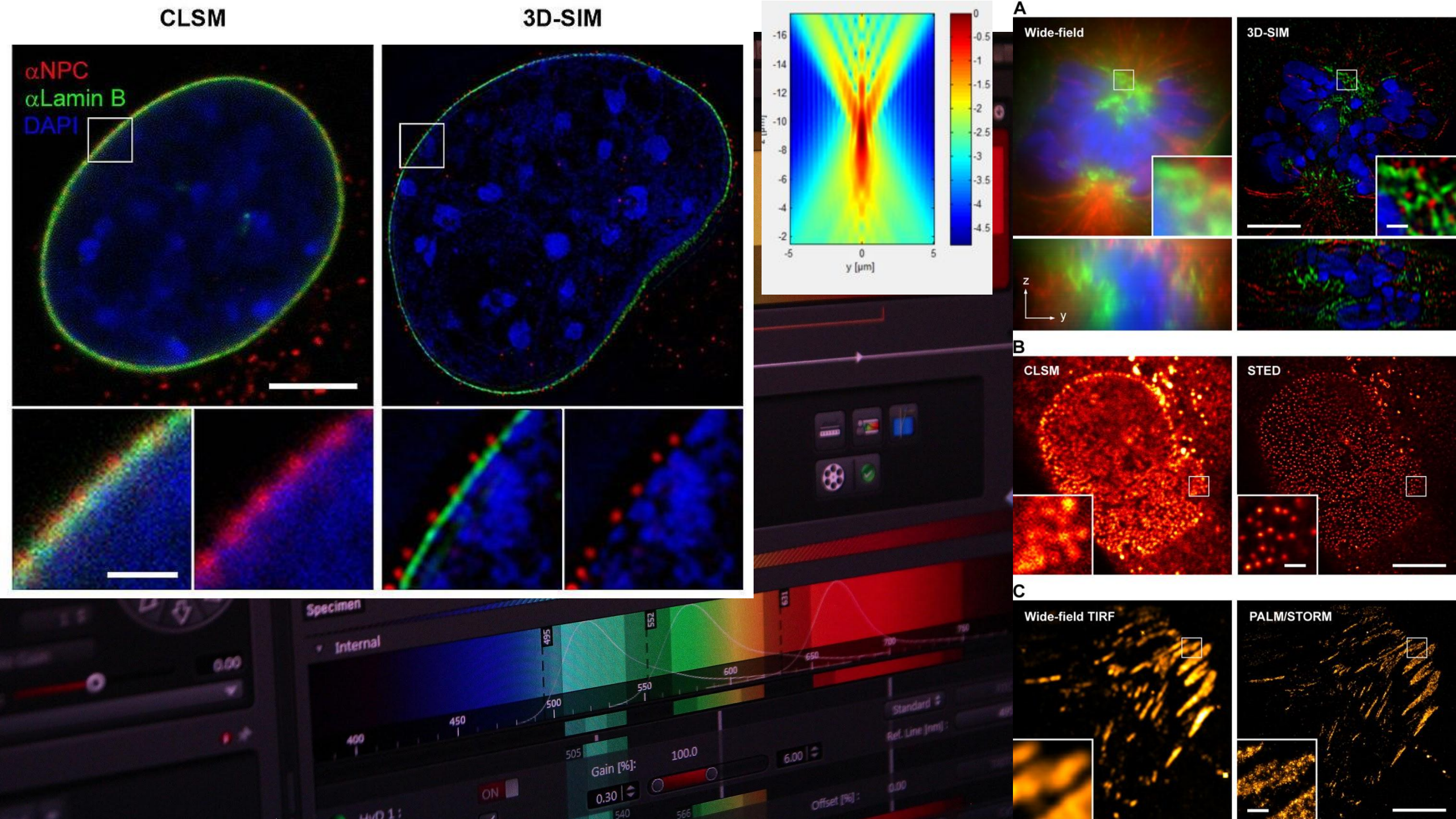
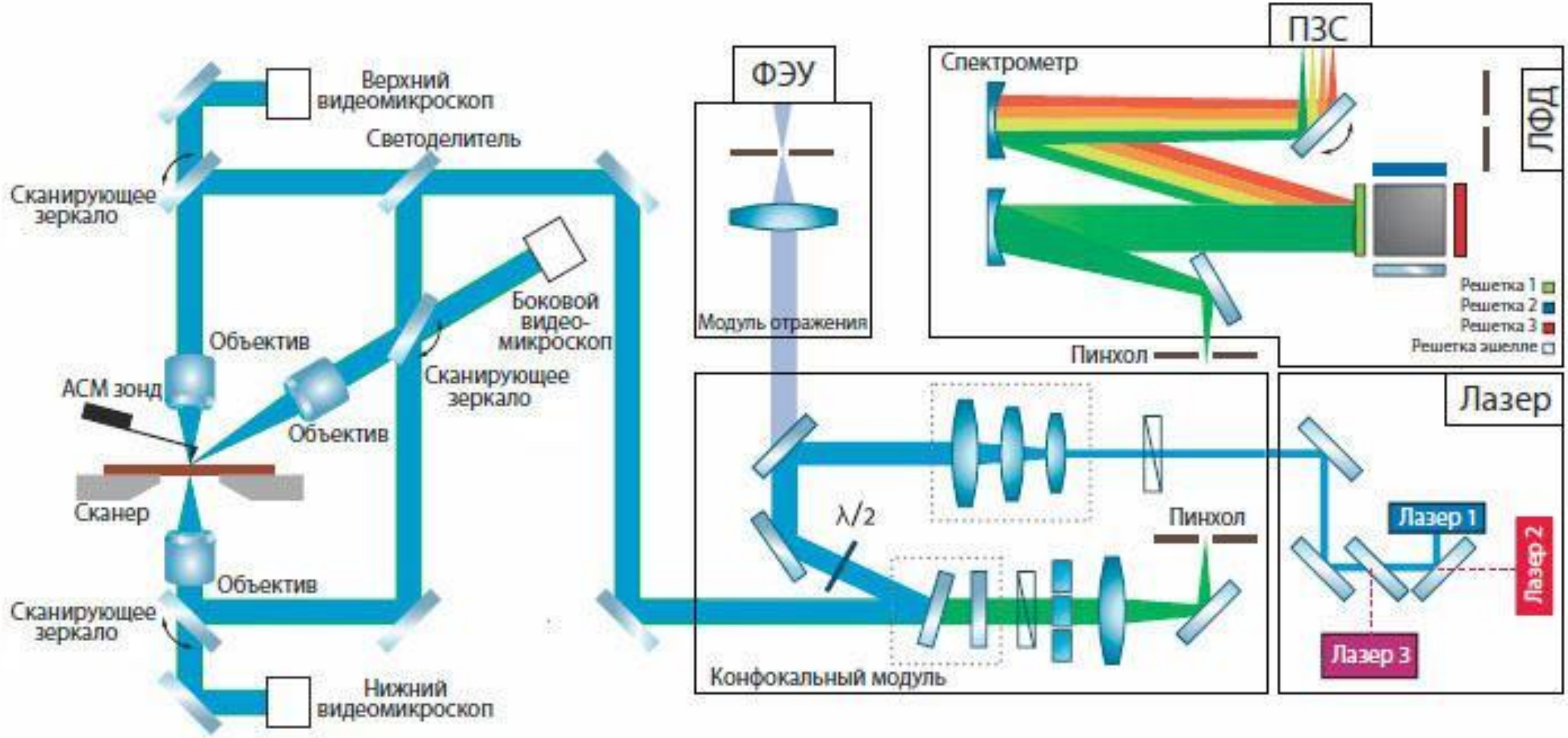
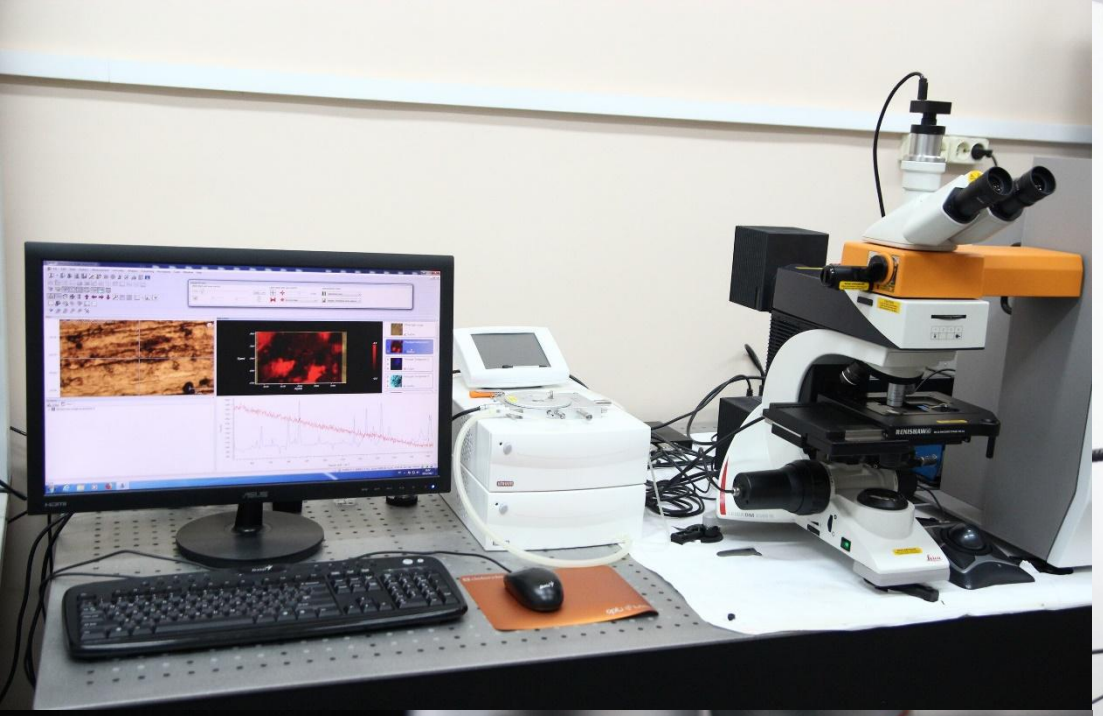
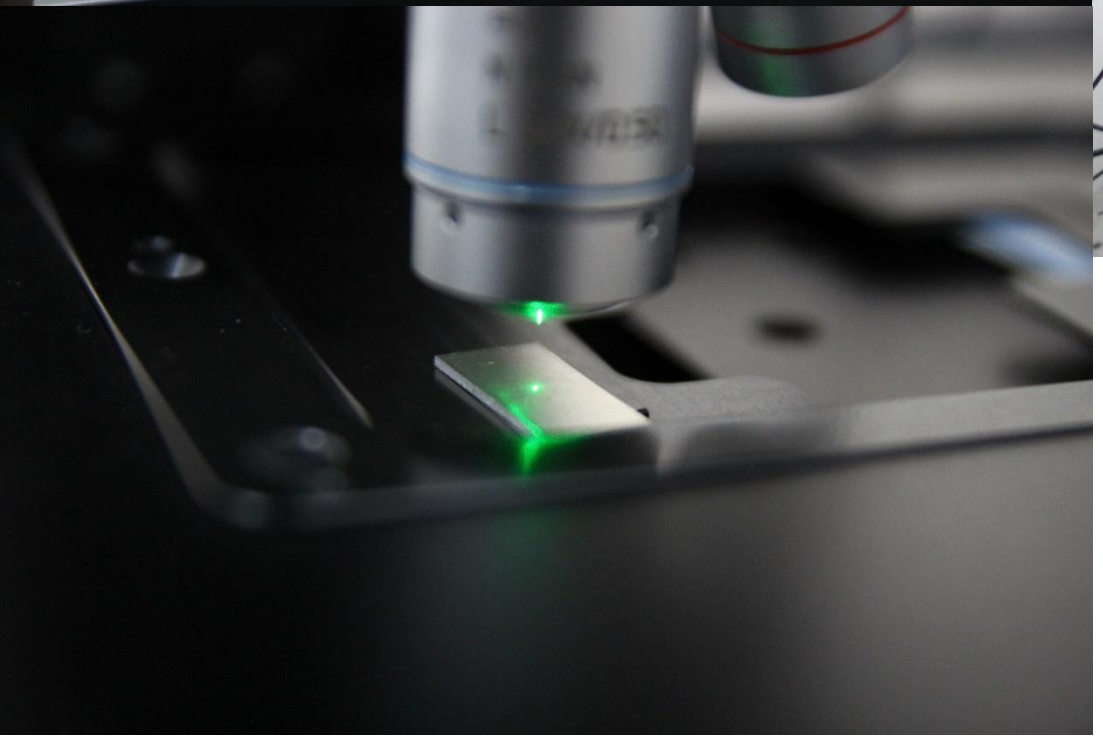
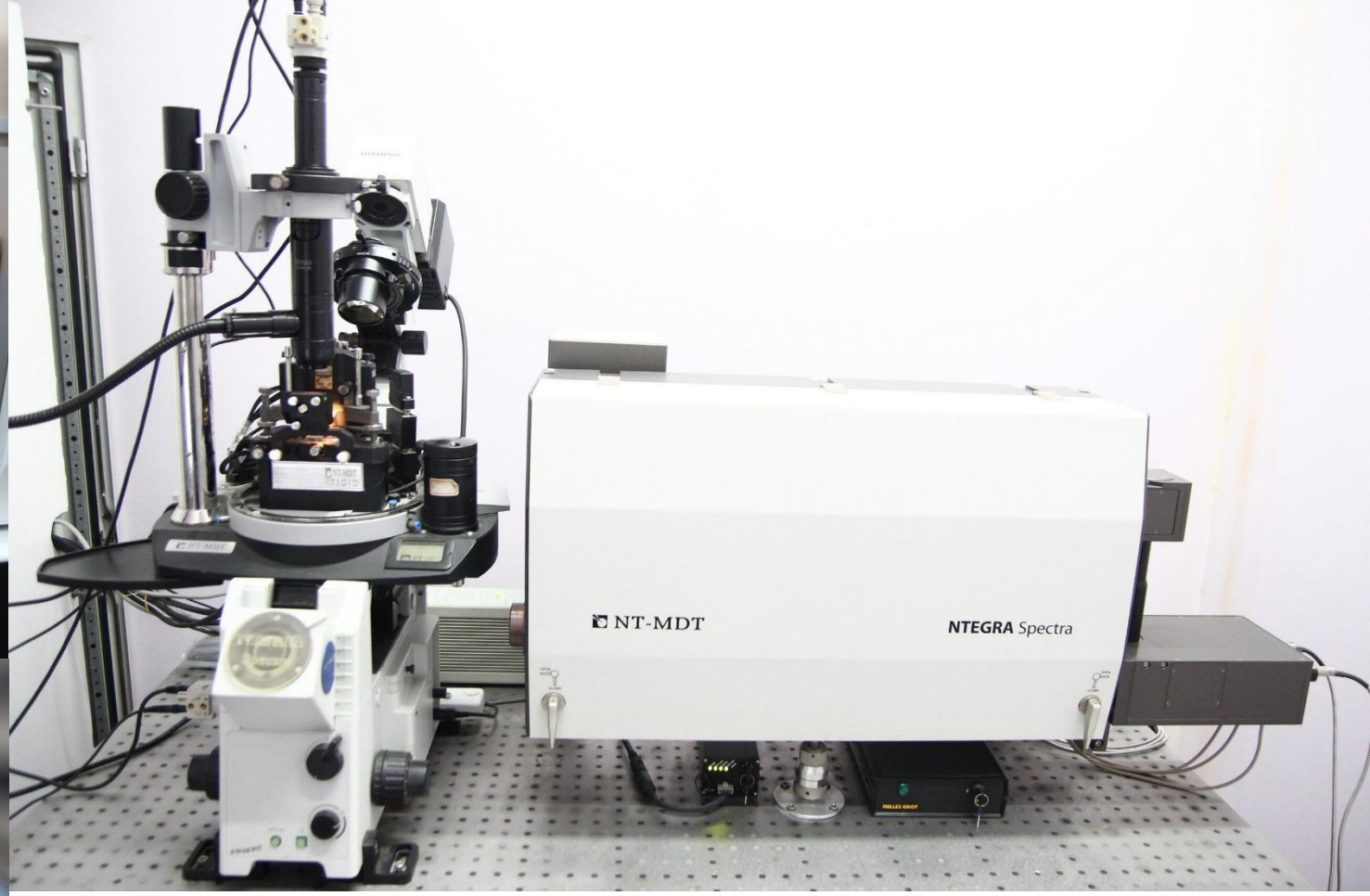
HD

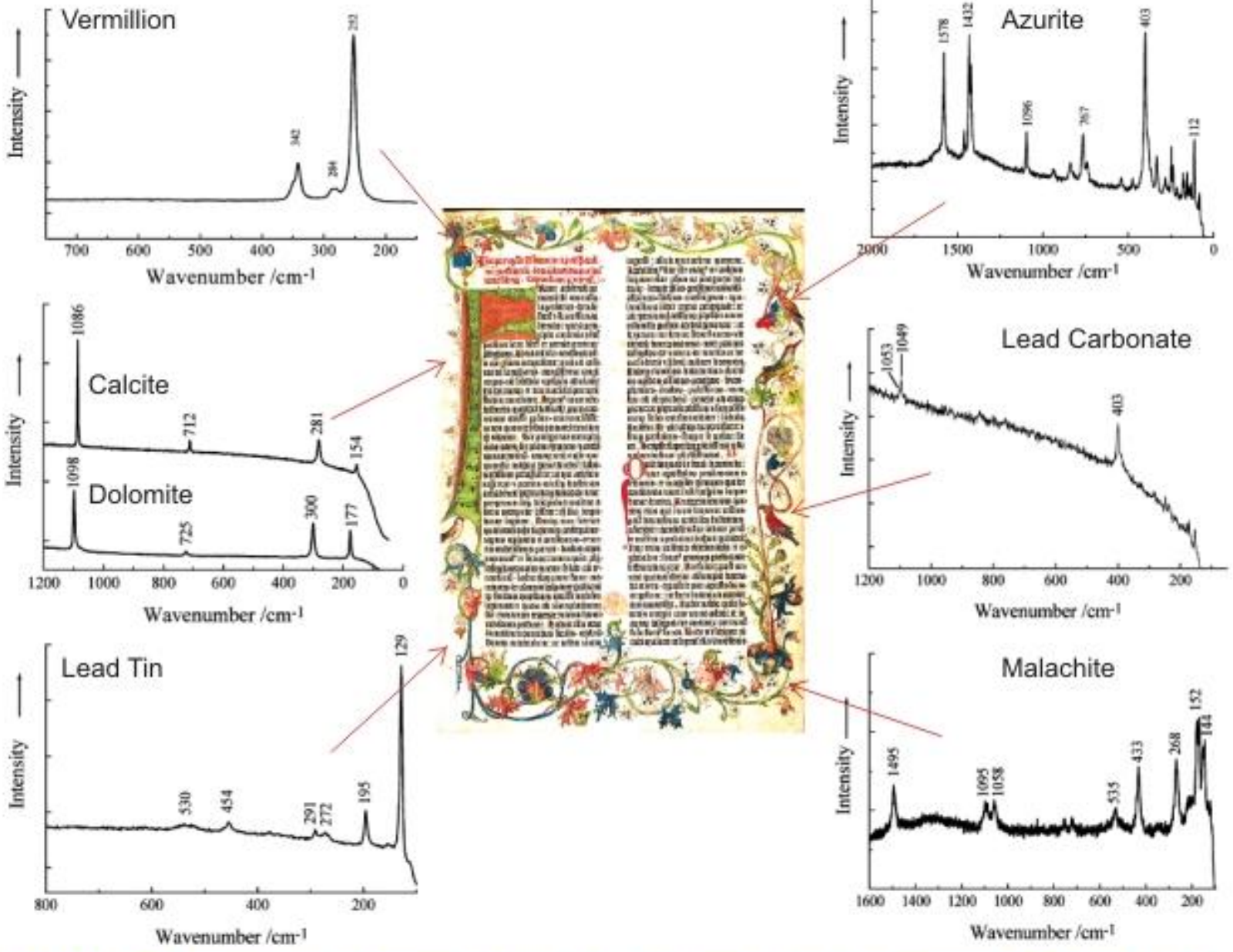

CLSM
3D-SIM
αNPC
αLamin B
DAPI
y [µm]
A
Wide-field
3D-SIM
z
y
B
CLSM
STED
C
Wide-field TIRF
PALM/STORM
Specimen
Internal
Gain [%]:
100.0
0.30
6.00
Offset [%]:
Standard
Ref. Line [nm]:
ON

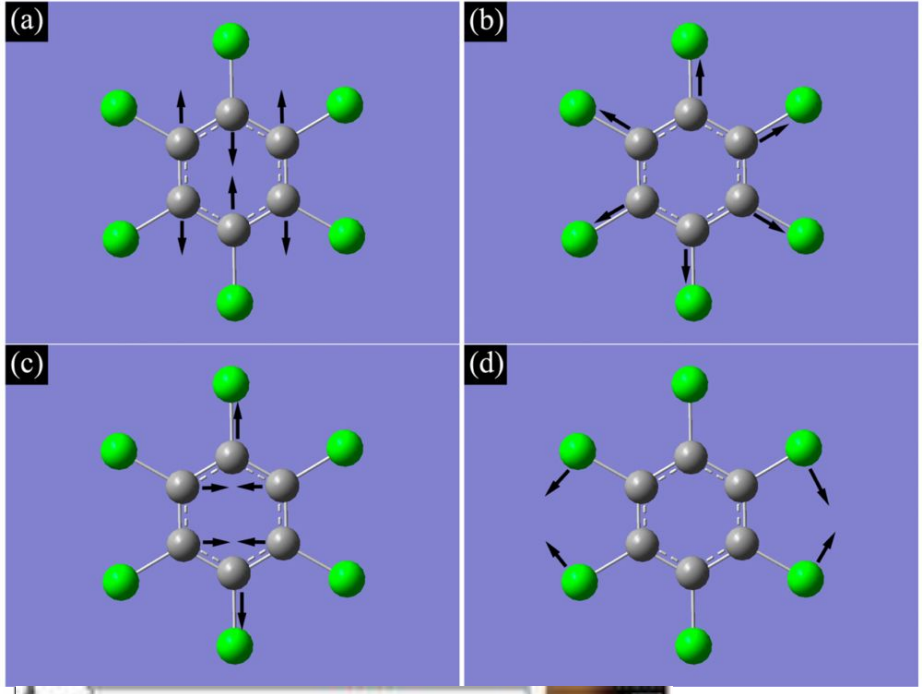

Верхний видеомикроскоп
Светоделитель
Сканирующее зеркало
Боковой видео-микроскоп
Объектив
Сканирующее зеркало
АСМ зонд
Объектив
Сканер
Объектив
Сканирующее зеркало
Нижний видеомикроскоп
ФЭУ
Модуль отражения
ПЗС
Спектрометр
ЛФД
Решетка 1
Решетка 2
Решетка 3
Решетка эшелле
Пинхол
λ/2
Пинхол
Конфокальный модуль
Лазер
Лазер 1
Лазер 2
Лазер 3






NT-MDT
NTEGRA Spectra





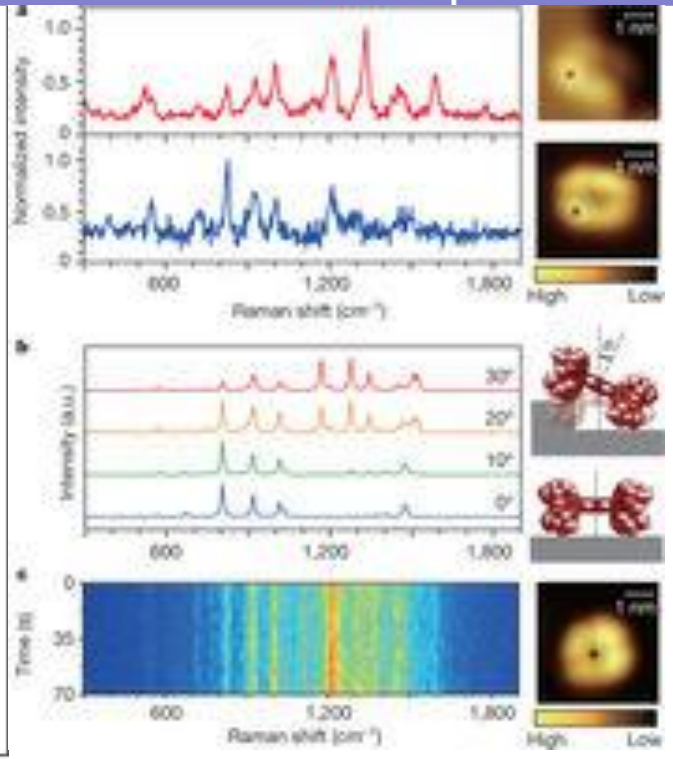


Fig. 4.1.8: Some Raman spectra of pigments used on a Gutenberg Bible (with permission, from Anal. Chem. 77 (2005) 3611).

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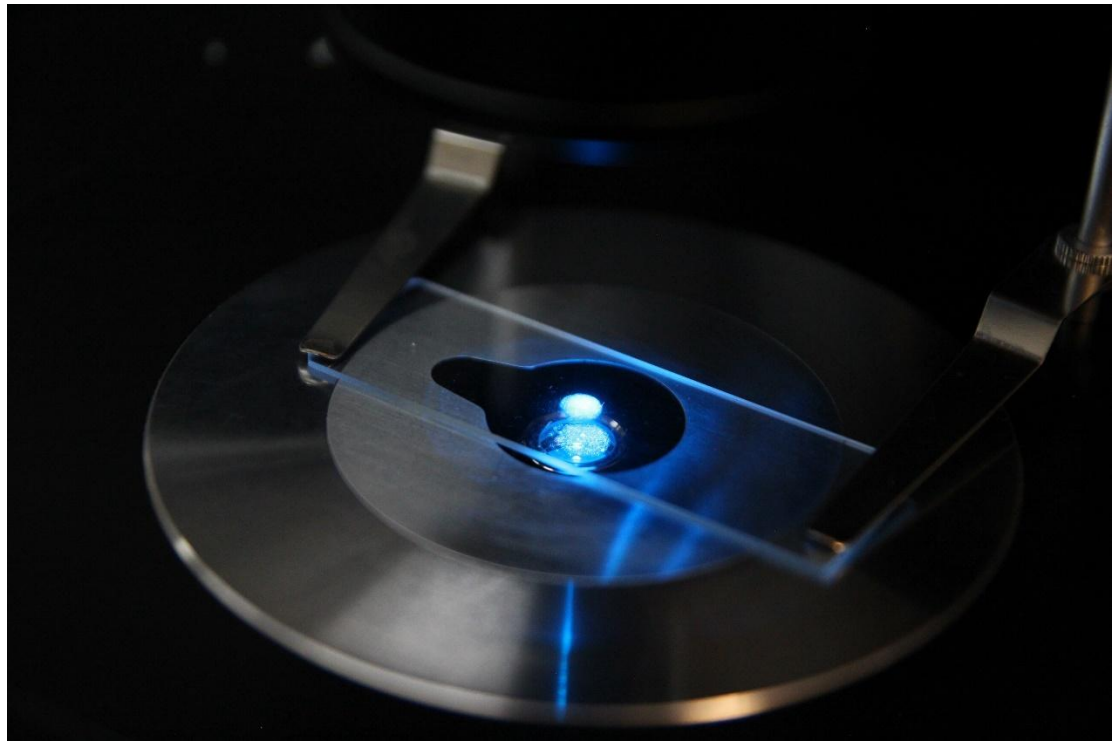
Спасибо за внимание
Вопросы?
dn2010@gmail.com