



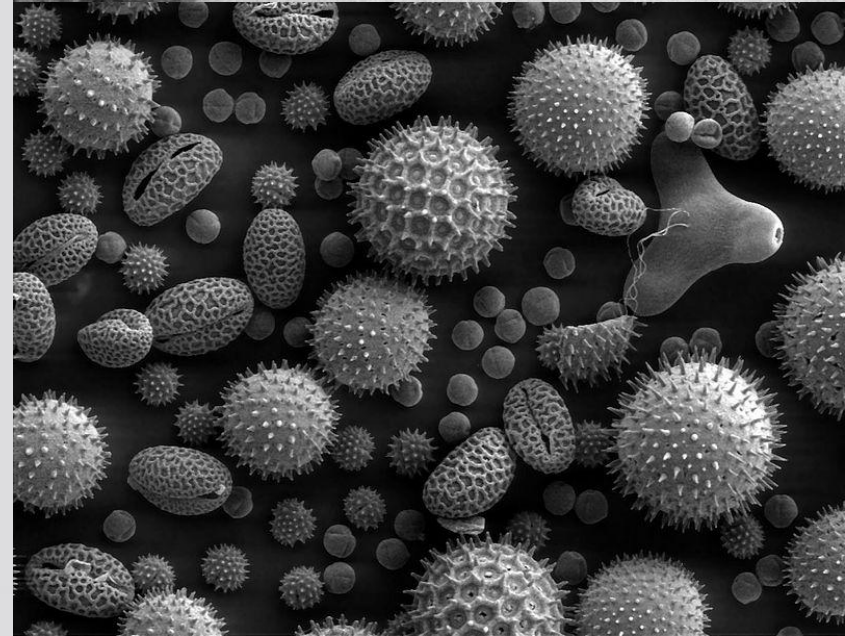
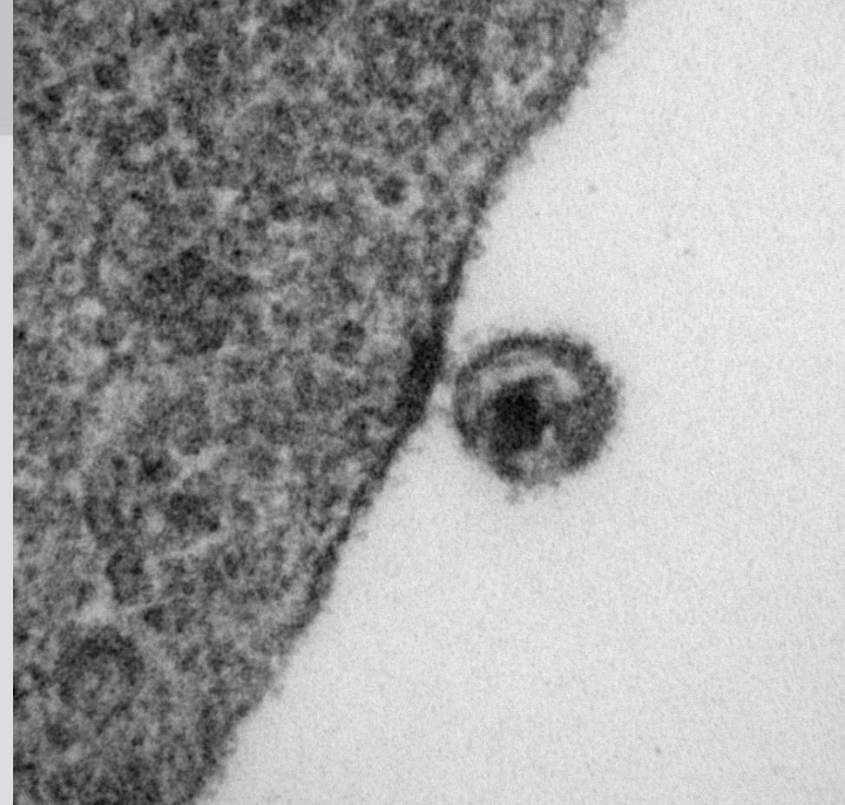
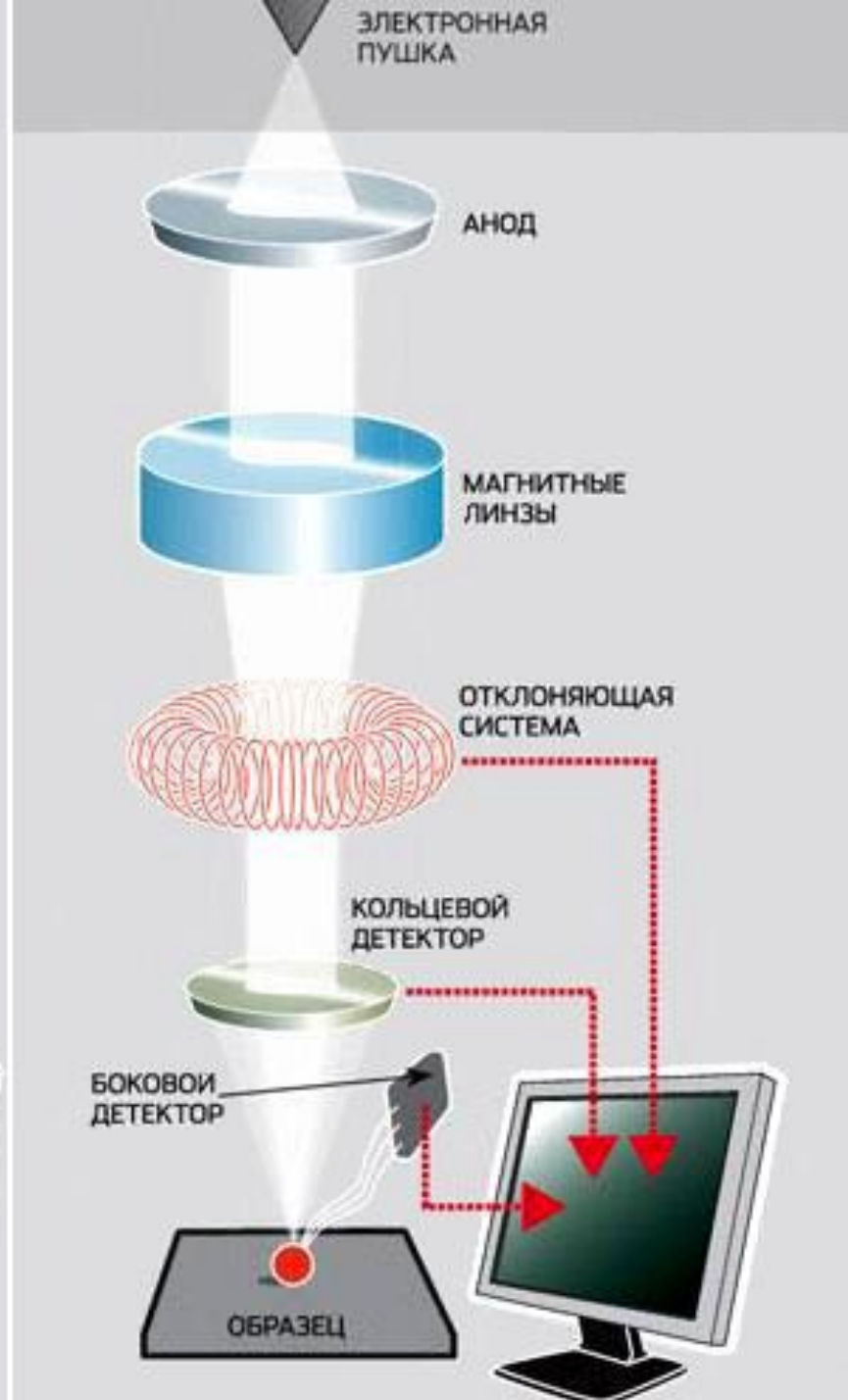
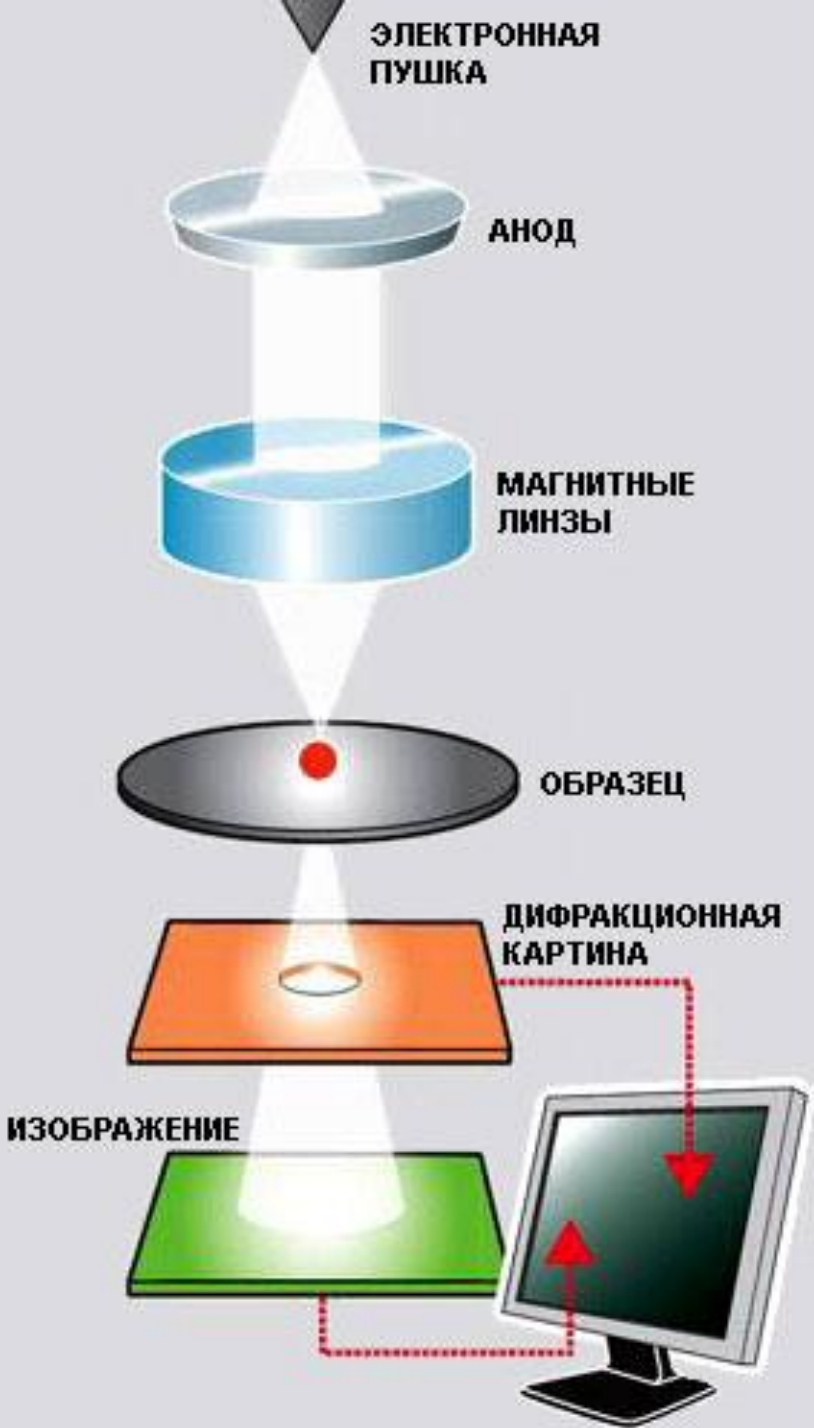
# Увидеть невидимое

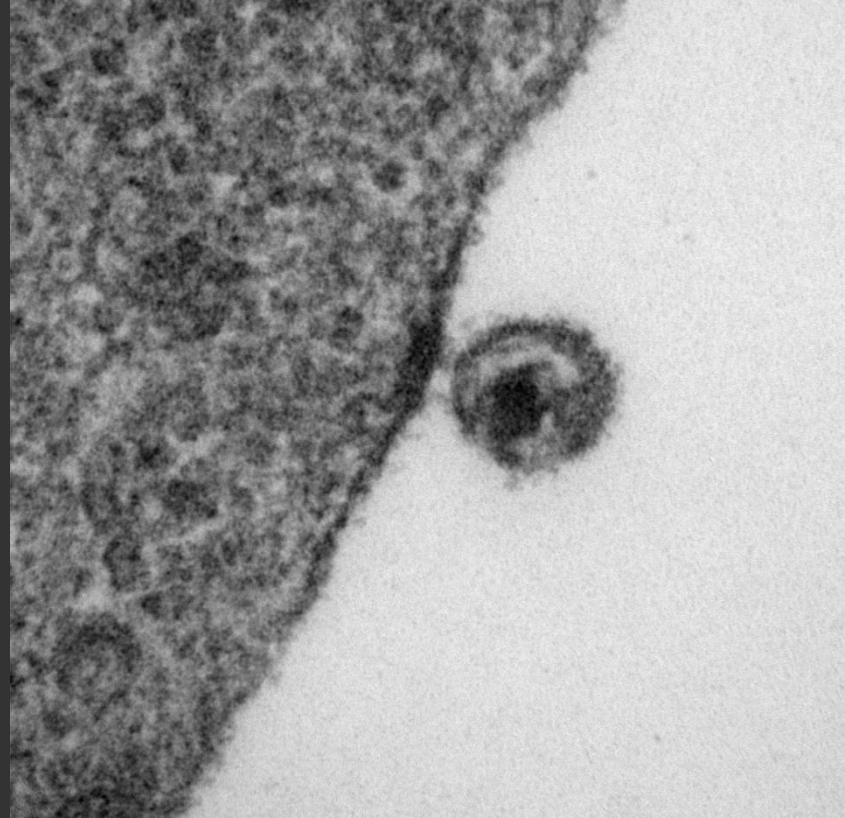
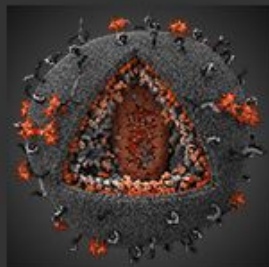
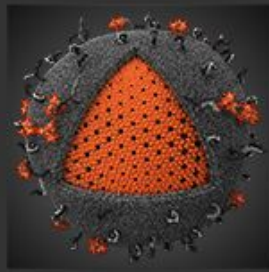
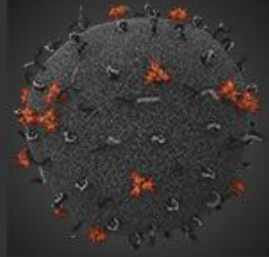
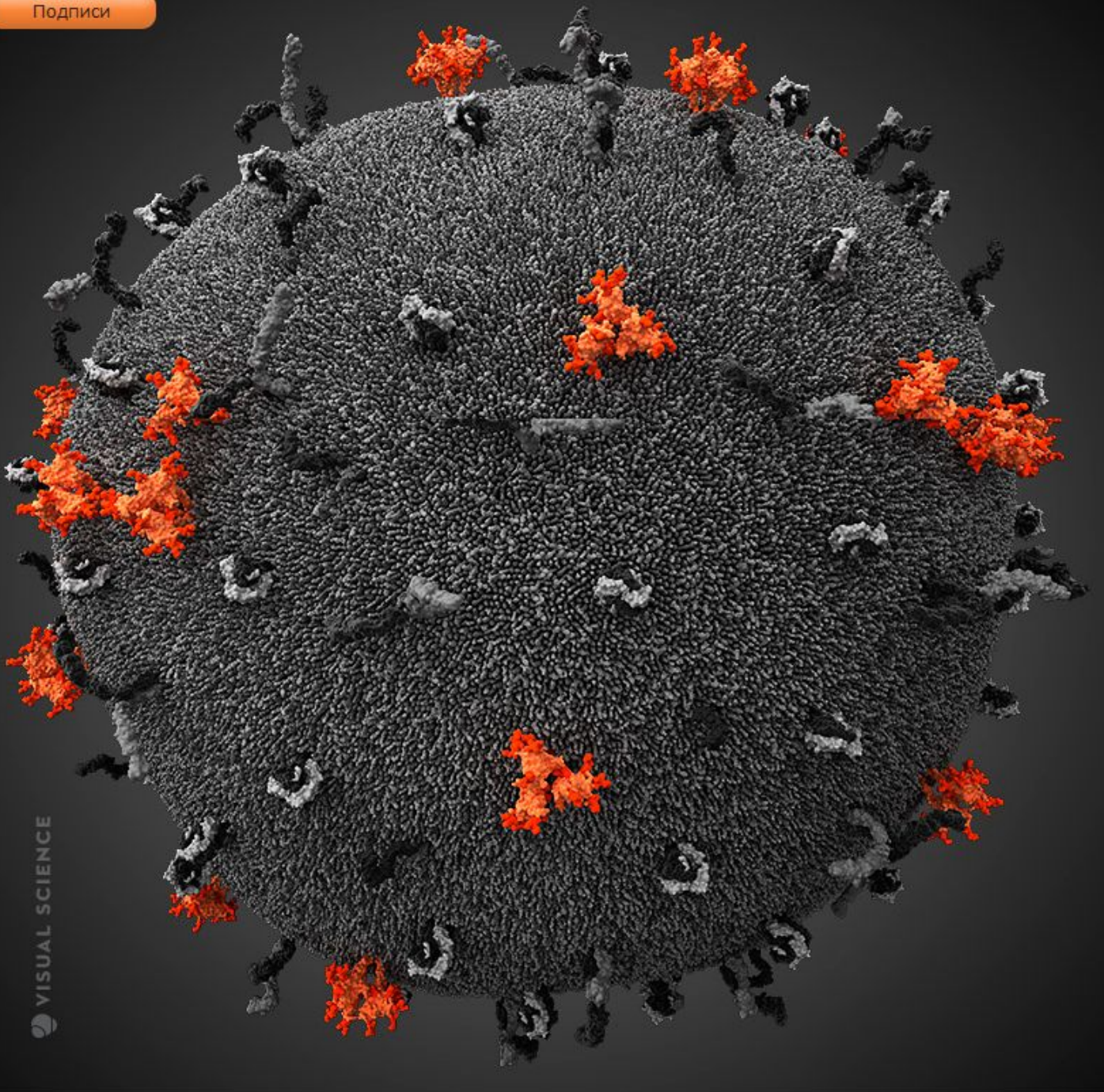
Даниил Браташов, доцент кафедры инноватики  
ФНБМТ СГУ им. Н.Г. Чернышевского

# Увидеть невидимое

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



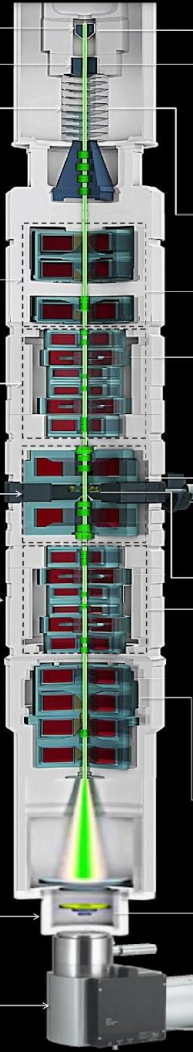
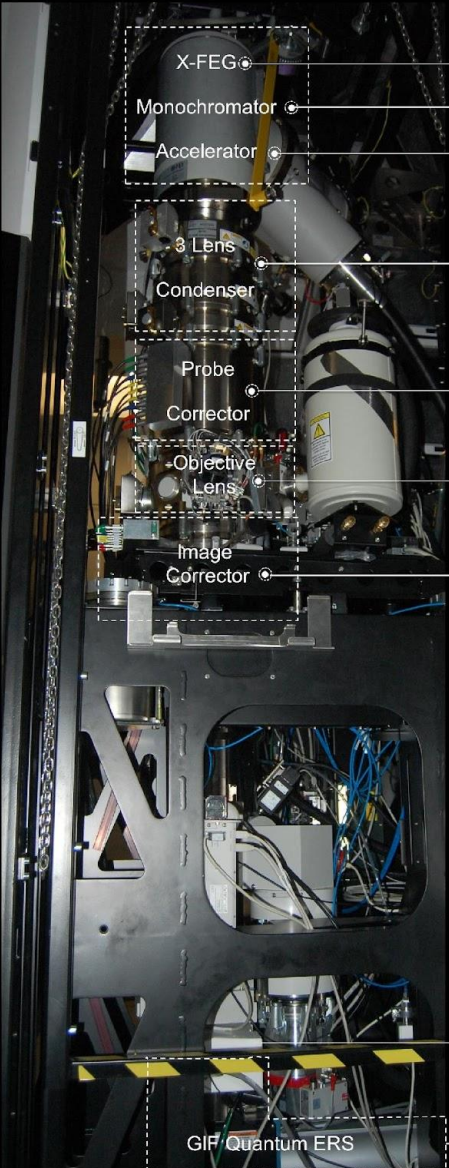




hiv-tc2.tif  
HIV-TC145kXtecnai20  
bio46  
Print Mag: 224000x @ 7.0 in  
16:14 10/31/06  
Microscopist: Louisa

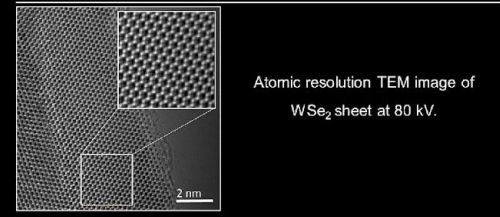
100 nm  
HV=100kV  
Direct Mag: 145000x  
X:174.603 Y: 32.357 T:0.01  
AMT Camera System

# FEI Titan Themis<sup>3</sup>

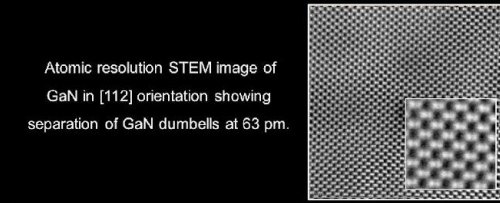


- **Extreme Field Emission Gun (X-FEG)**
  - + Brightness ( $\geq 7 \times 10^7$  A/m<sup>2</sup> sr V)
  - + Current ( $\geq 50$  nA before monochromator)
  - + Current-Stability ( $\leq 1\%$  over 7 days)
  - + Spatial Coherency
  - + Temporal Coherency
  - (Energy resolution at 300 kV without monochromator  $\leq 0.8$  eV)
- **Monochromator**
  - + Energy resolution at 300 kV  $\leq 0.2$  eV
- **Accelerator**
  - + 60 to 300 kV
- **3 Lens Condenser**
  - + Large parallel illumination range in TEM (from nm to  $\mu$ m)
  - + Large convergence angle range in STEM
- **DCOR probe Cs corrector**
  - + Correct high order aberrations (3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> order aberrations)
- **Super-Twin Objective Lens**
  - + Wide Pole Piece Gap (5 mm)
  - + Large sample tilt range ( $\pm 70^\circ$ )
- **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  $\mu$ s
- **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)

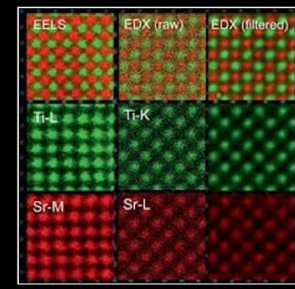
### Application Highlights:



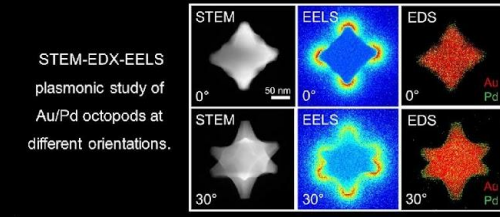
Atomic resolution TEM image of WSe<sub>2</sub> sheet at 80 kV.



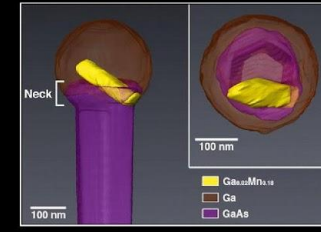
Atomic resolution STEM image of GaN in [112] orientation showing separation of GaN dumbbells at 63 pm.



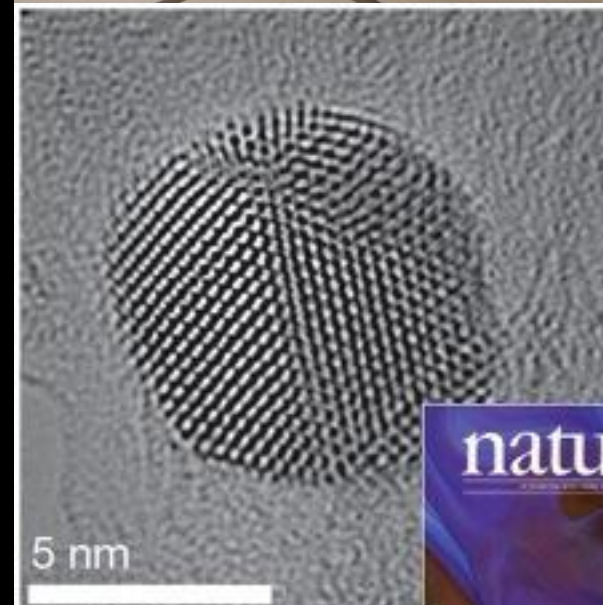
Atomic resolution chemical maps of SrTiO<sub>3</sub>. Raw EELS and EDX data are shown in the first two columns for comparison.

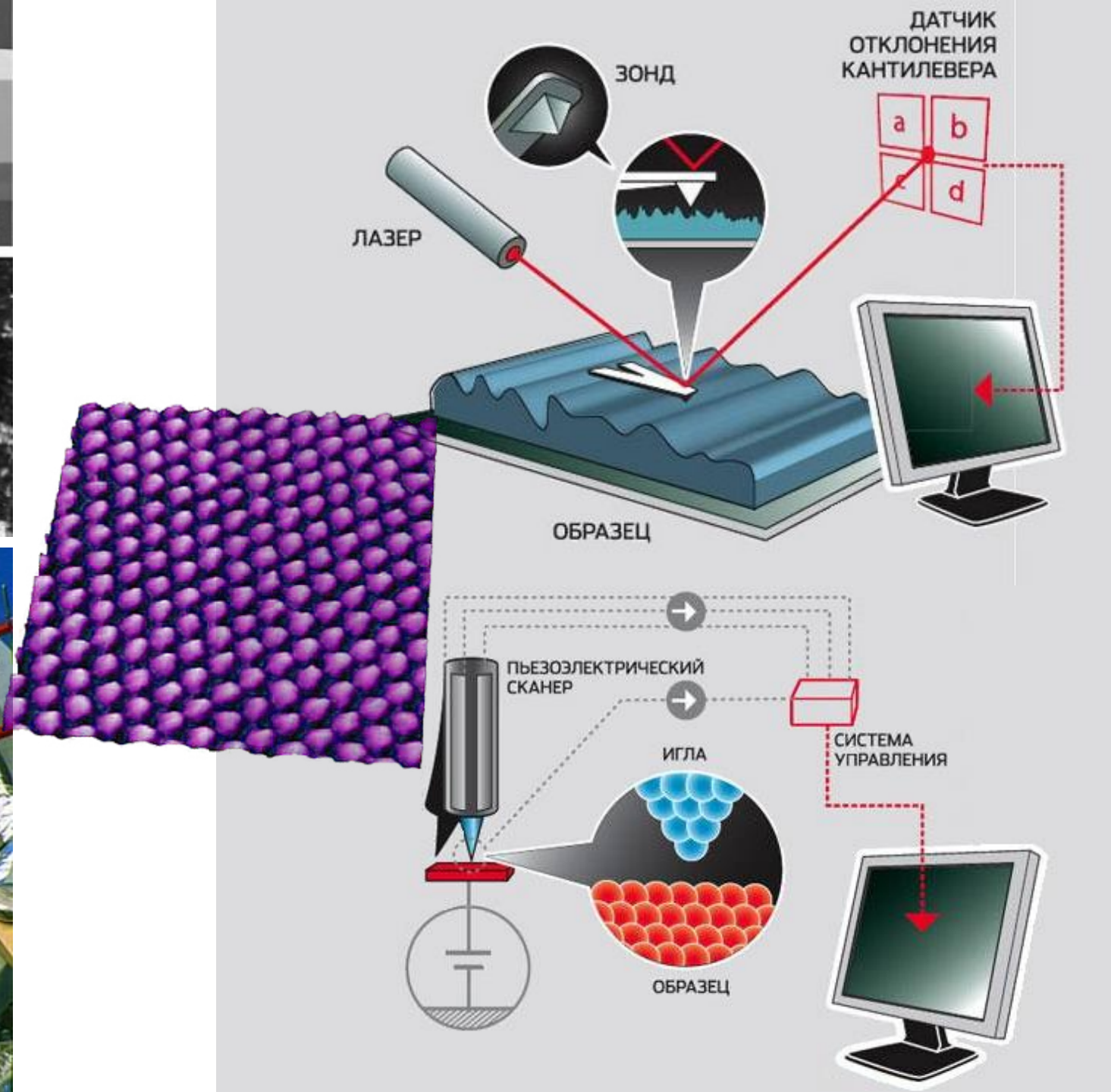
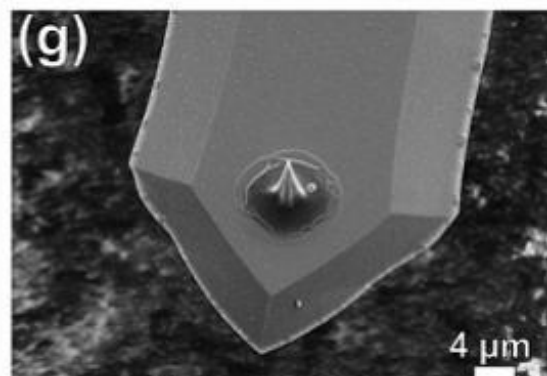
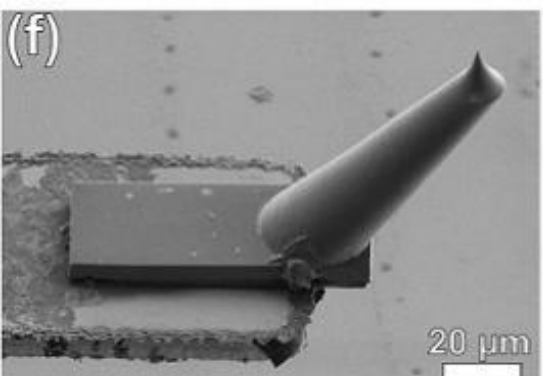
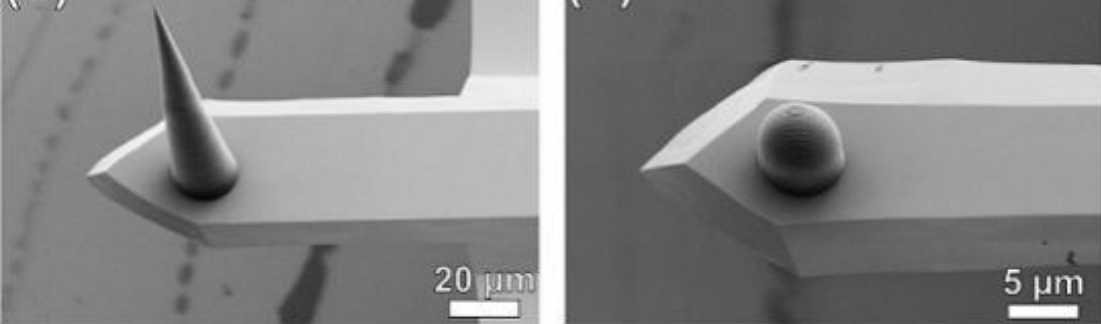


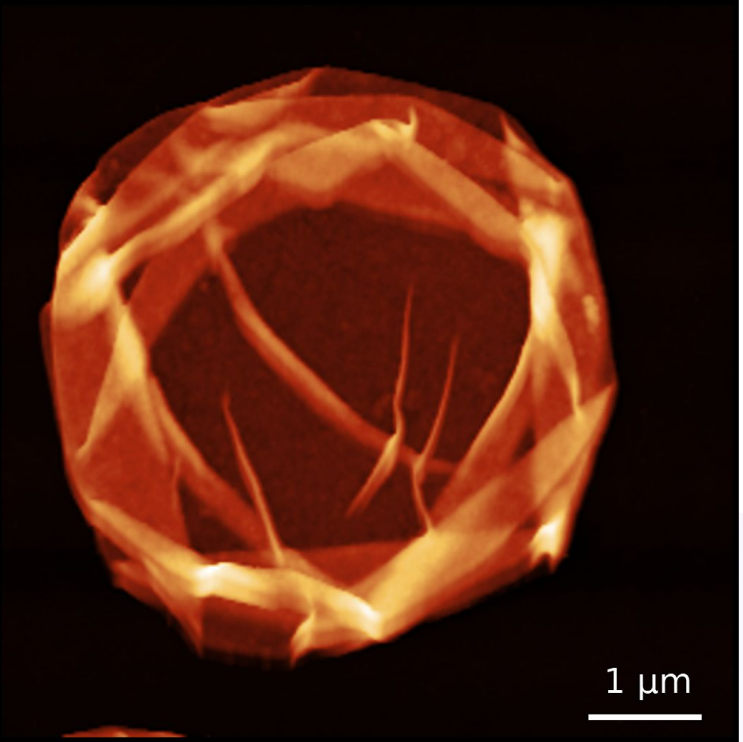
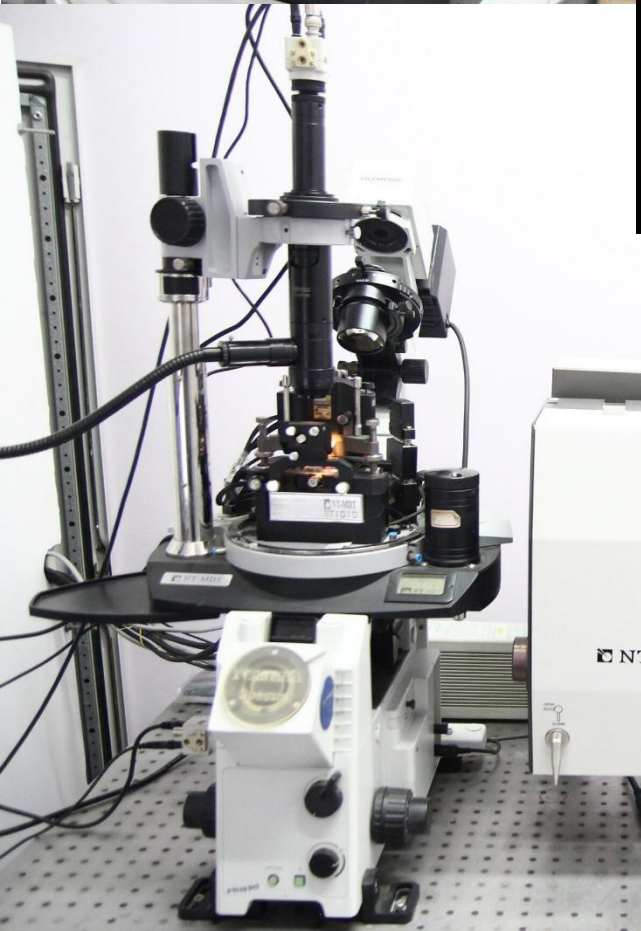
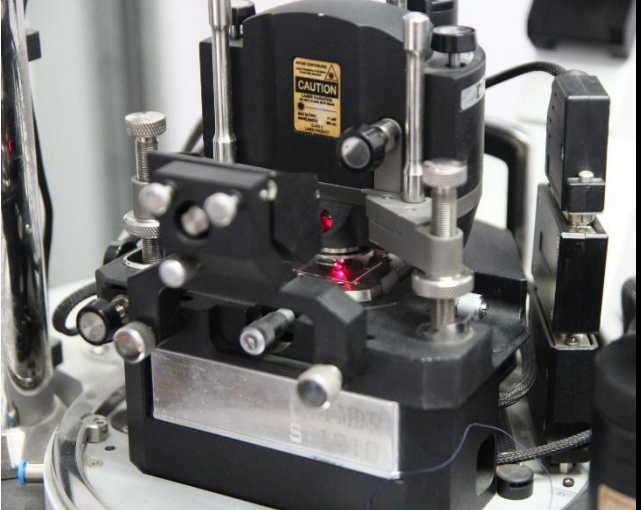
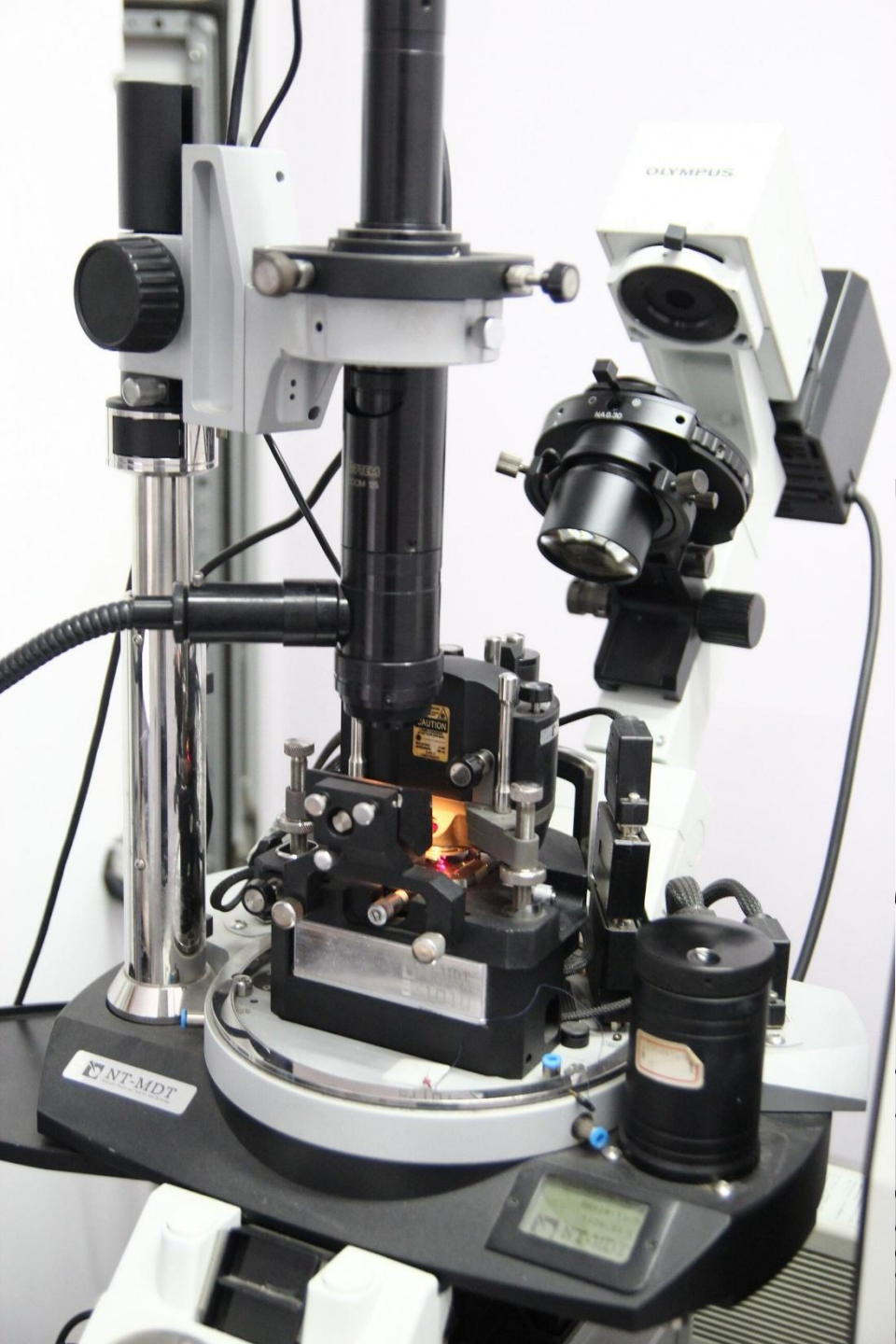
STEM-EDX-EELS plasmonic study of Au/Pd octopods at different orientations.

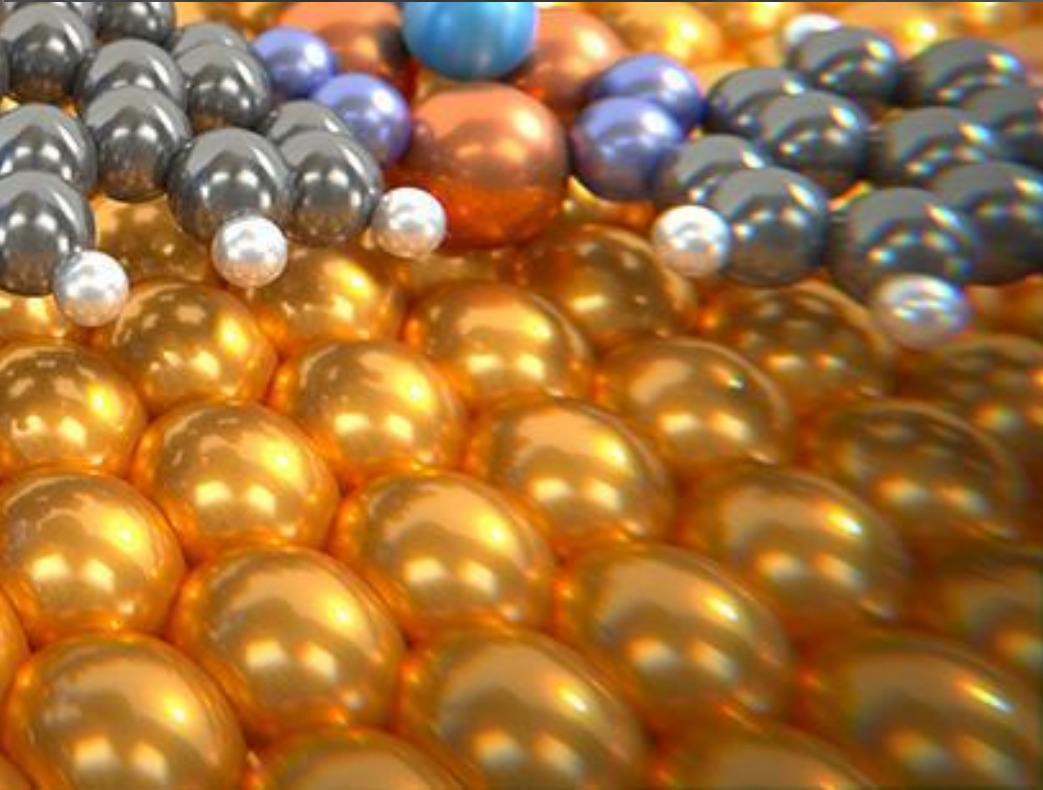
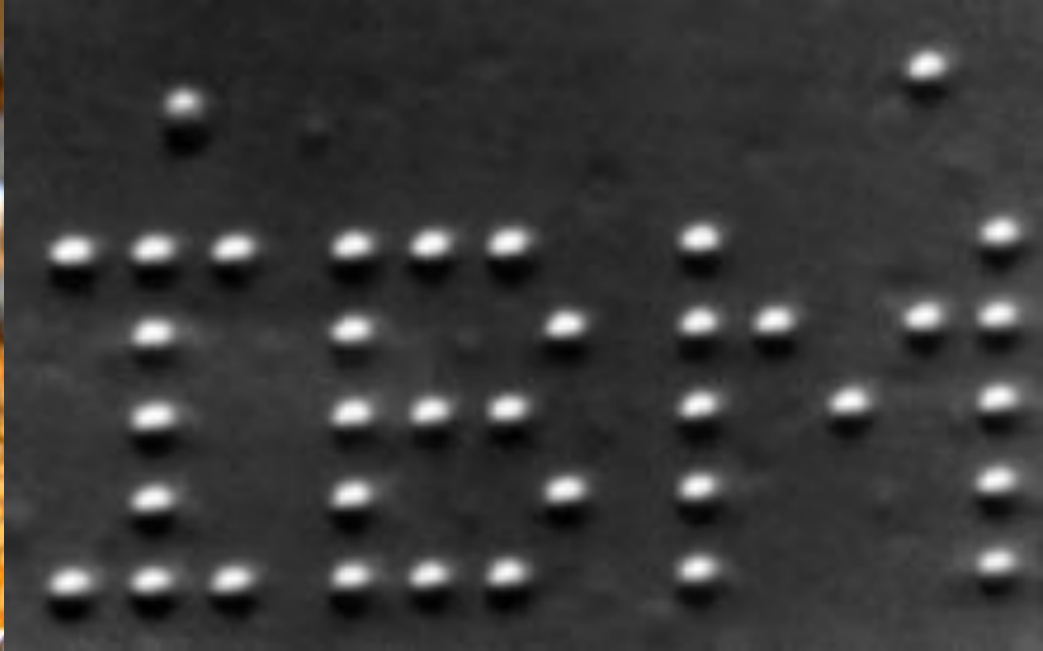
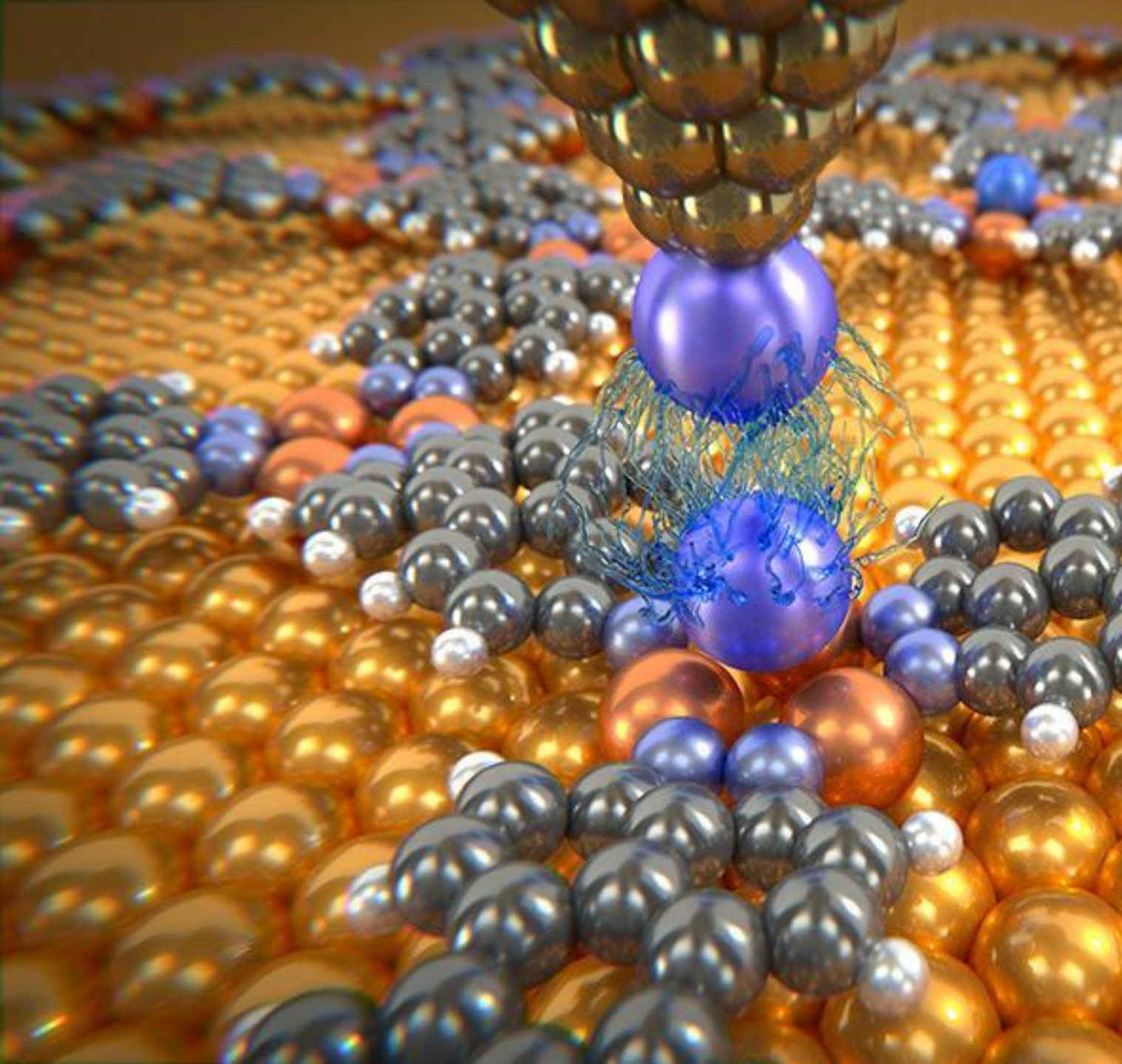


Isosurface visualization of an electron tomographic reconstruction of GaMnAs nanowire.











A Boy And His Atom: The World's Smallest Movie



Moving Atoms: Making The World's Smallest Movie

ПОКАЗАТЬ ДРУГИЕ ВИДЕО



0:38 / 1:33



YouTube



ПОКАЗАТЬ ДРУГИЕ ВИДЕО

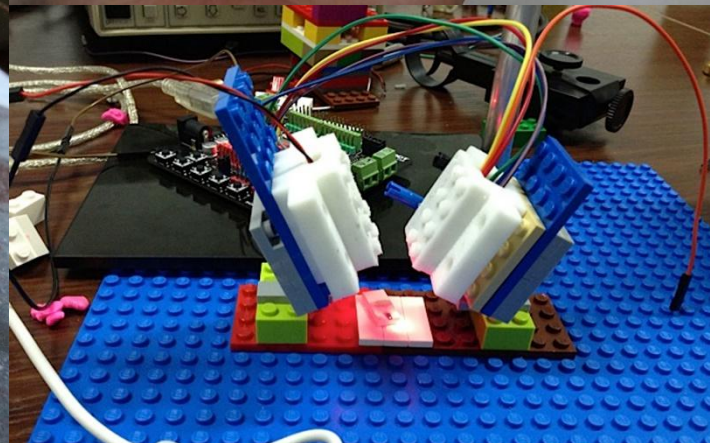
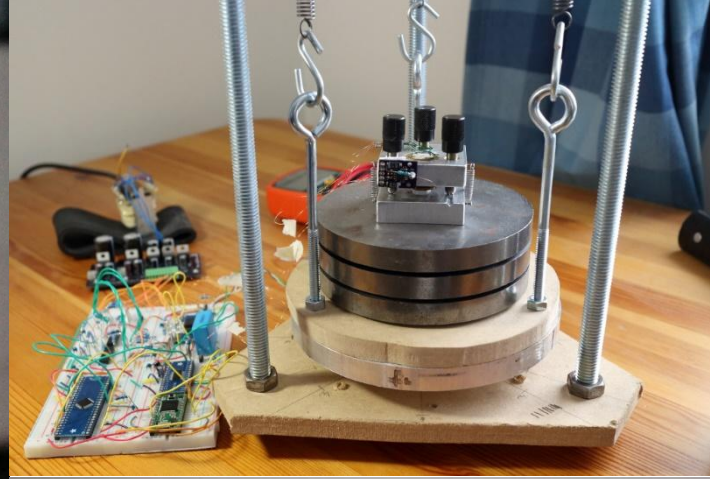
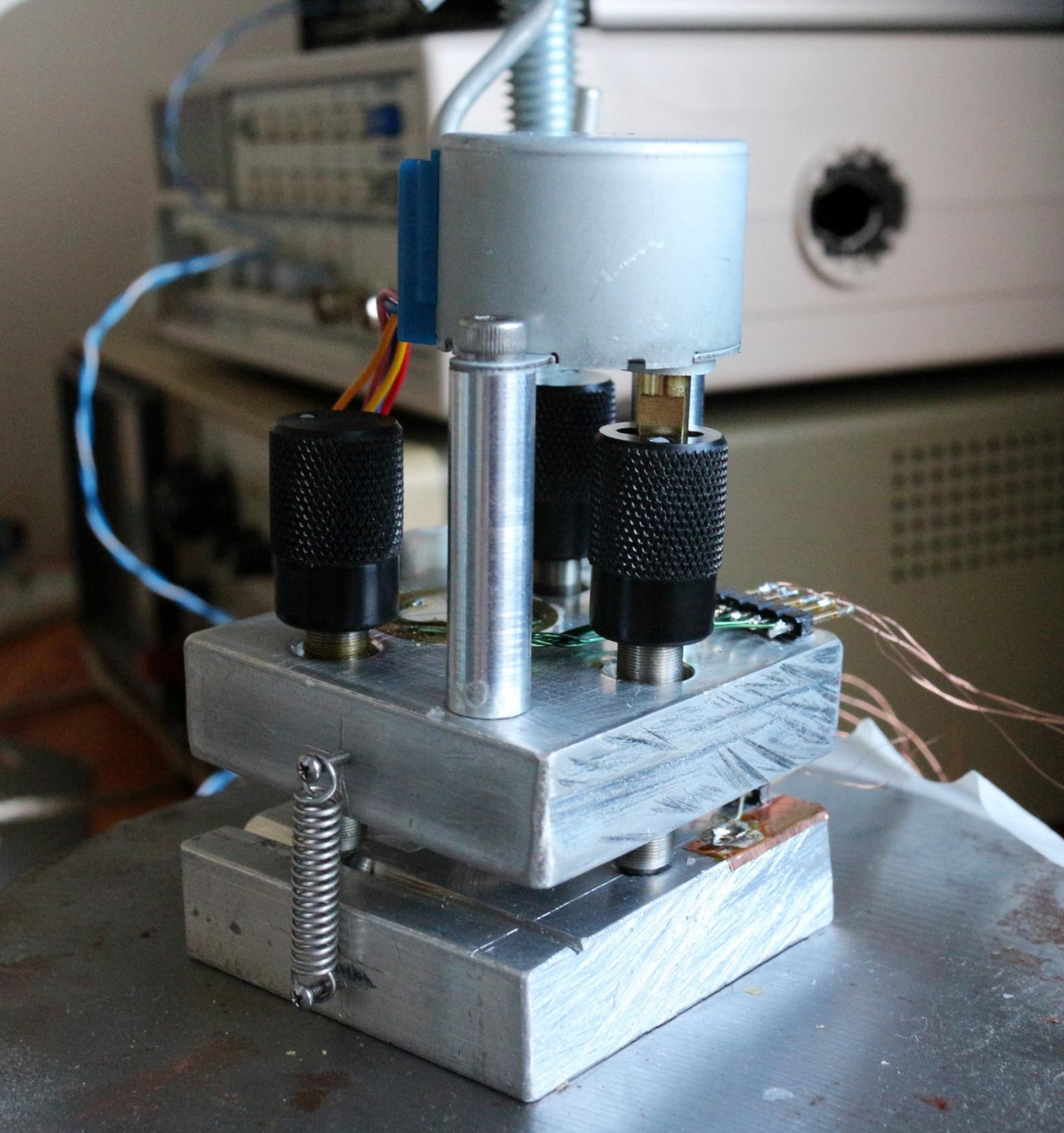


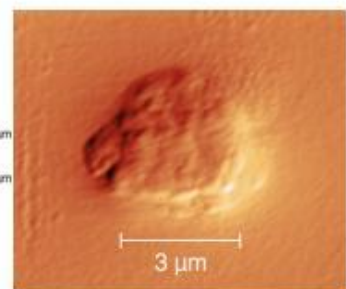
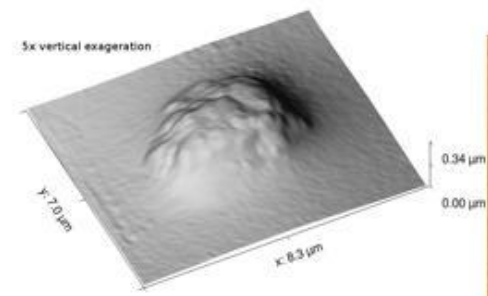
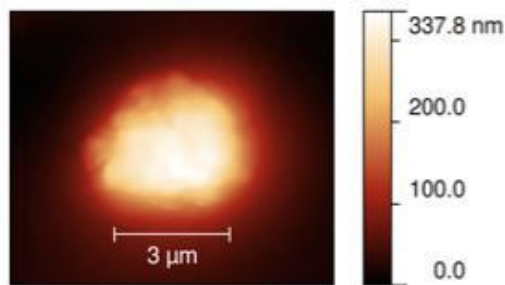
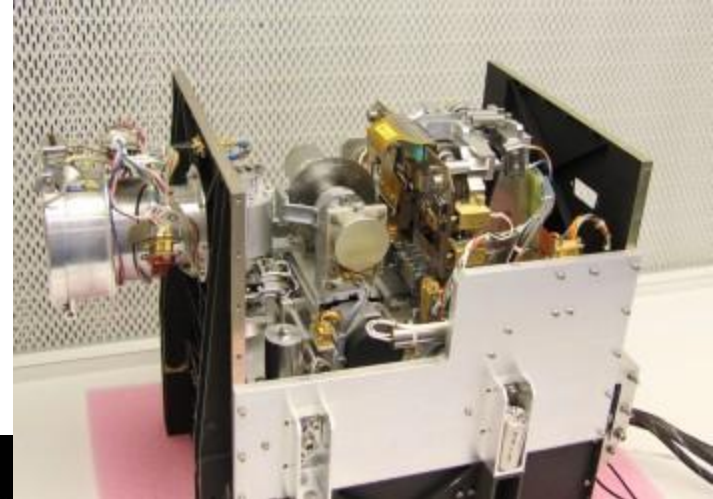
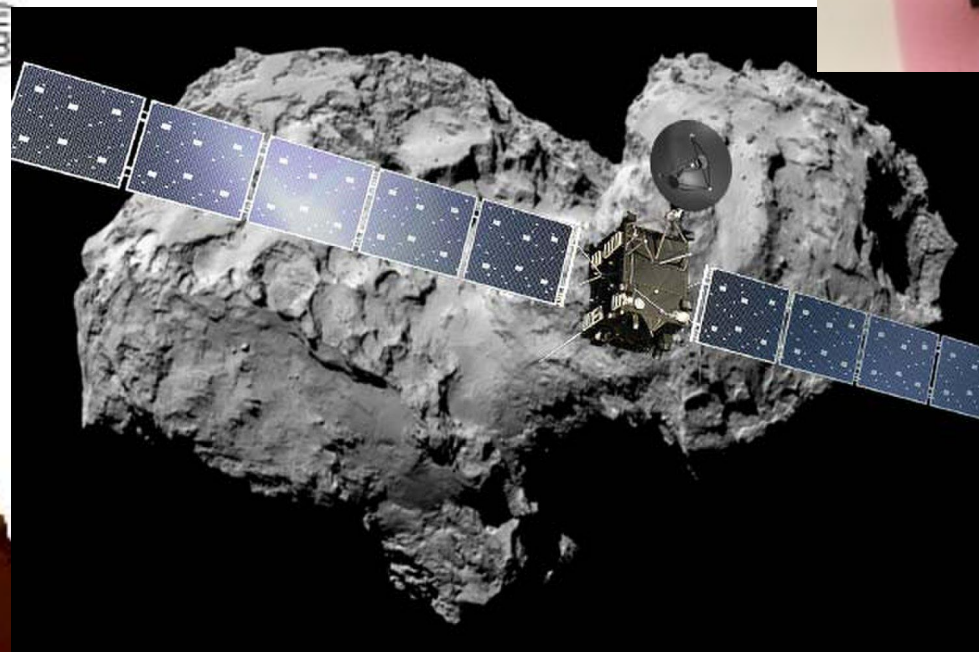
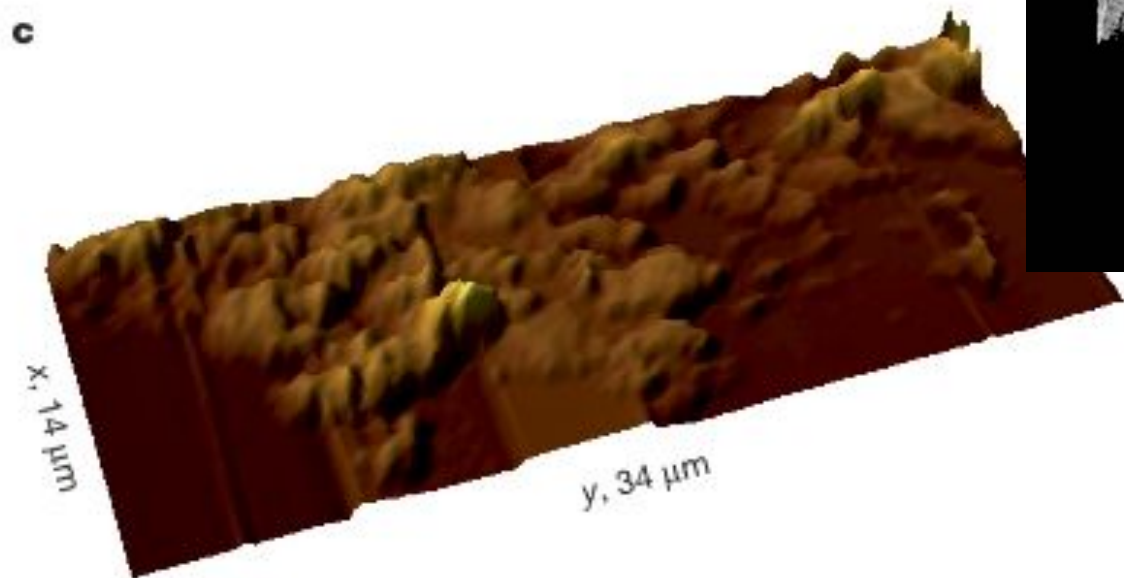
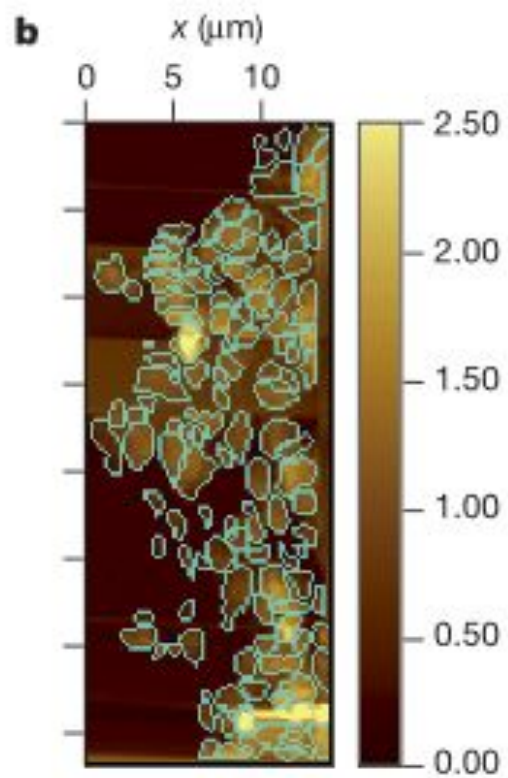
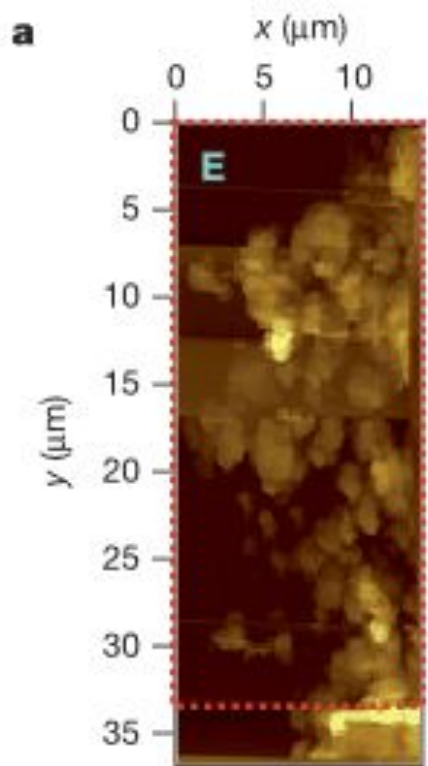
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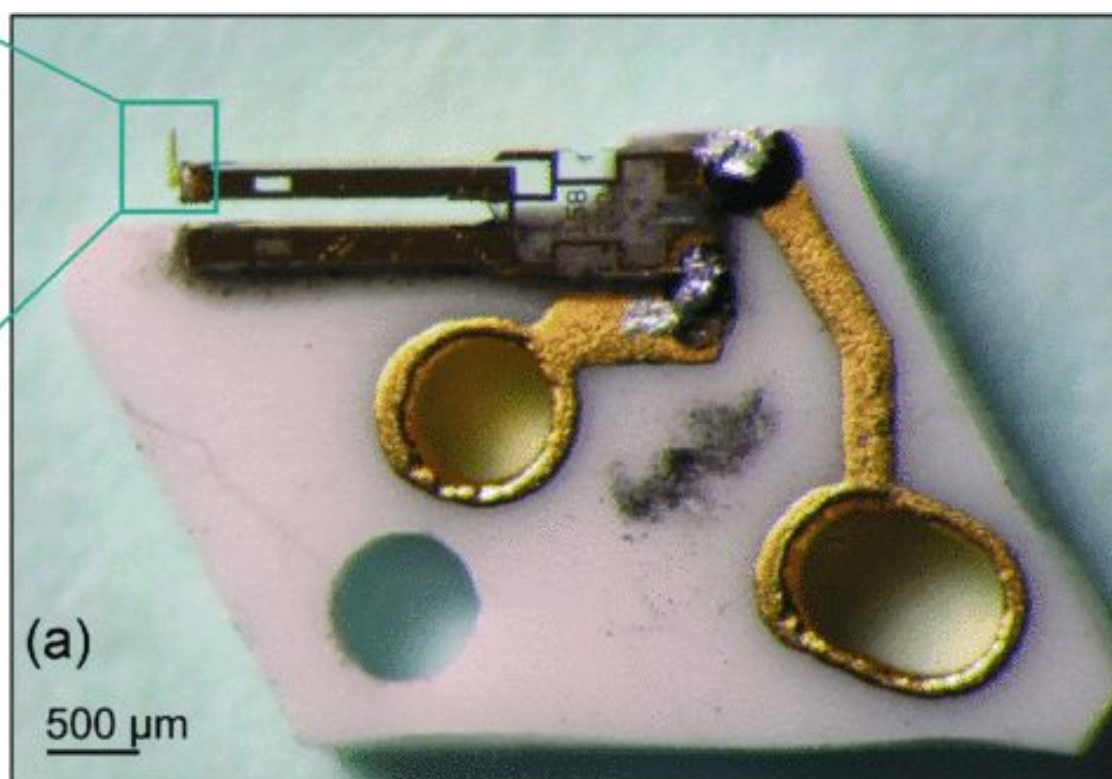
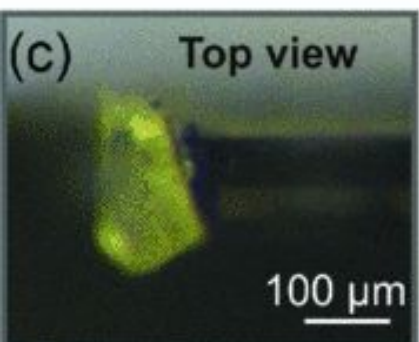
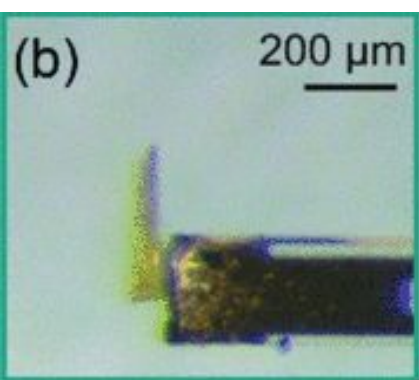
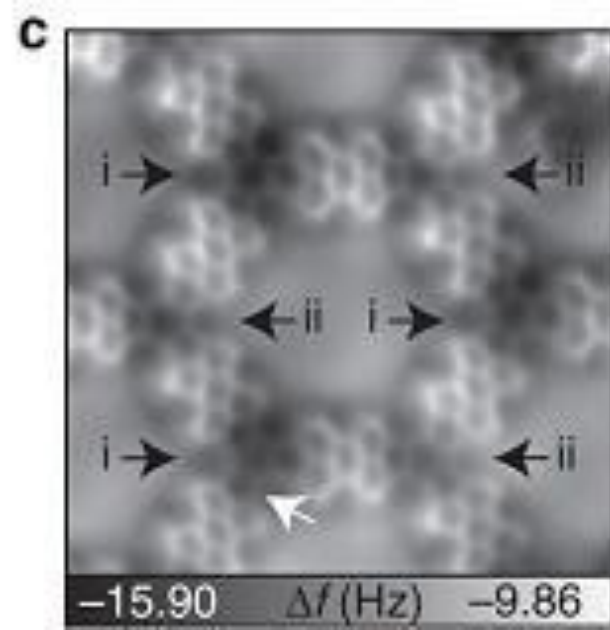
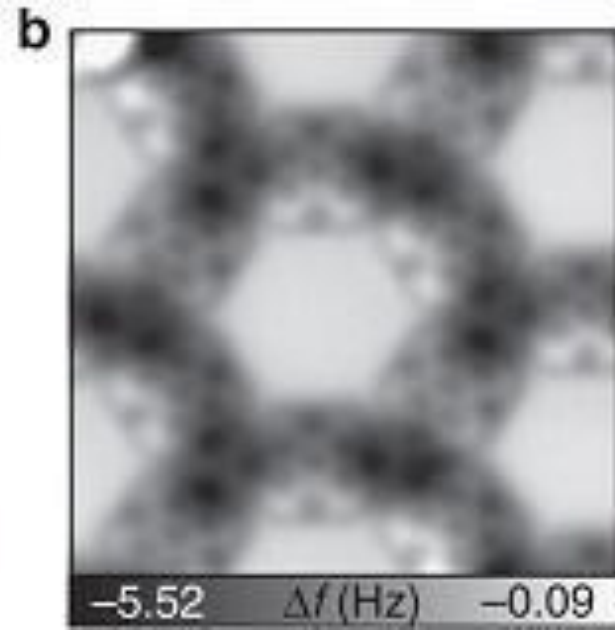
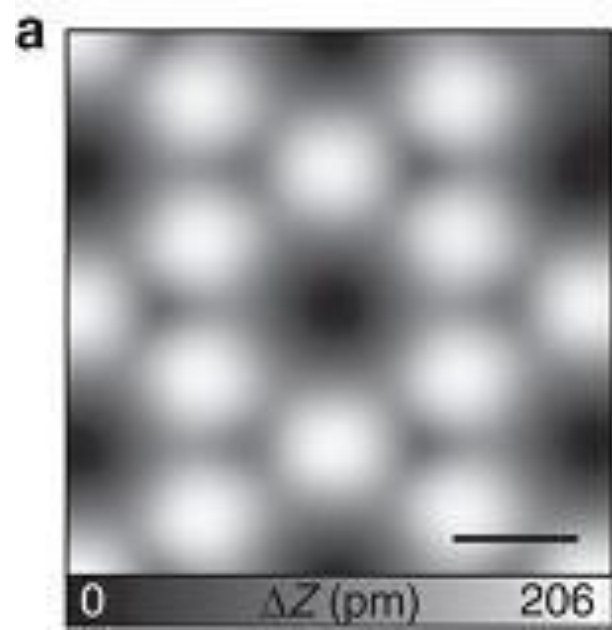


YouTube





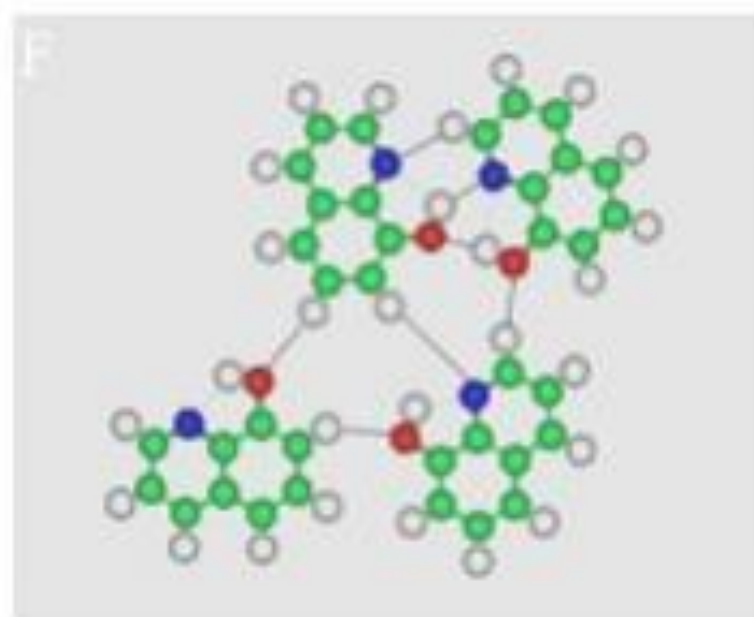
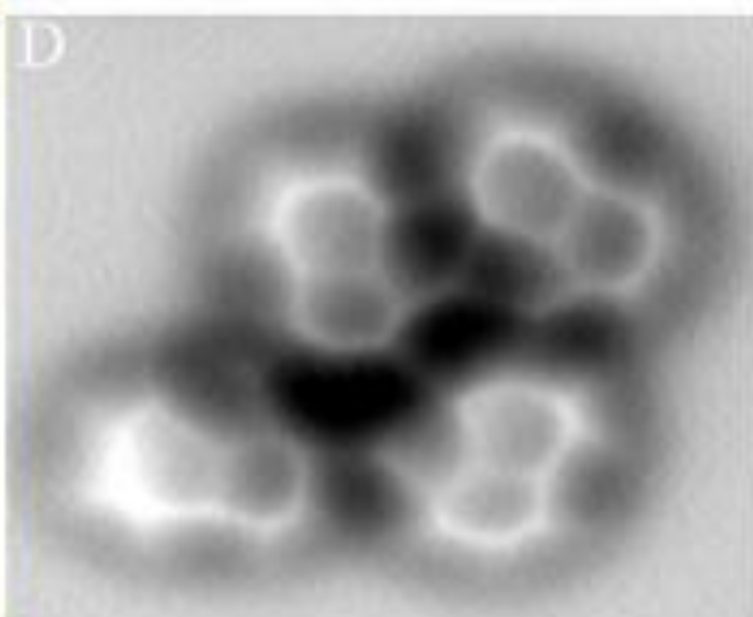
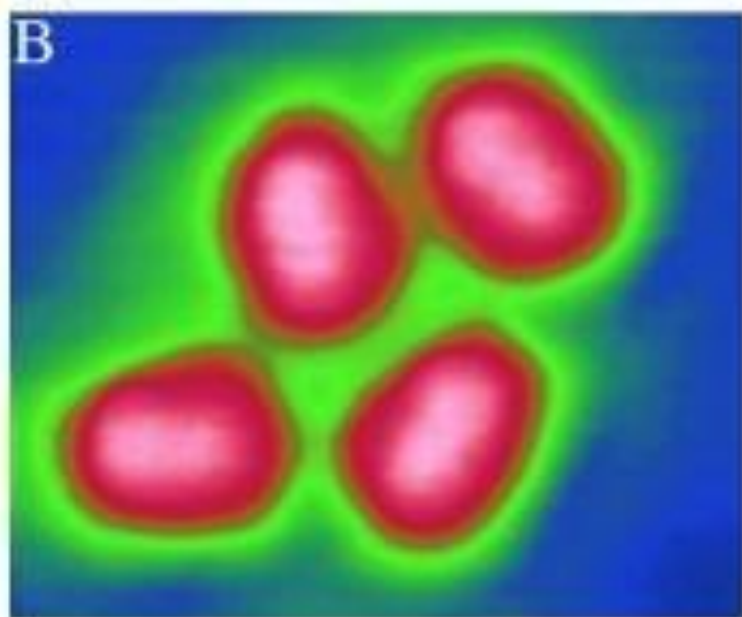
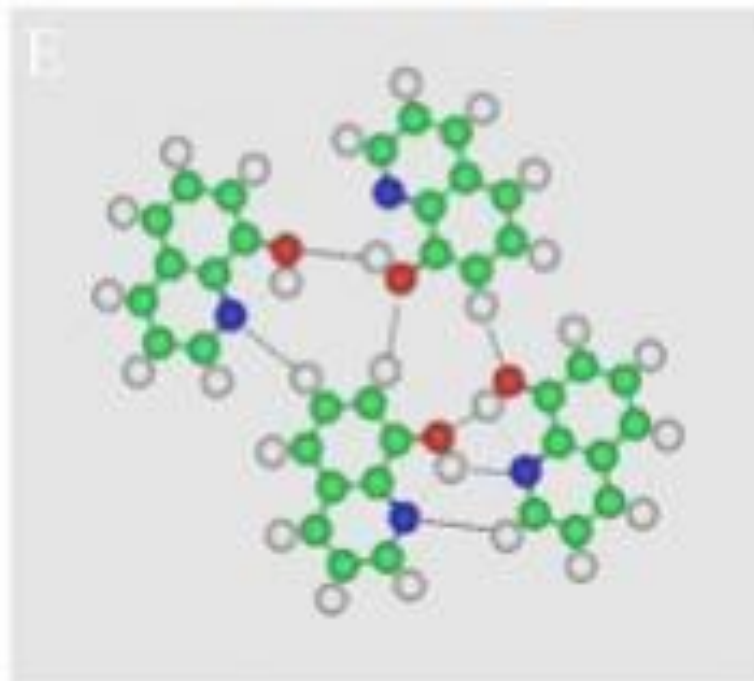
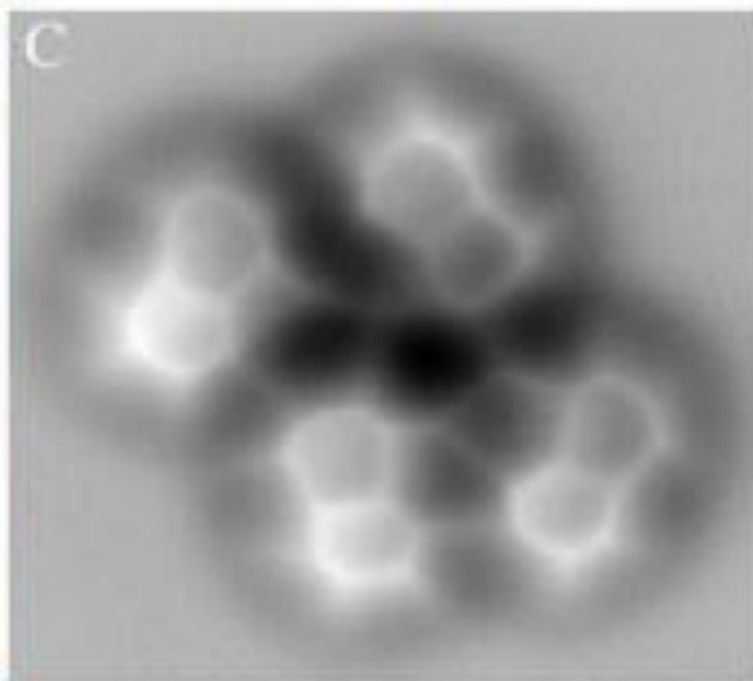
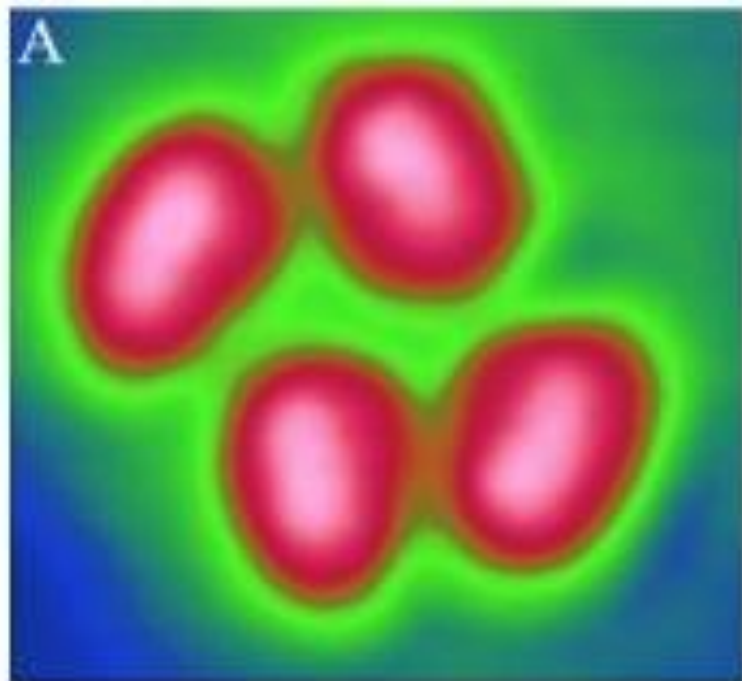


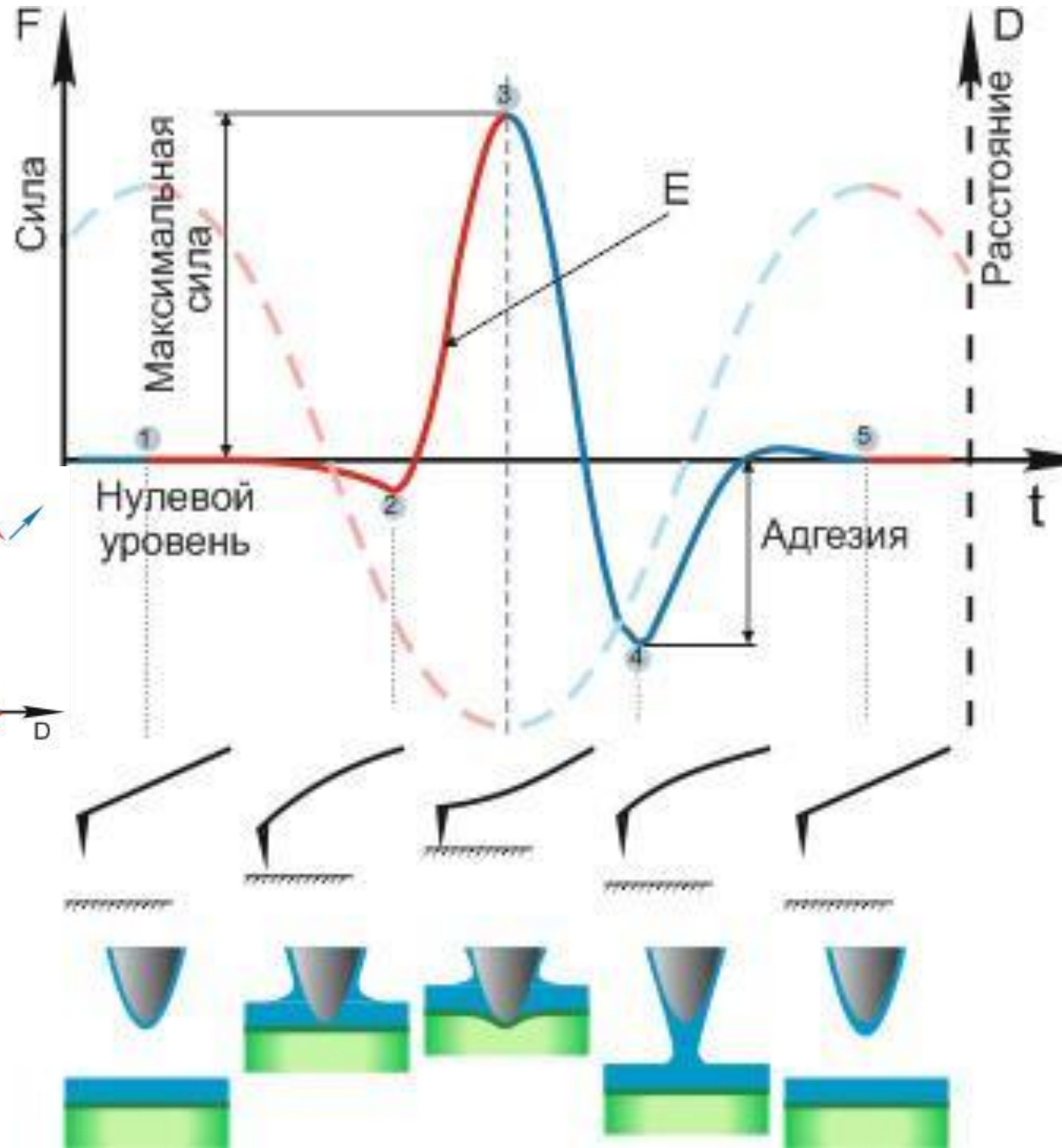
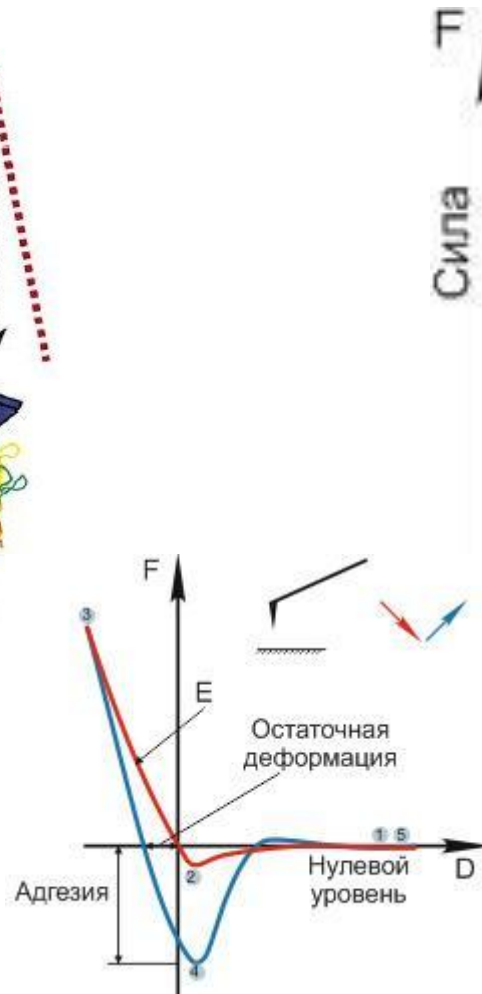
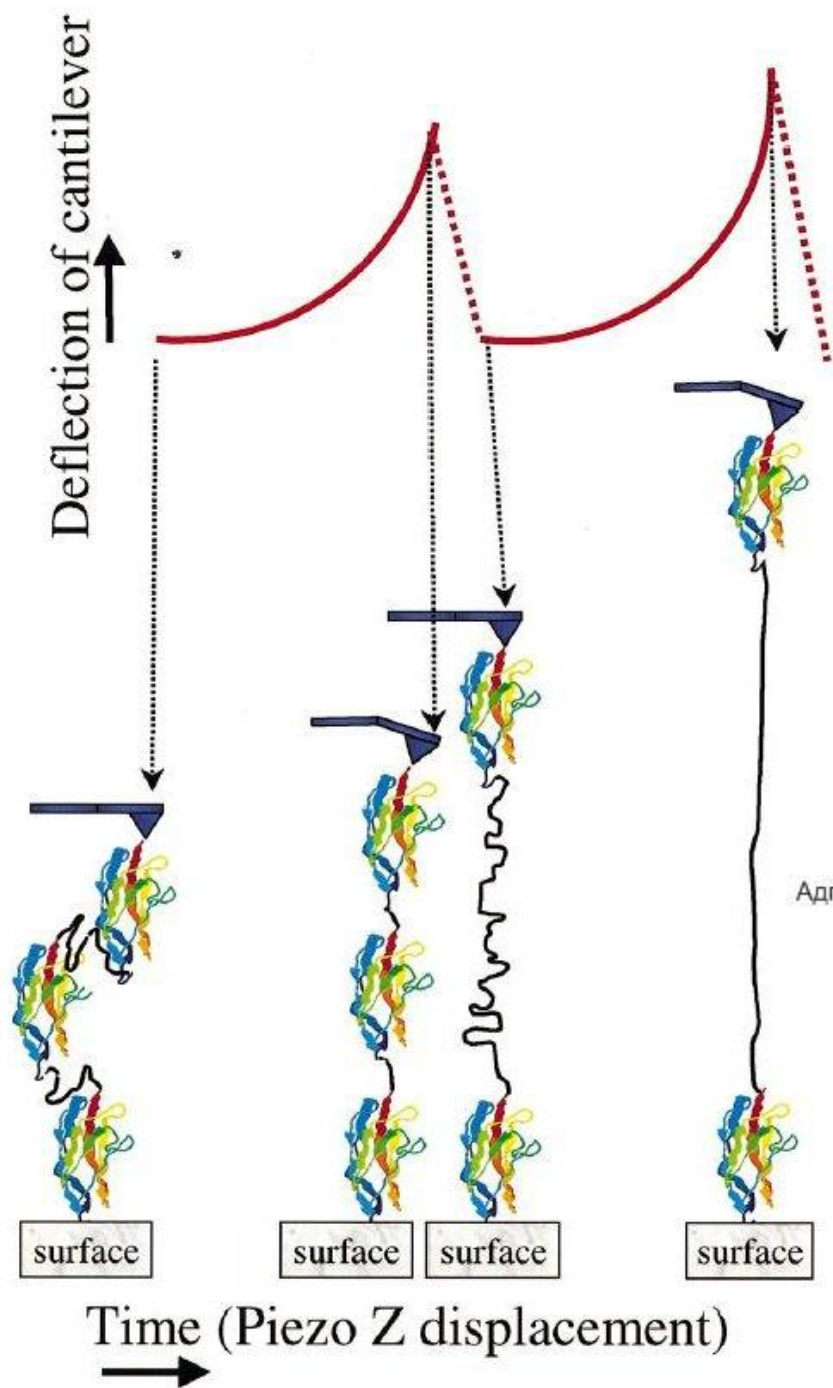


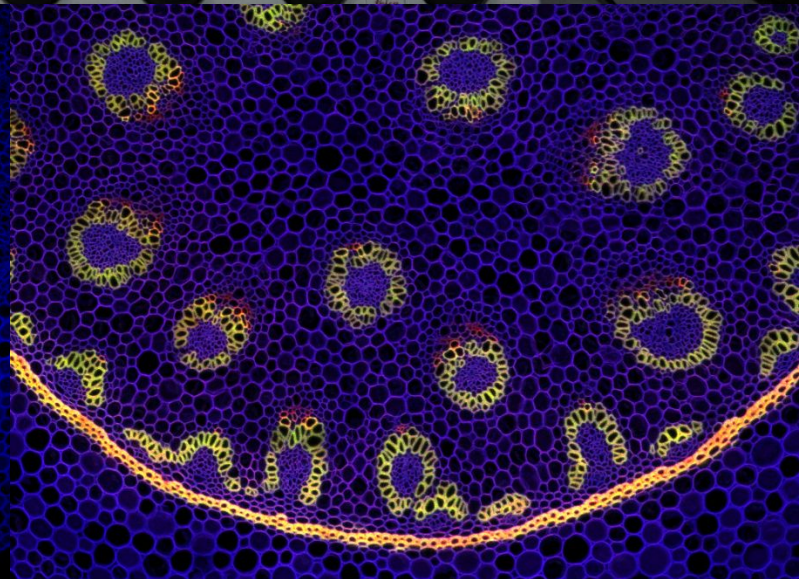
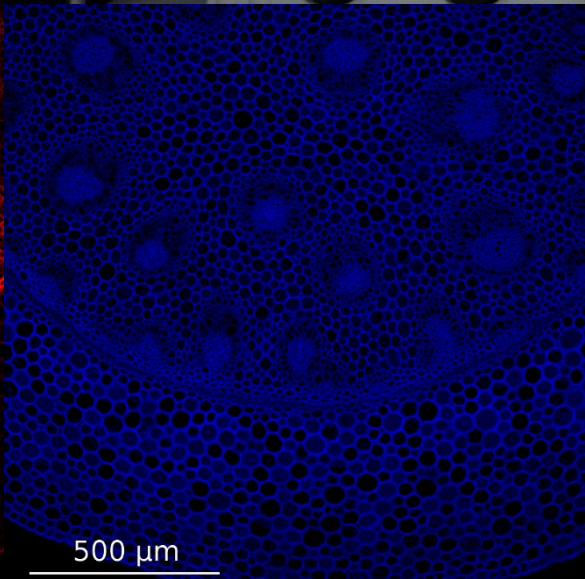
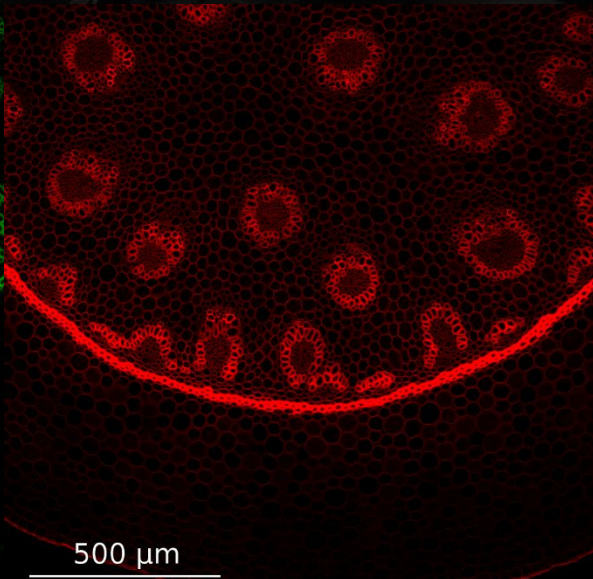
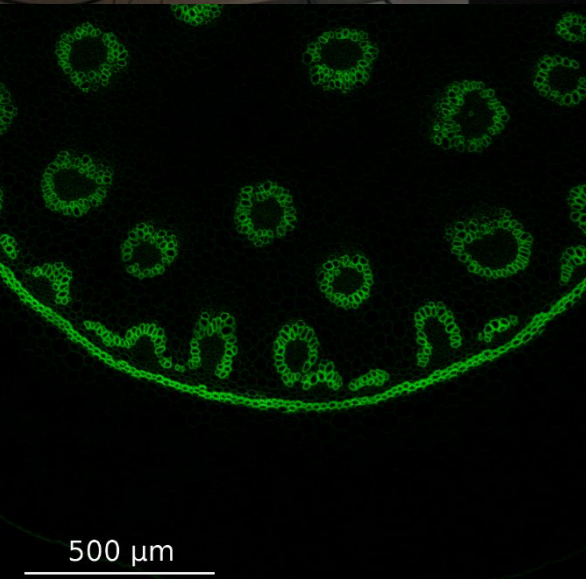
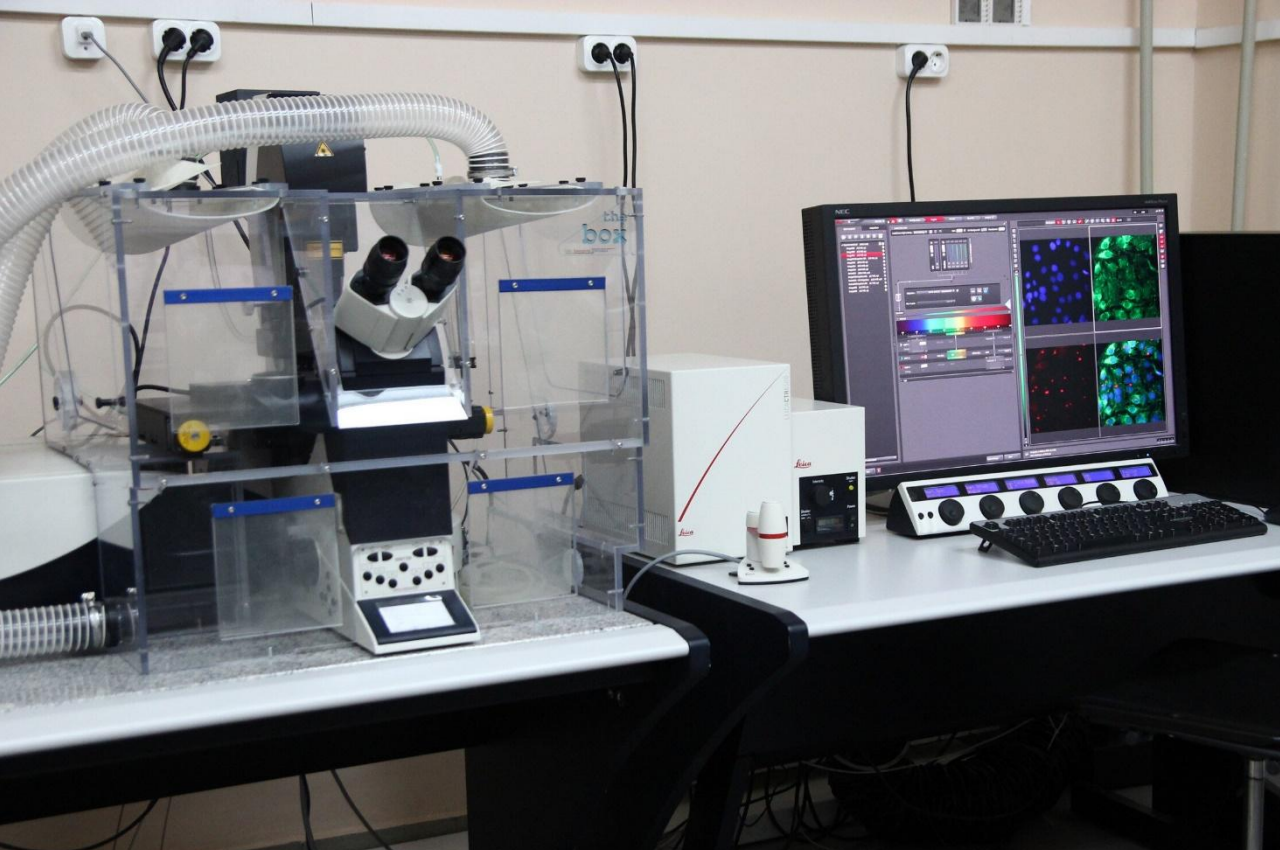
# STM

# AFM

# Model





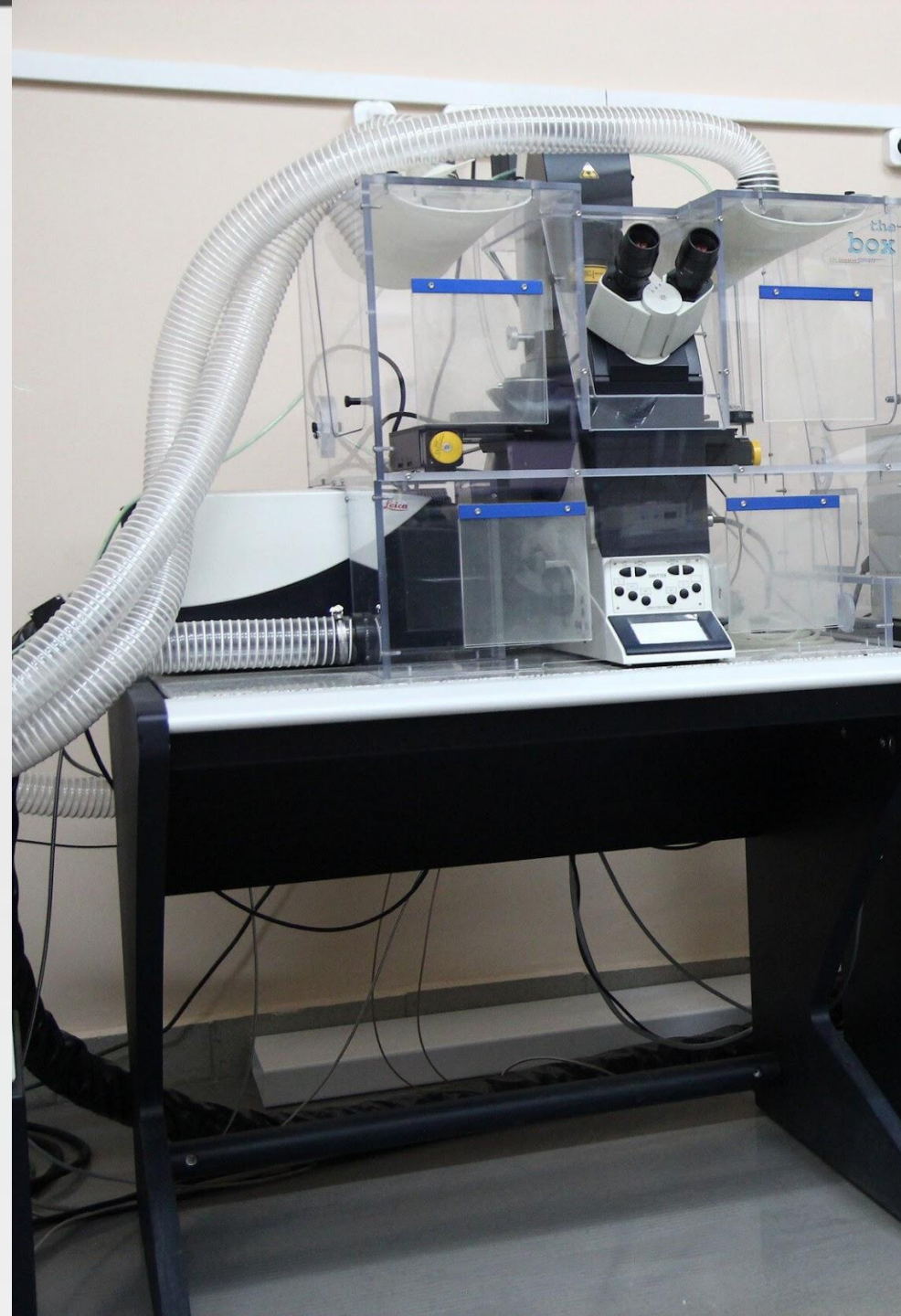
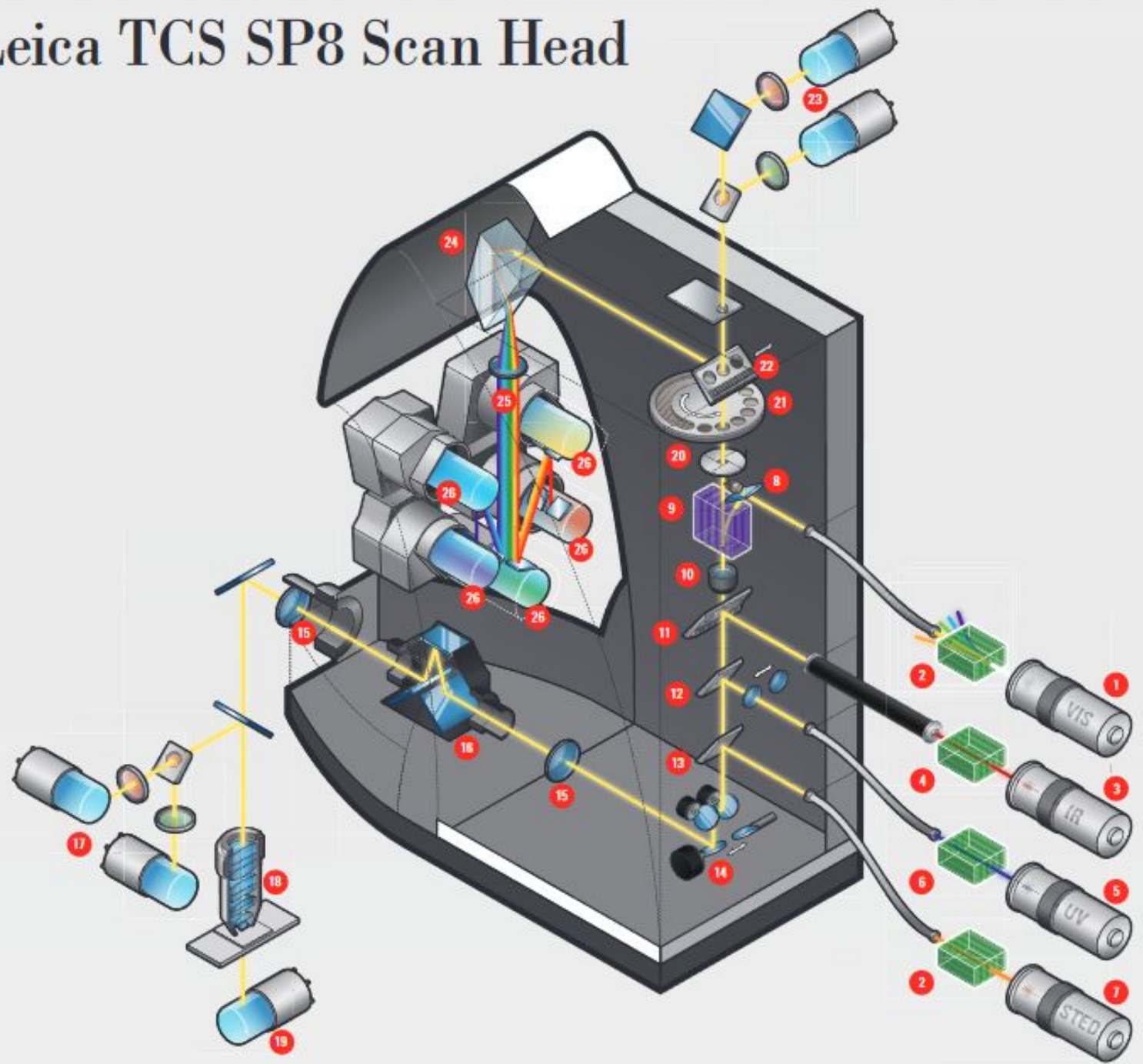


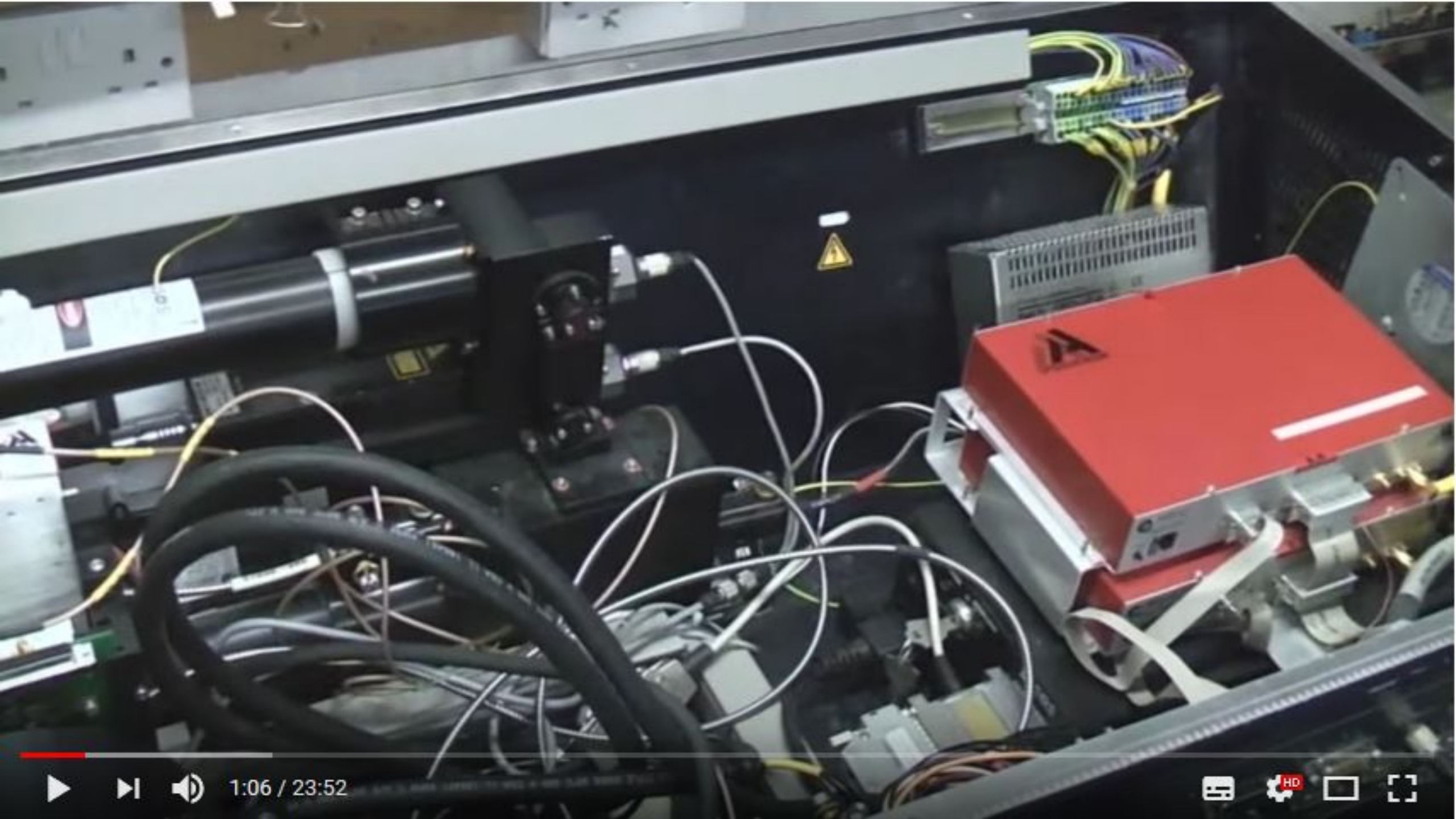


NIH3T3 cells transduced with five individual fluorescent protein (FP) vectors. FPs: Cerulean, EGFP, Venus, tdTomato and mCherry. Each FP was visible only in the cells transduced with the corresponding vector. Courtesy of Daniela Malide, NIH Bethesda, MD USA



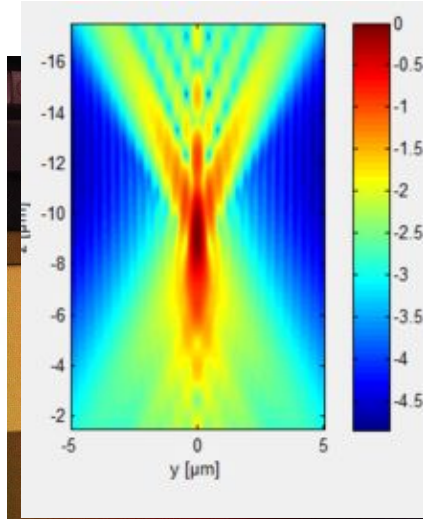
# Leica TCS SP8 Scan Head





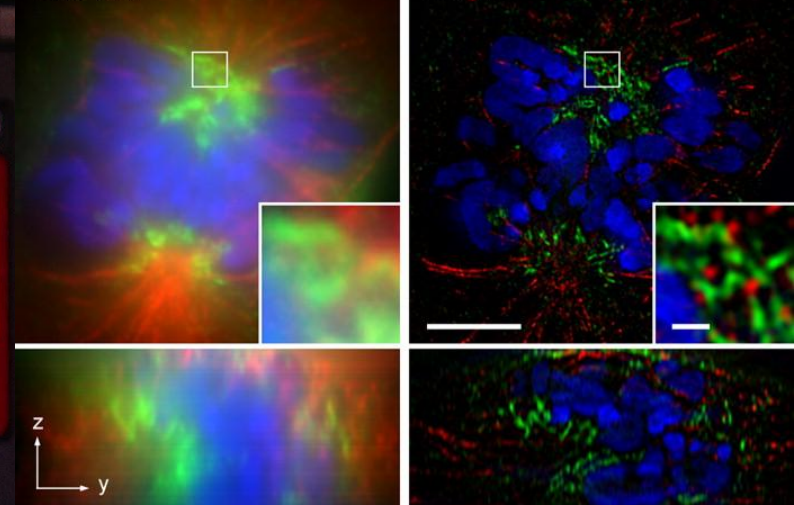
1:06 / 23:52



**CLSM****3D-SIM****A**

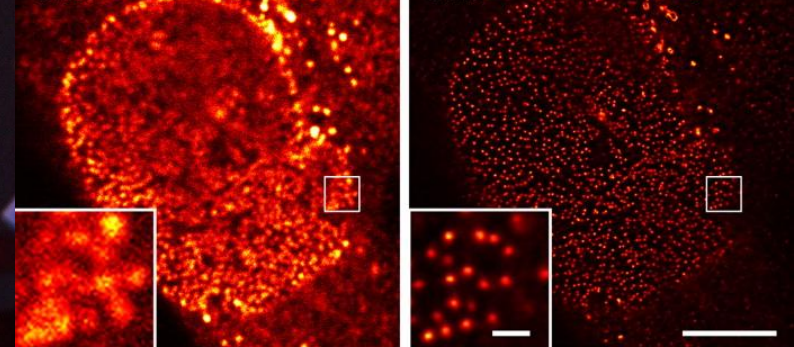
Wide-field

3D-SIM

**B**

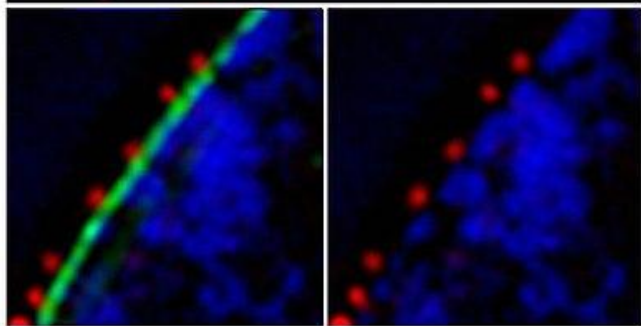
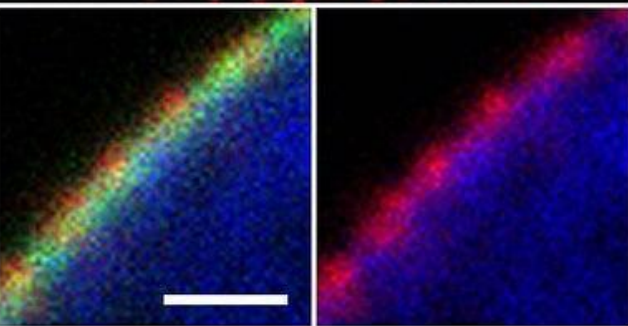
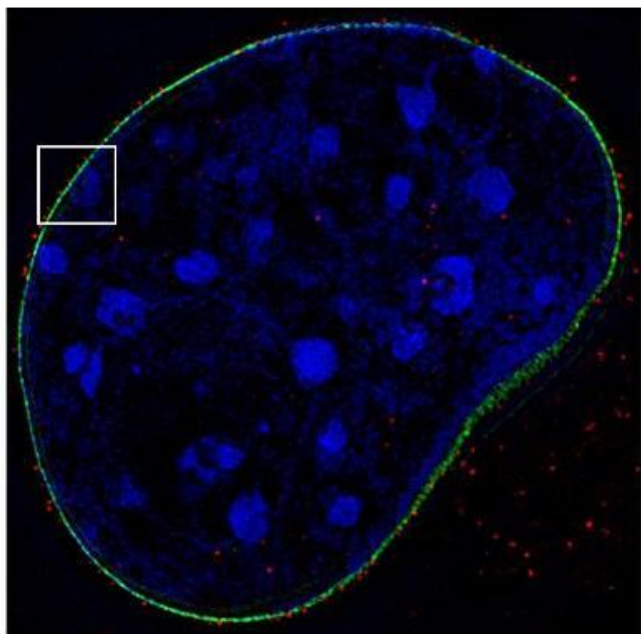
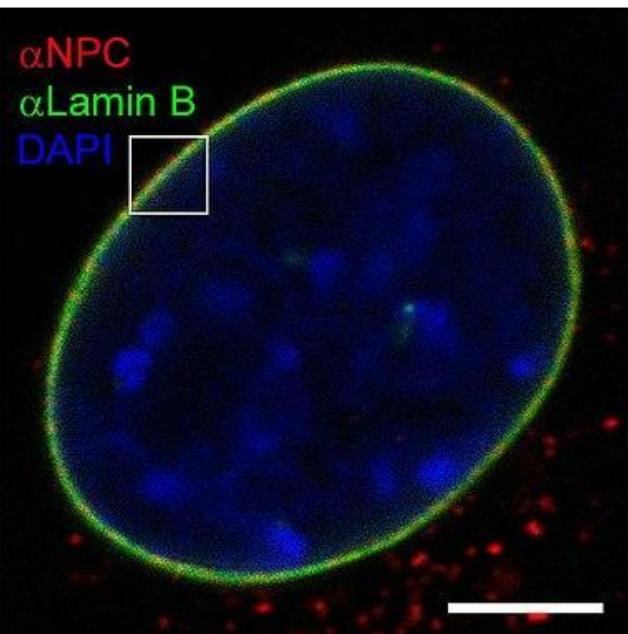
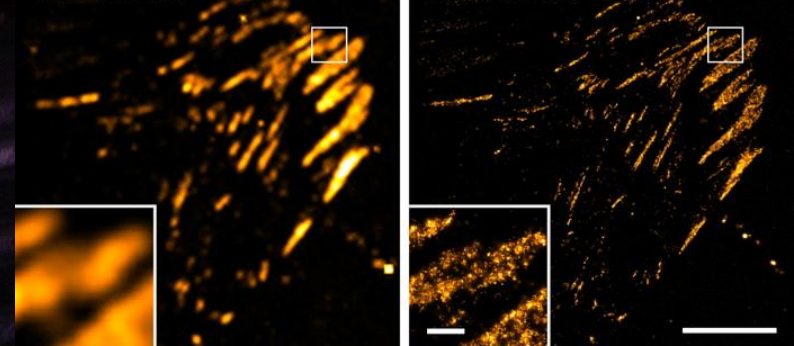
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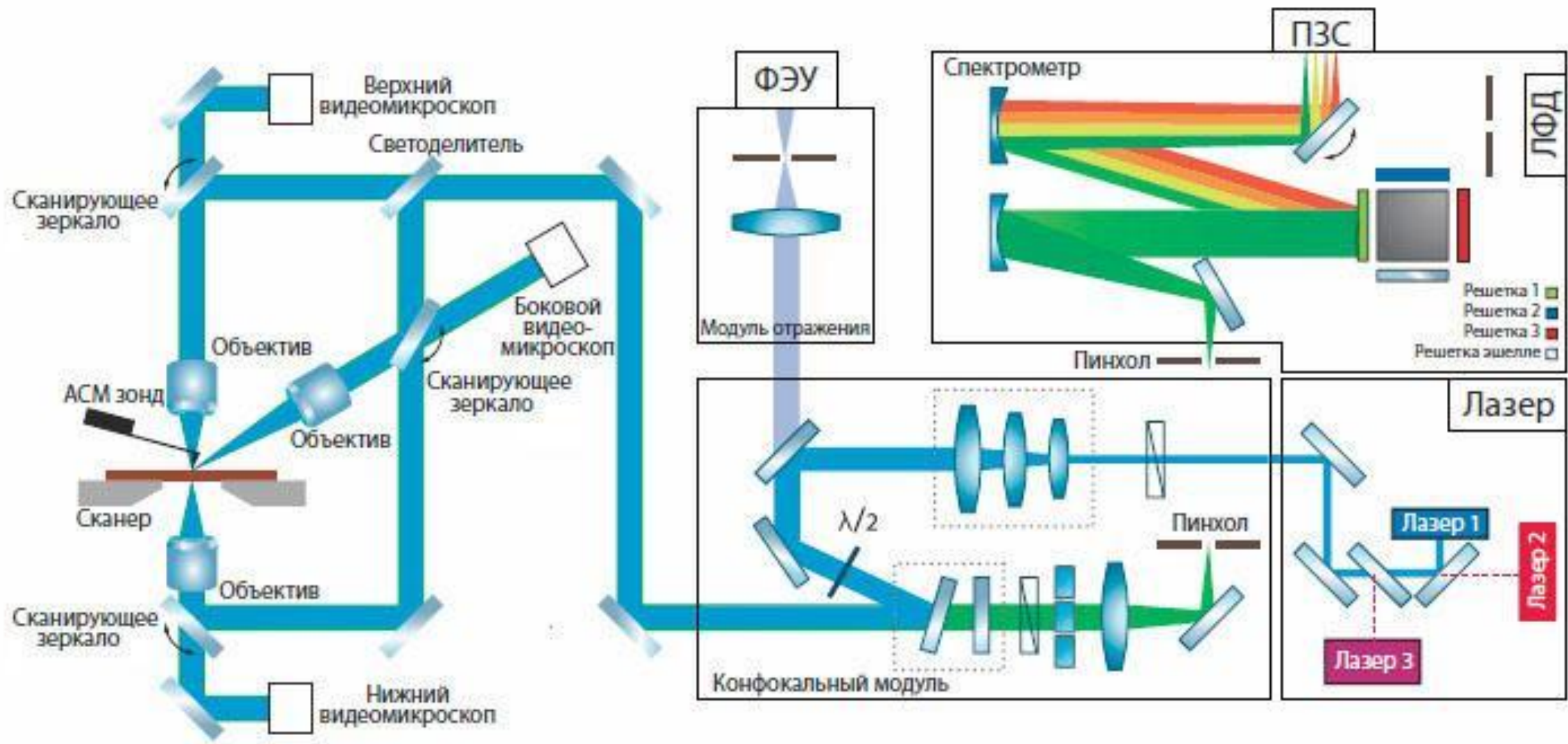
STED

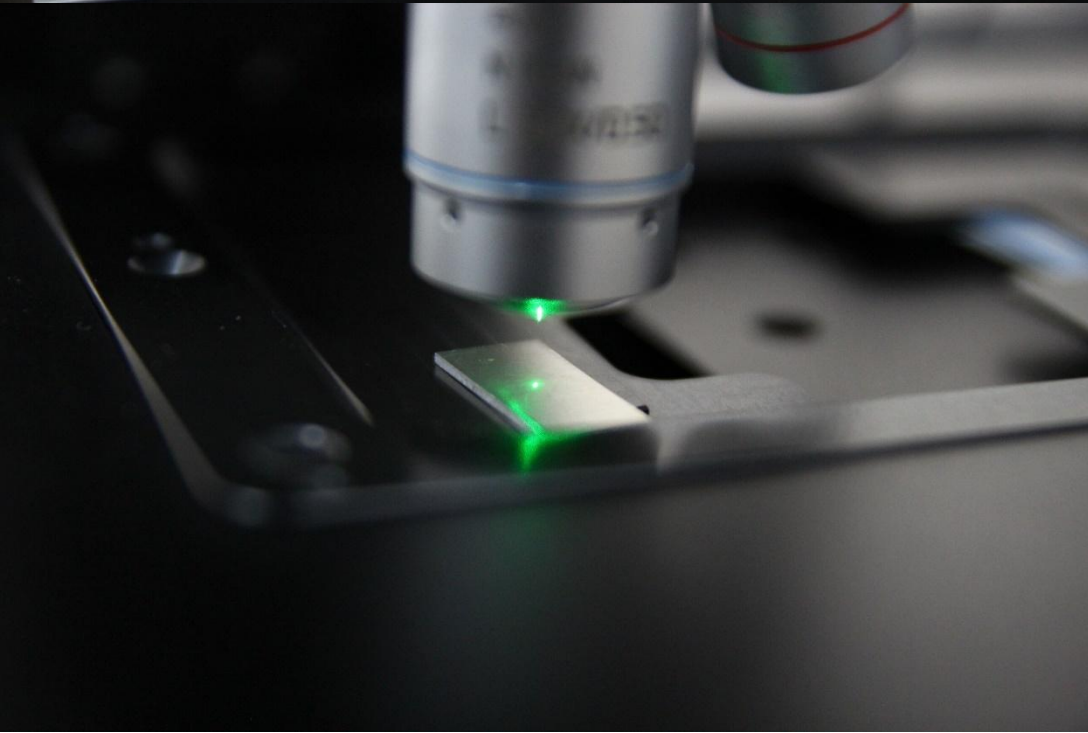
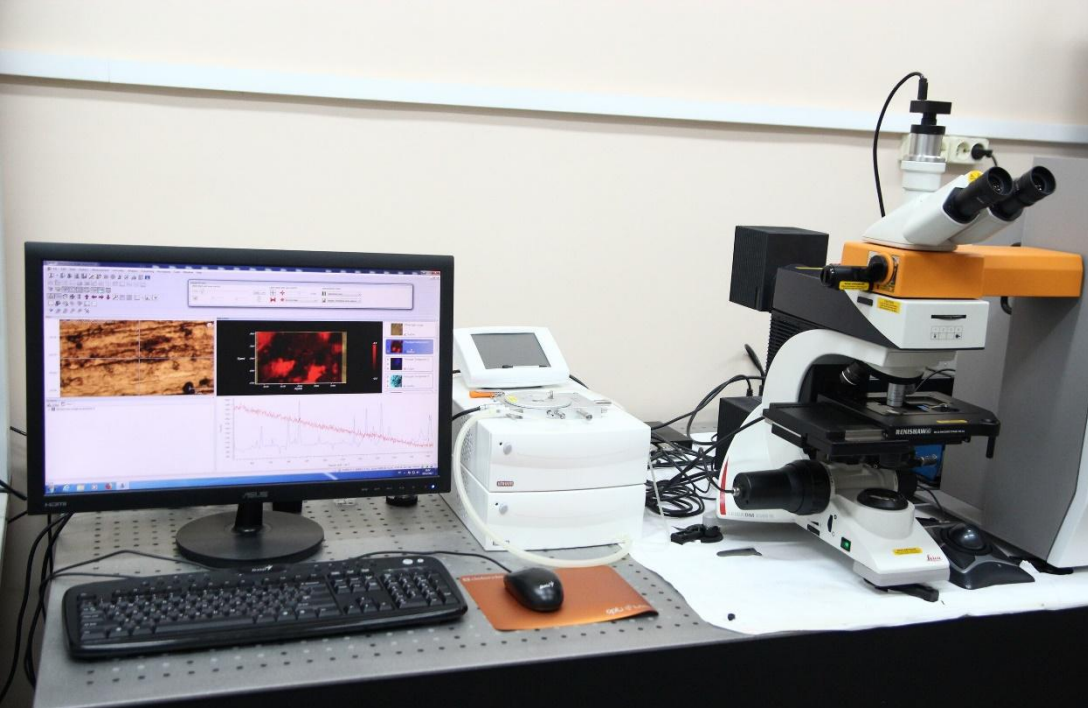
**C**

Wide-field TIRF

PALM/STORM







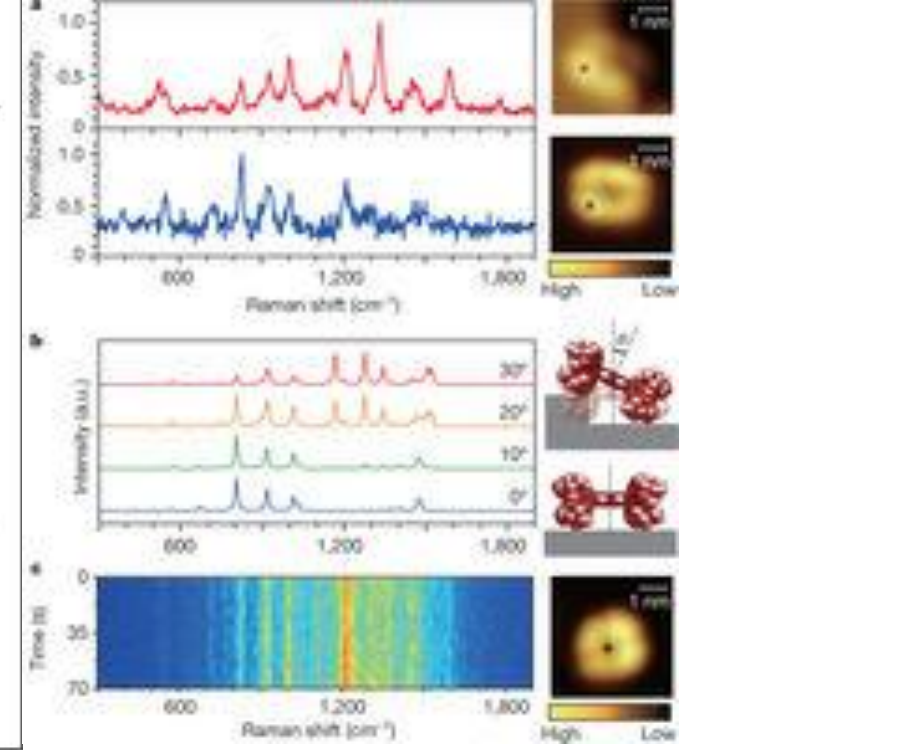
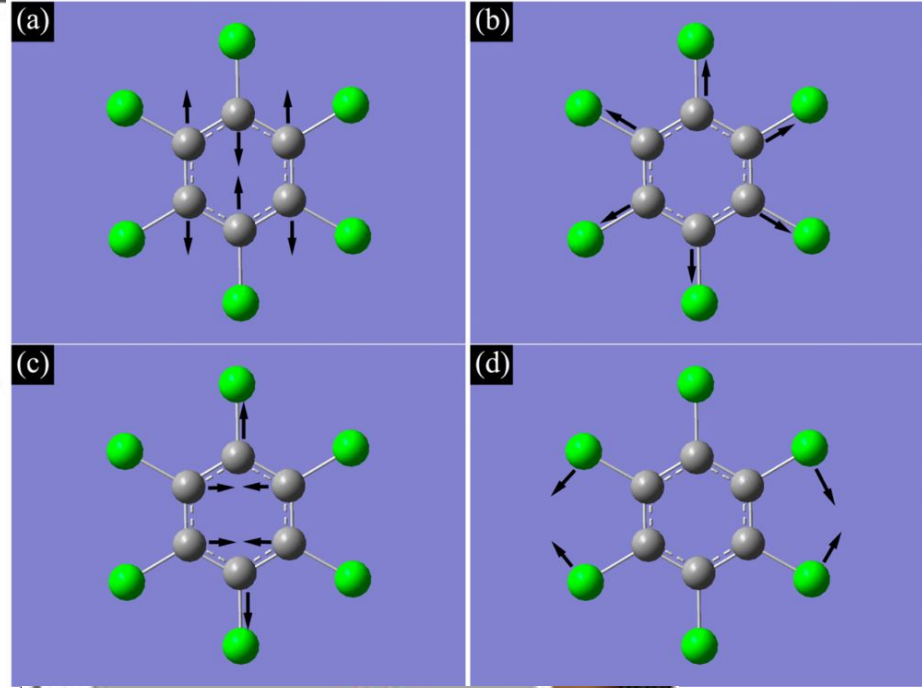
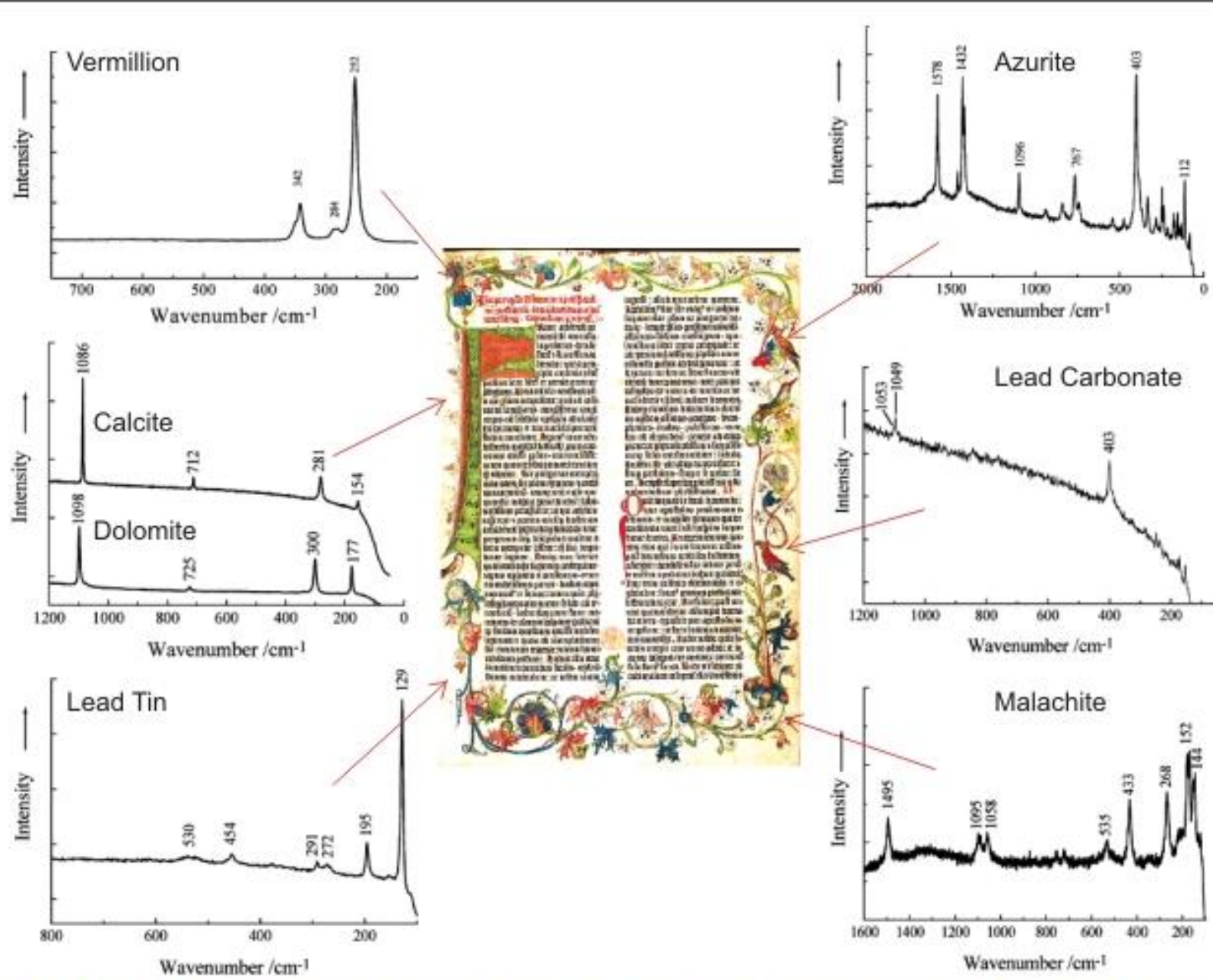


Fig. 4.1.8: Some Raman spectra of pigments used on a Gutenberg Bible (with permission, from Anal. Chem. 77 (2005) 3611).

Спасибо за внимание  
Вопросы?  
[dn2010@gmail.com](mailto:dn2010@gmail.com)

