Estudio y caracterización de sistemas unidimensionales usando un microscopio JEM-2010F FasTem por manipulación remota a través de Internet 2

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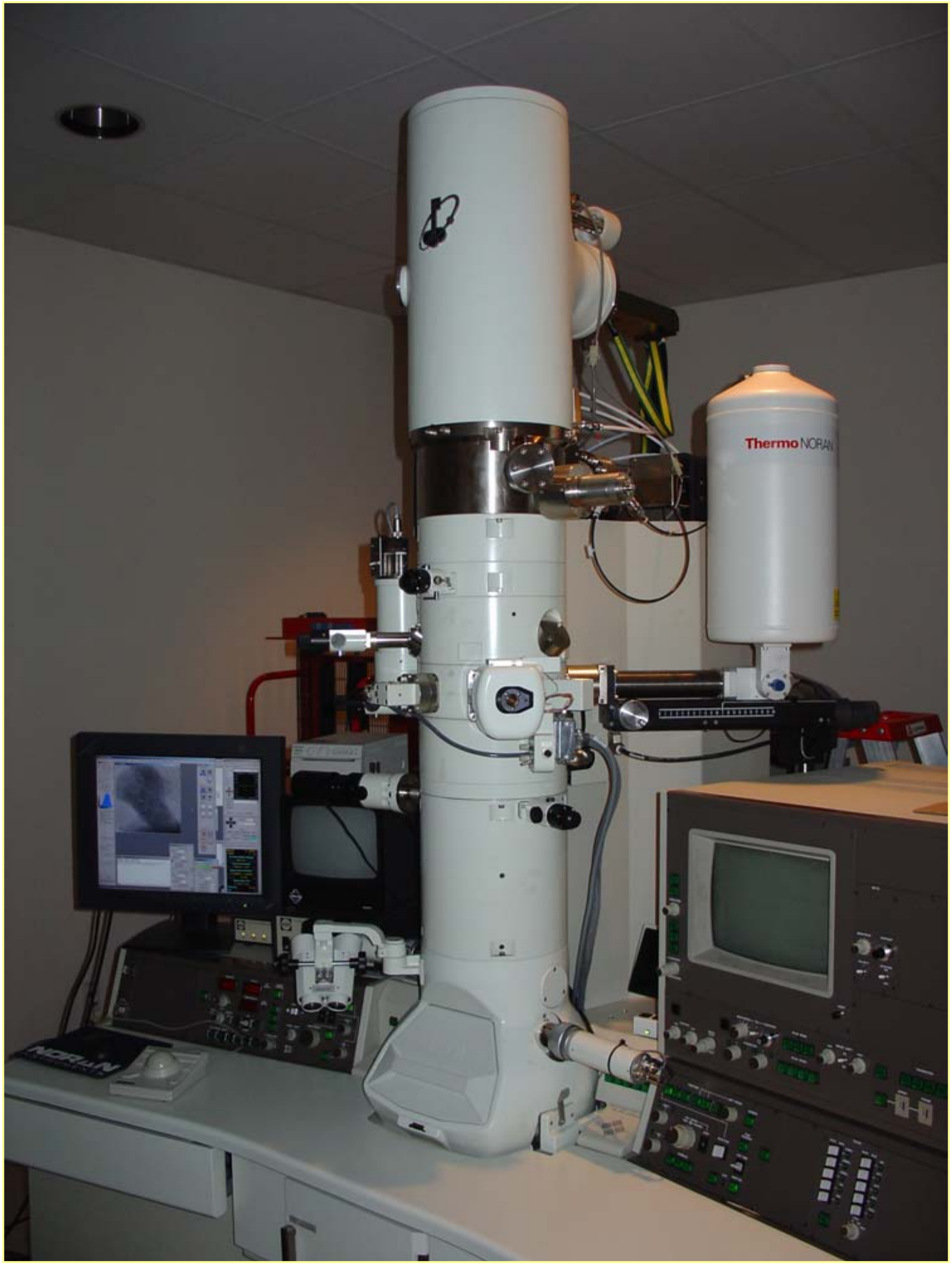
Dra. Patricia Santiago IF-UNAM

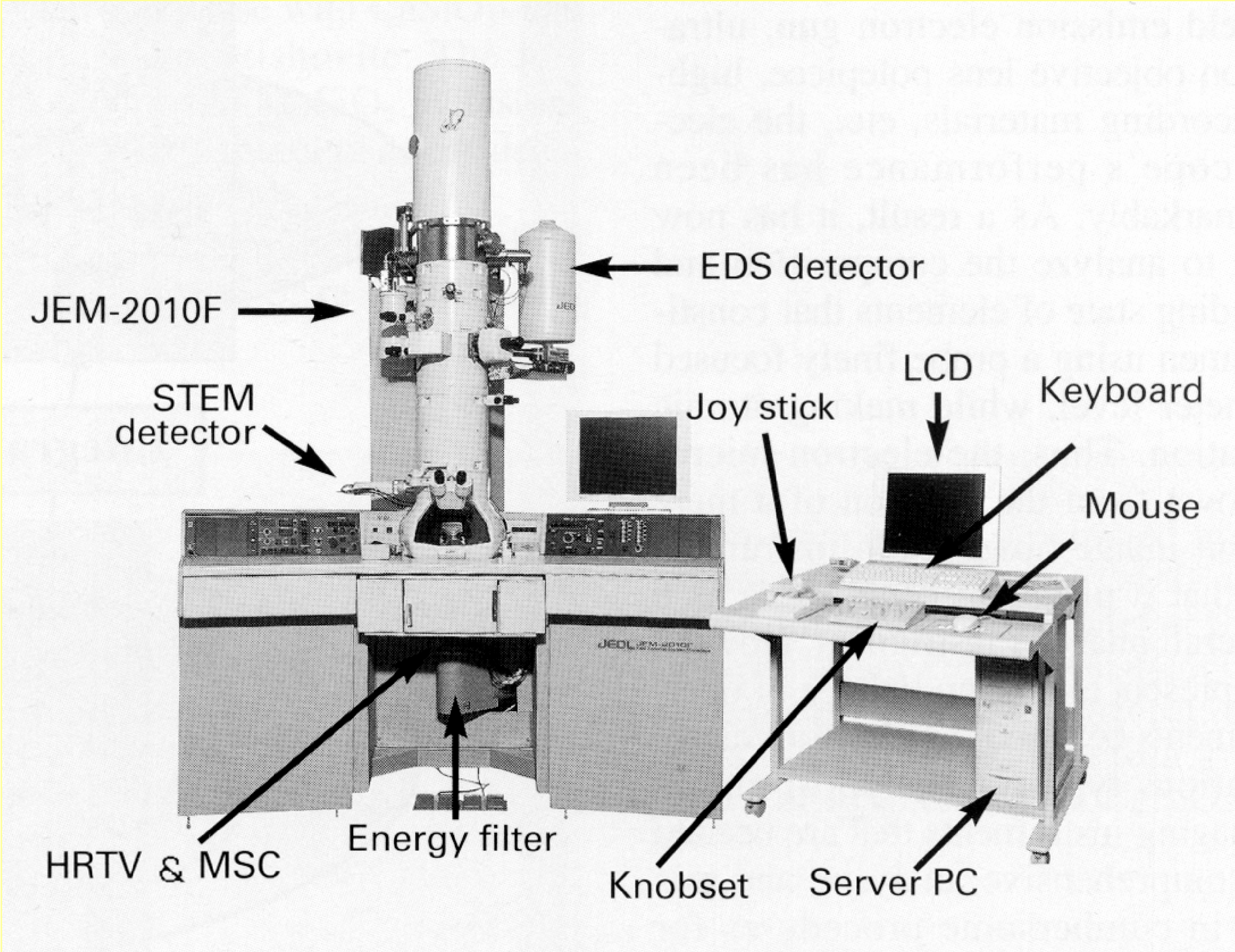
A partir de la aceptación del proyecto por parte del CUDI, se lograron implementar las siguientes tareas:

- *- Comunicación directa entre los investigadores del IFUNAM y del IMP mediante métodos de internet involucrando video y sonido.*
- *- Sistema de control y observación directa de condiciones del microscopio electrónico JEOL 2010 FEG mediante un sistema remoto de control.*
- *- Sistema de participación paralela de los microscopios de transmisión del IFUNAM y el de fuerza atómica del IMP.*
- *- Sistema de participación de datos inmediatos entre el microscopio de transmisión y el sistema de reconocimiento de patrones desarrollado por el grupo.*
- *- Conjunción de las diversas técnicas analíticas con los métodos de simulación molecular clásica y cuántica para la determinación estructural y de propiedades de los materiales desarrollados.*

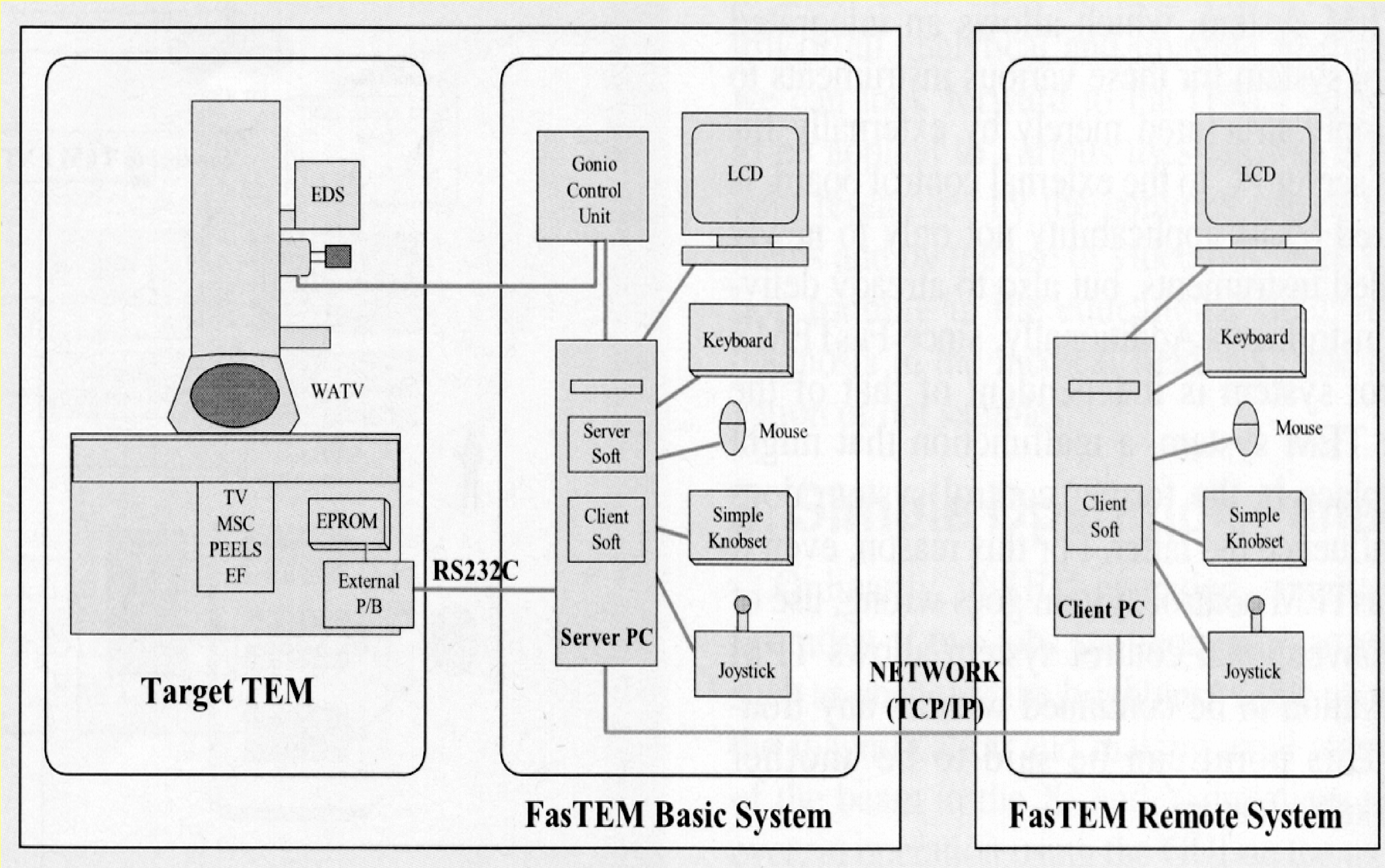
- Asociado a estas tareas directamente dependientes del uso del Internet2, se efectuaron actividades en la síntesis de materiales nanoestructurados de una dimensión, logrando resultados importantes en metales (Au, Ag y Zn), semiconductores (CdSe, CdS, ZnS y CuInTe) además de calcogenuros con propiedades catalíticas (MoS2 y MoS2+C).
- Los resultados técnicos sobre los materiales obtenidos y sus aplicaciones serán discutidos también, mostrando importantes avances en este ámbito, lo que ha representado diversos trabajos publicados y presentados en revistas y congresos internacionales respectivamente.

Instituto de Física
Universidad Nacional Autónoma de México

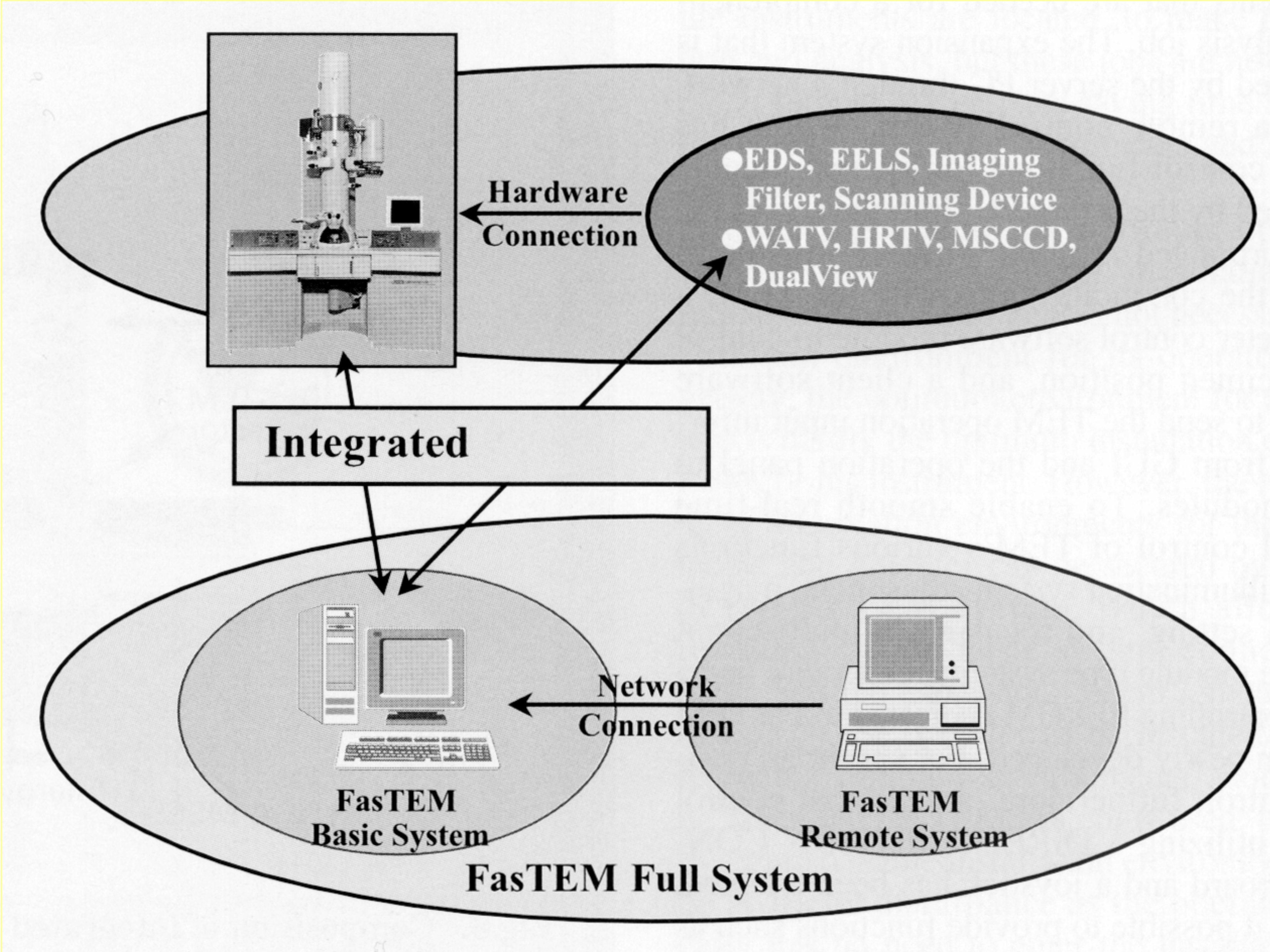

Thermo NORAN



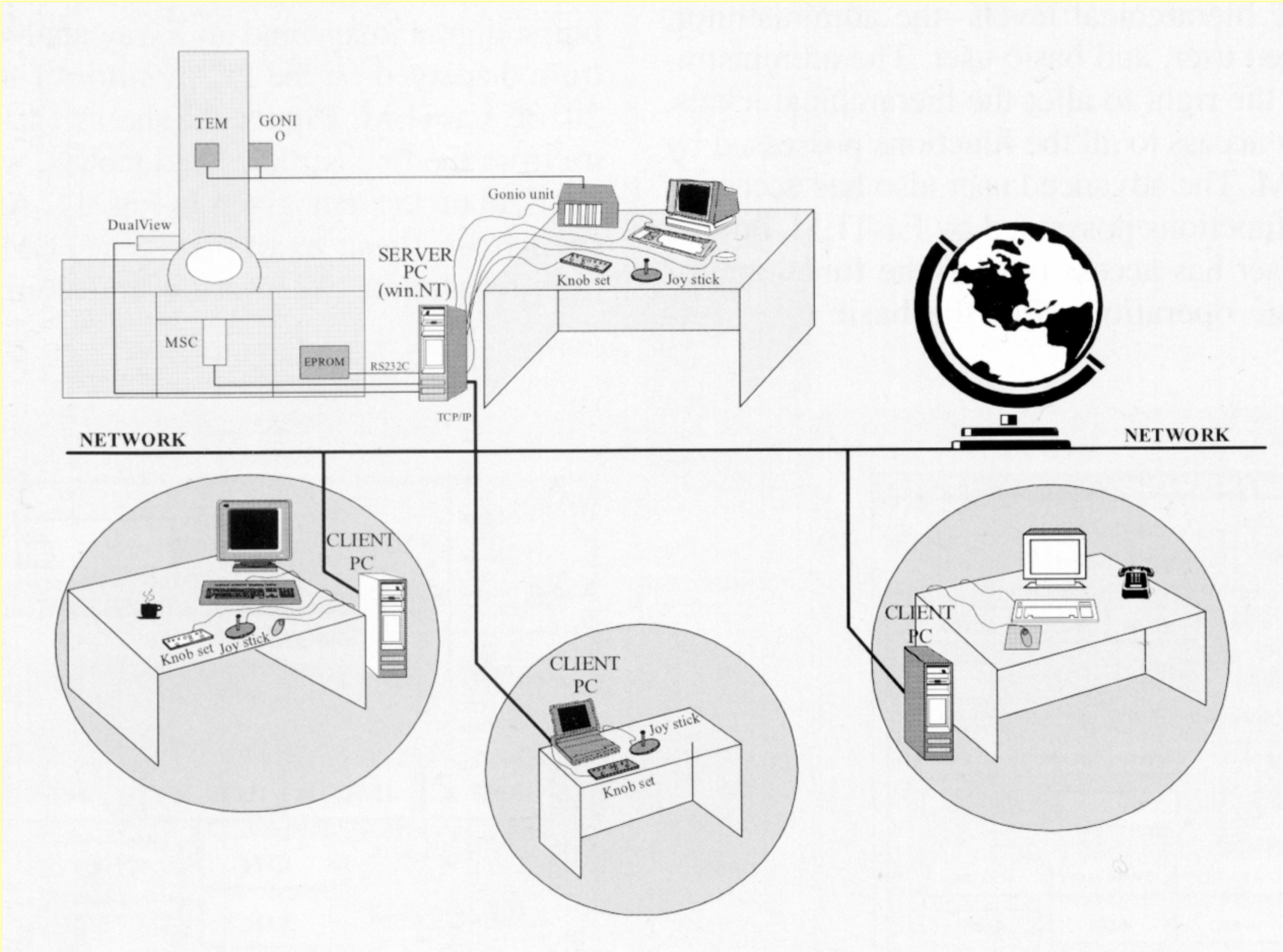
Composition of integrated analysis instrument system centered around JEM-2010 to which is connected FasTEM basic system.



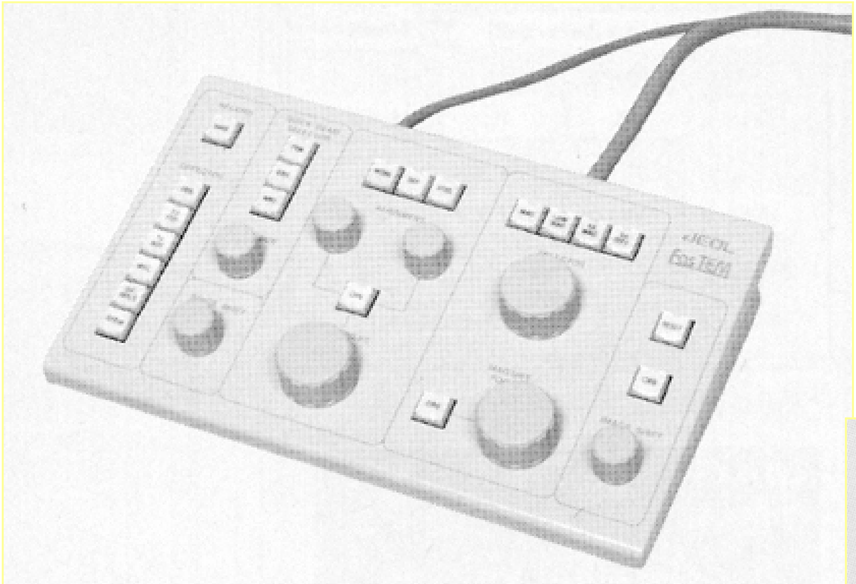
Schematic diagram of instrument connection in FasTEM



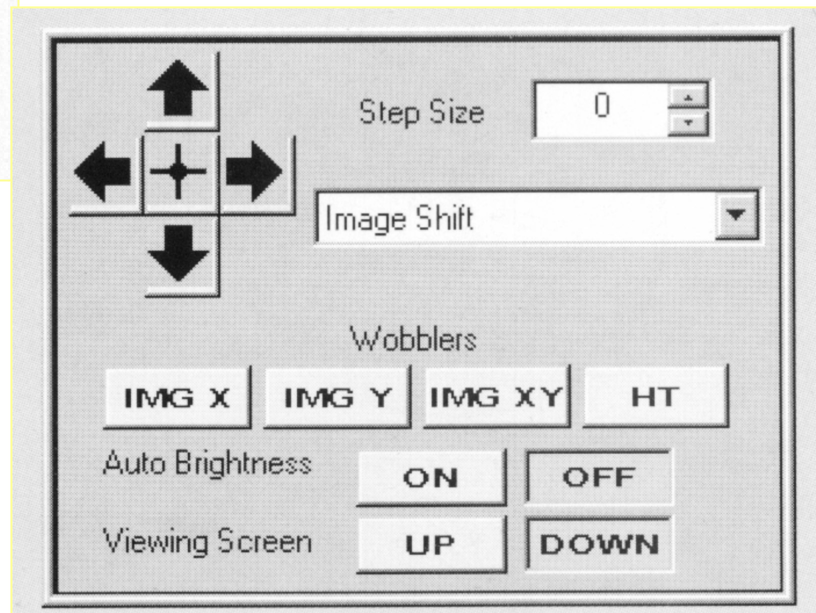
Conceptual diagram of instrument composition in integrated analysis environment equipped with the JEM-2010 FasTEM system



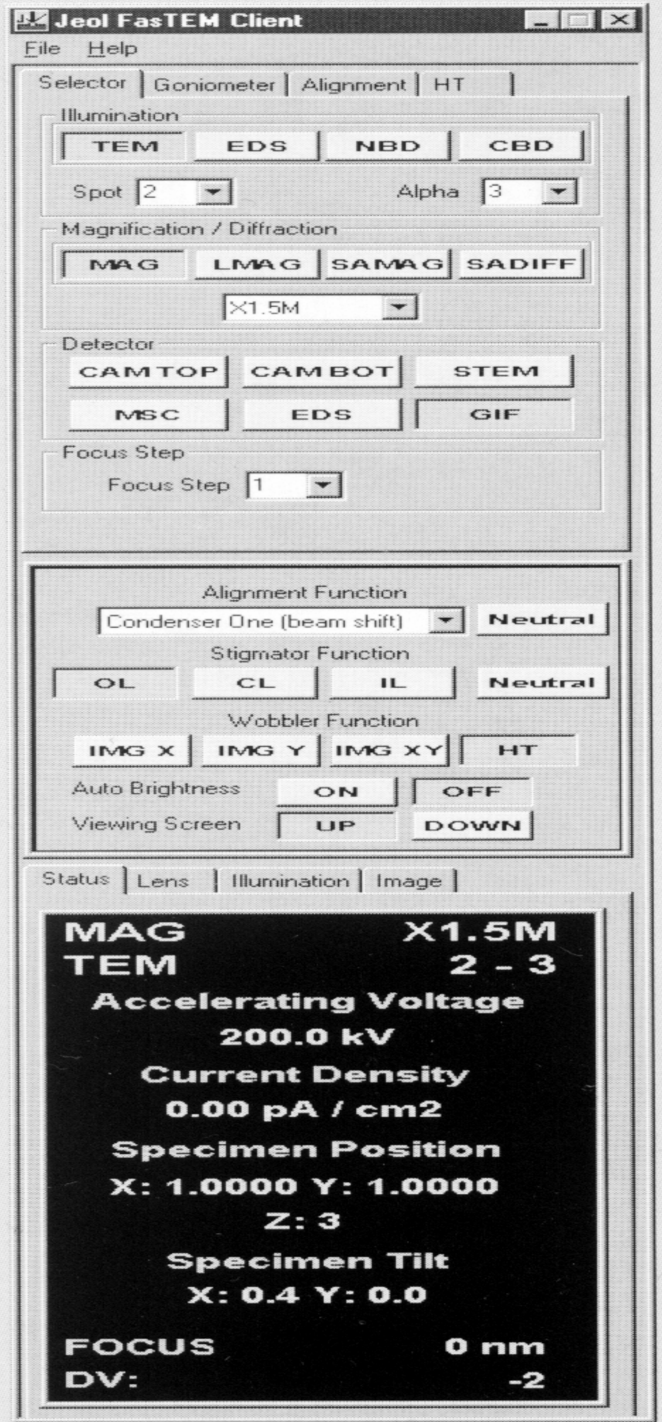
Network composition diagram of FasTEM system



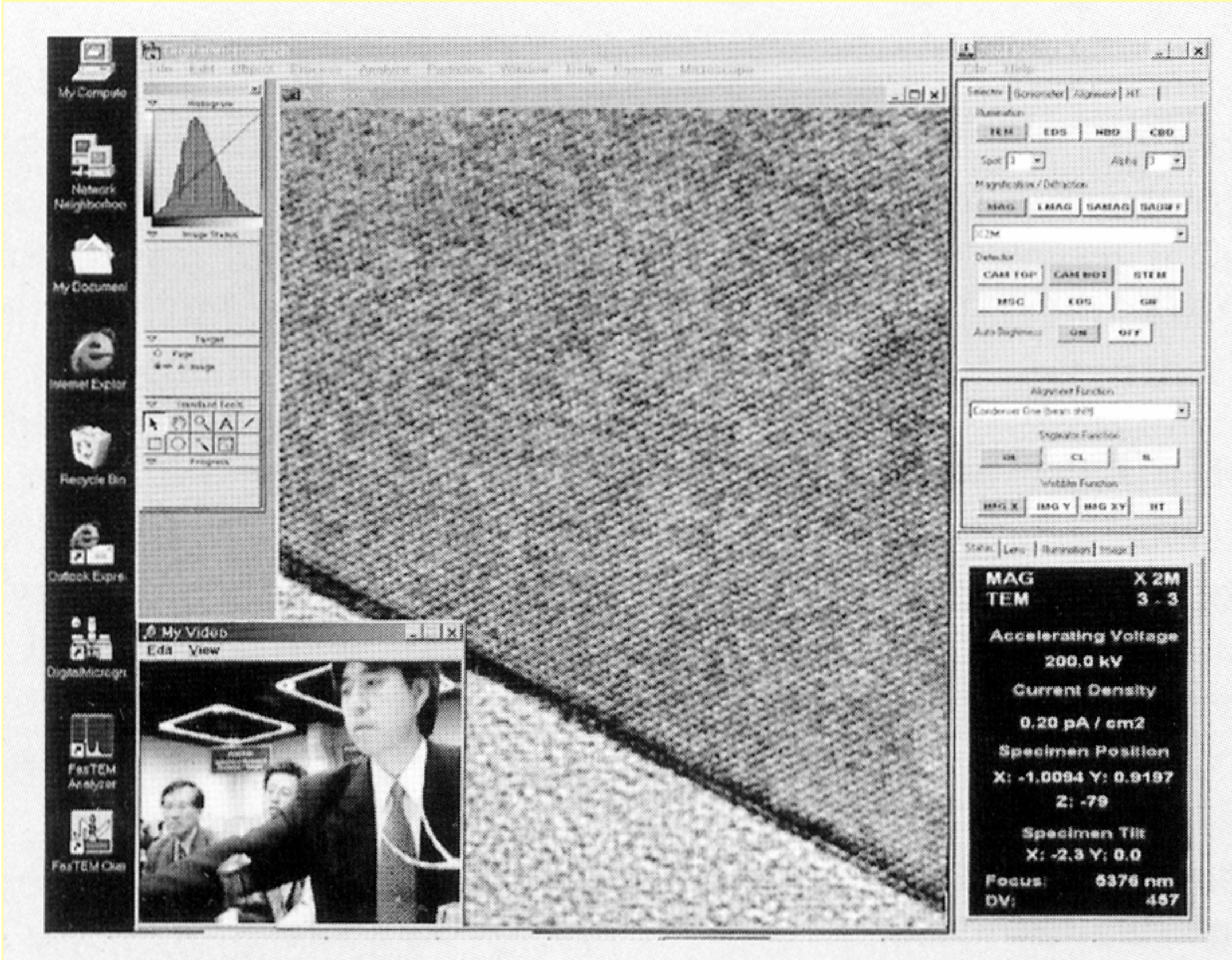
Simple operation panel for FasTEM



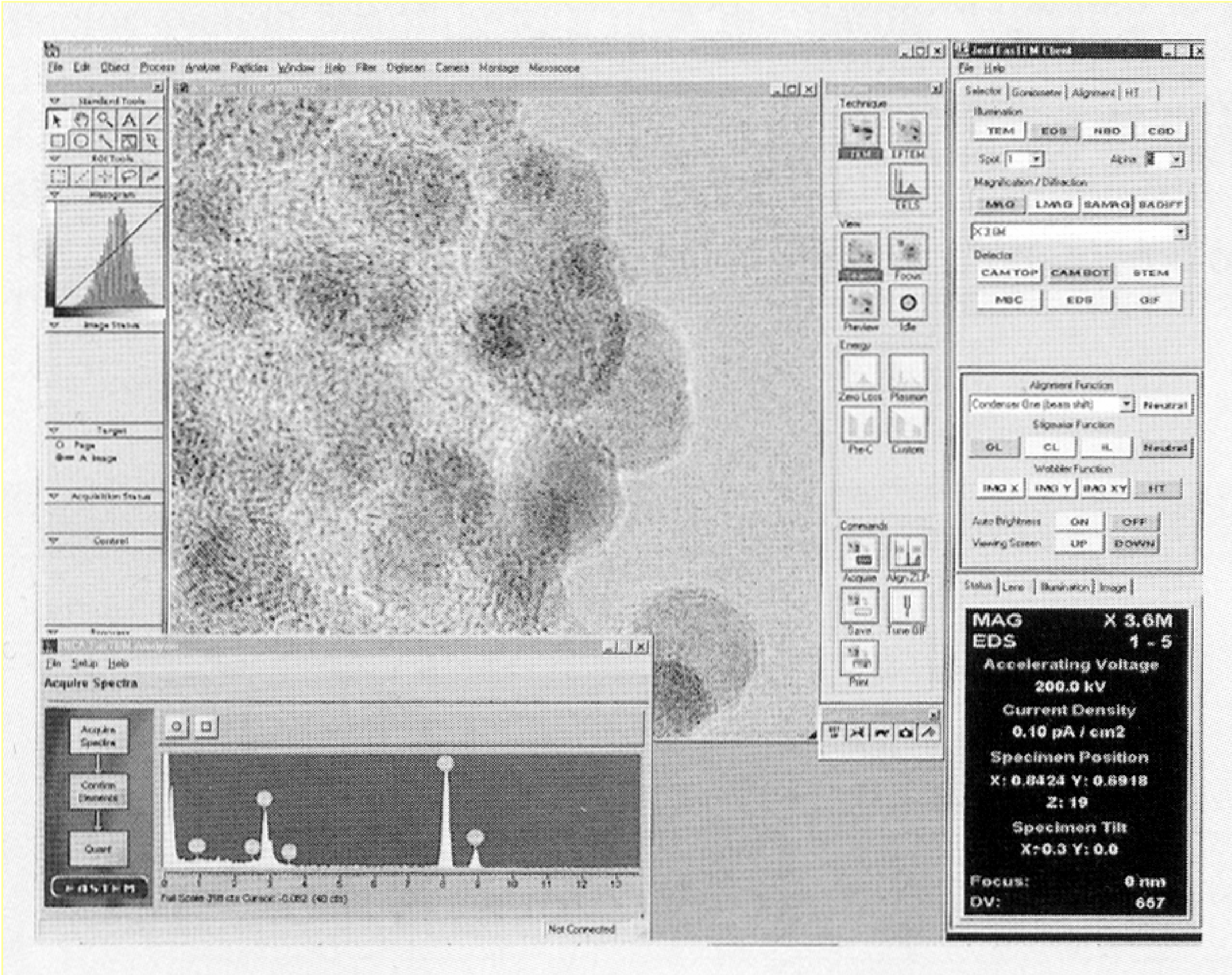
Alignment window changeover for no simple operation panel. Axial alignment can be done by mouse button.



GUI for FasTEM: The upper section is provided with a selector window with four tabs; the middle section is provided with a constantly displayed alignment window; and the lower section is provided with a status window with four tabs.



High resolution digital image of the cross section of a silicon device, which is displayed together with video conferencing window.



High-resolution digital image and EDS spectrum of a fine catalyst particles containing Pd

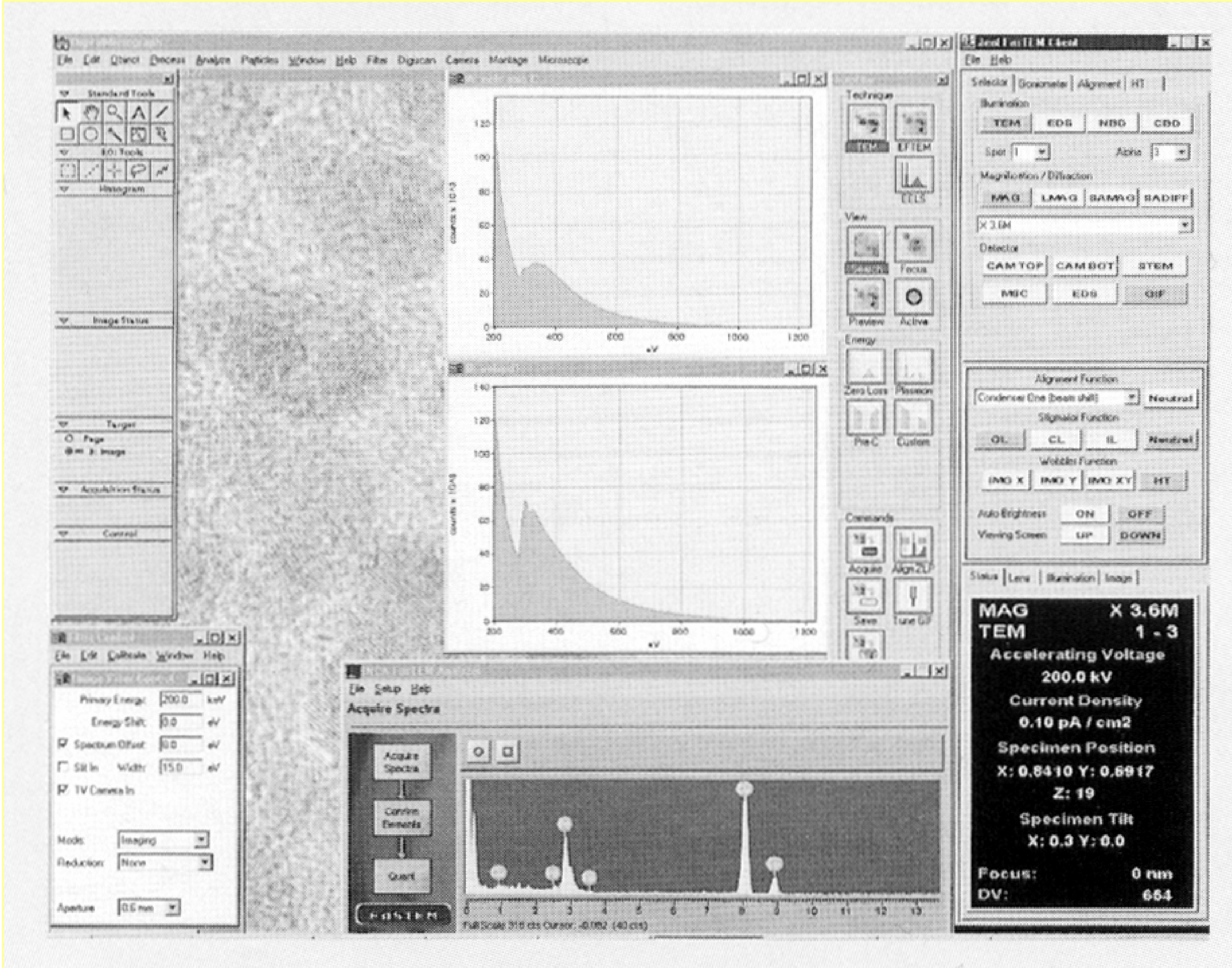
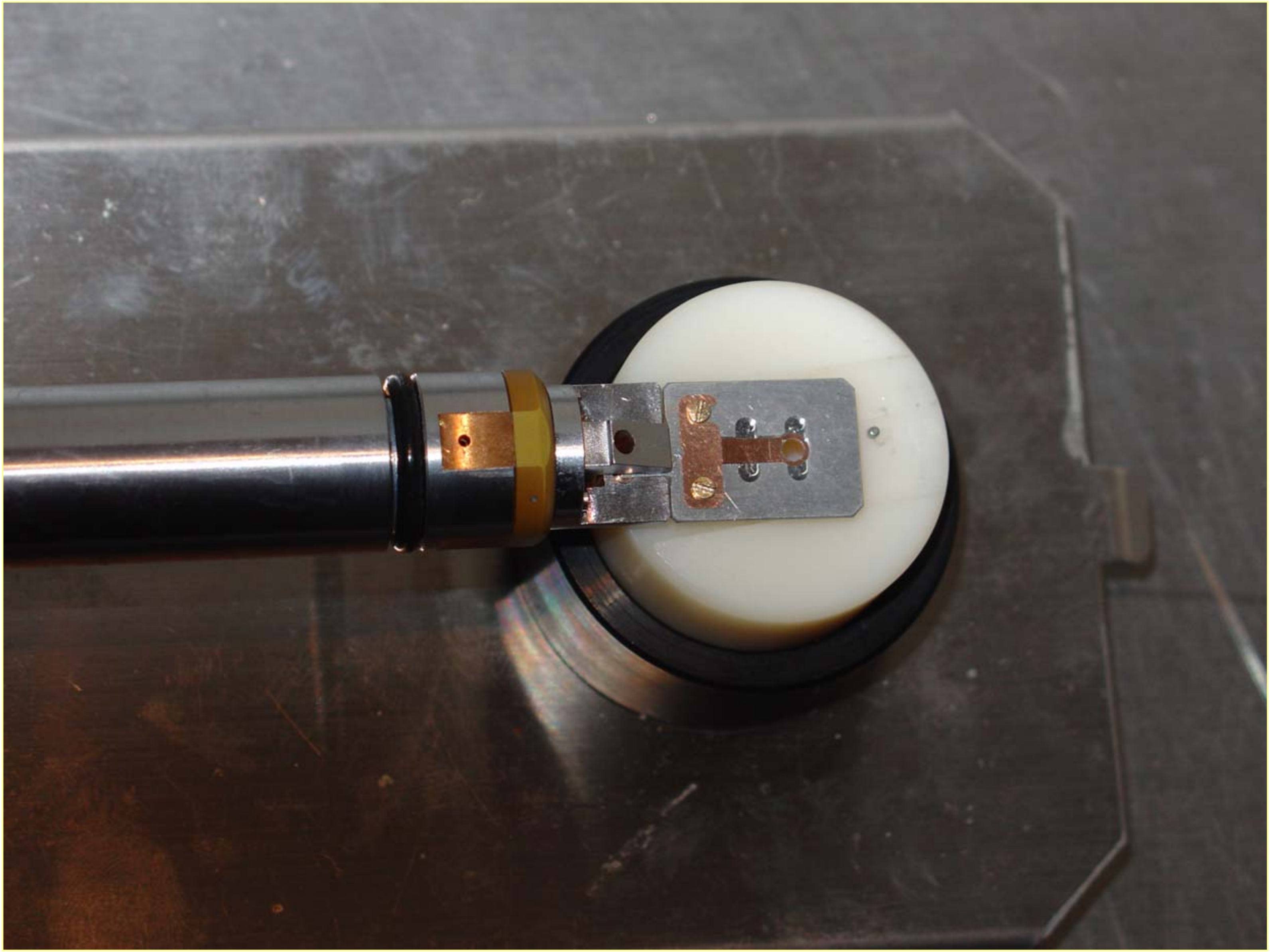
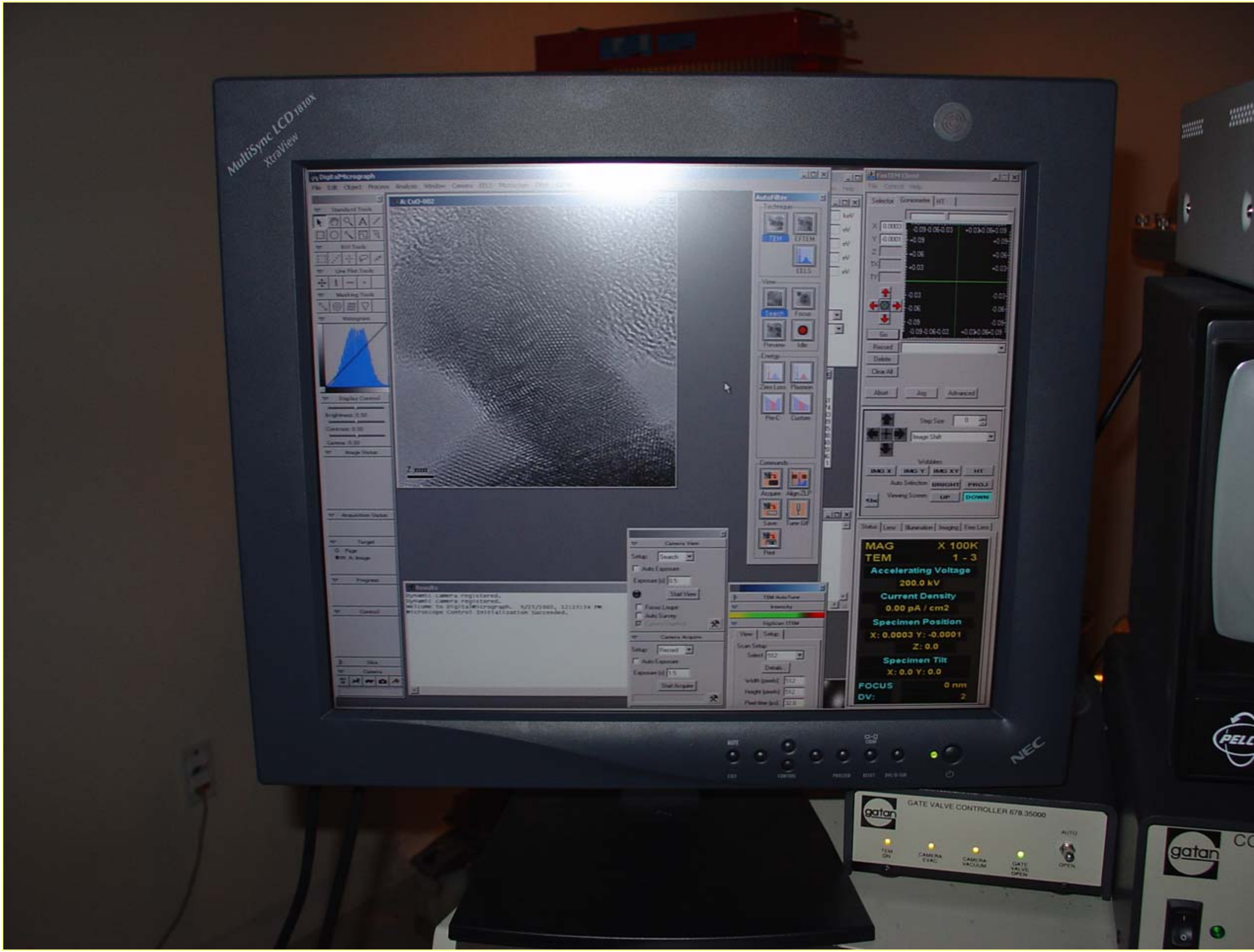
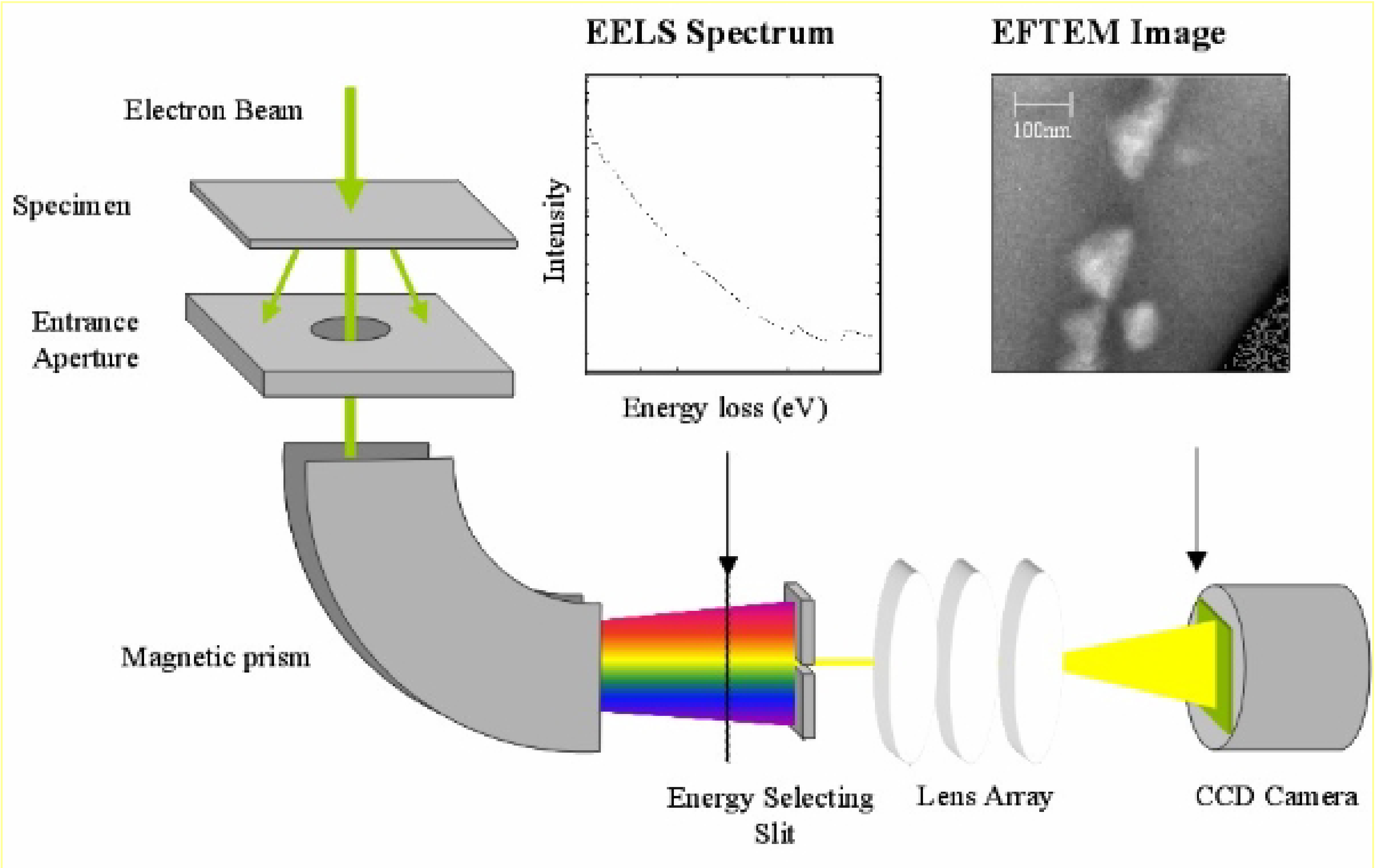


Image acquired by superposing EELS spectrum data on the data

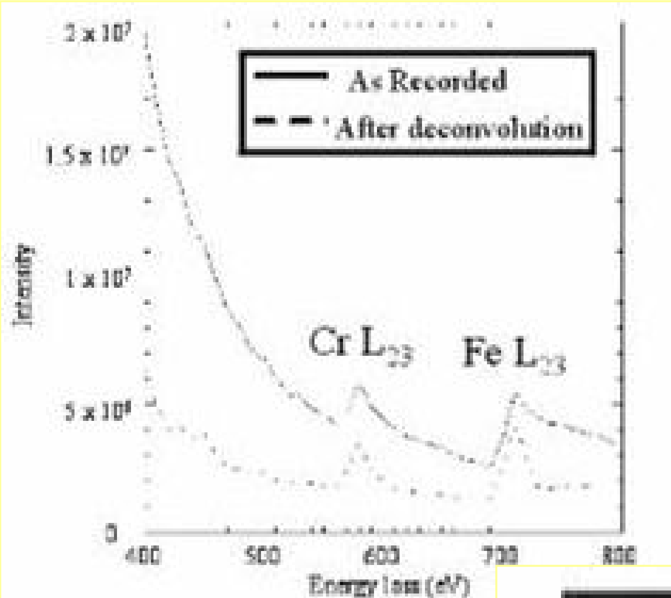



MultiSync LCD 1810X
XtraView
MAG X 100K
TEM 1 - 3
Accelerating Voltage
200.0 kV
Current Density
0.00 pA / cm2
Specimen Position
X: 0.0003 Y: -0.0001
Z: 0.0
Specimen Tilt
X: 0.0 Y: 0.0
FOCUS 0 nm
DV: 2
NEC
gatan
GATE VALVE CONTROLLER 678.35000
gatan
PELCO

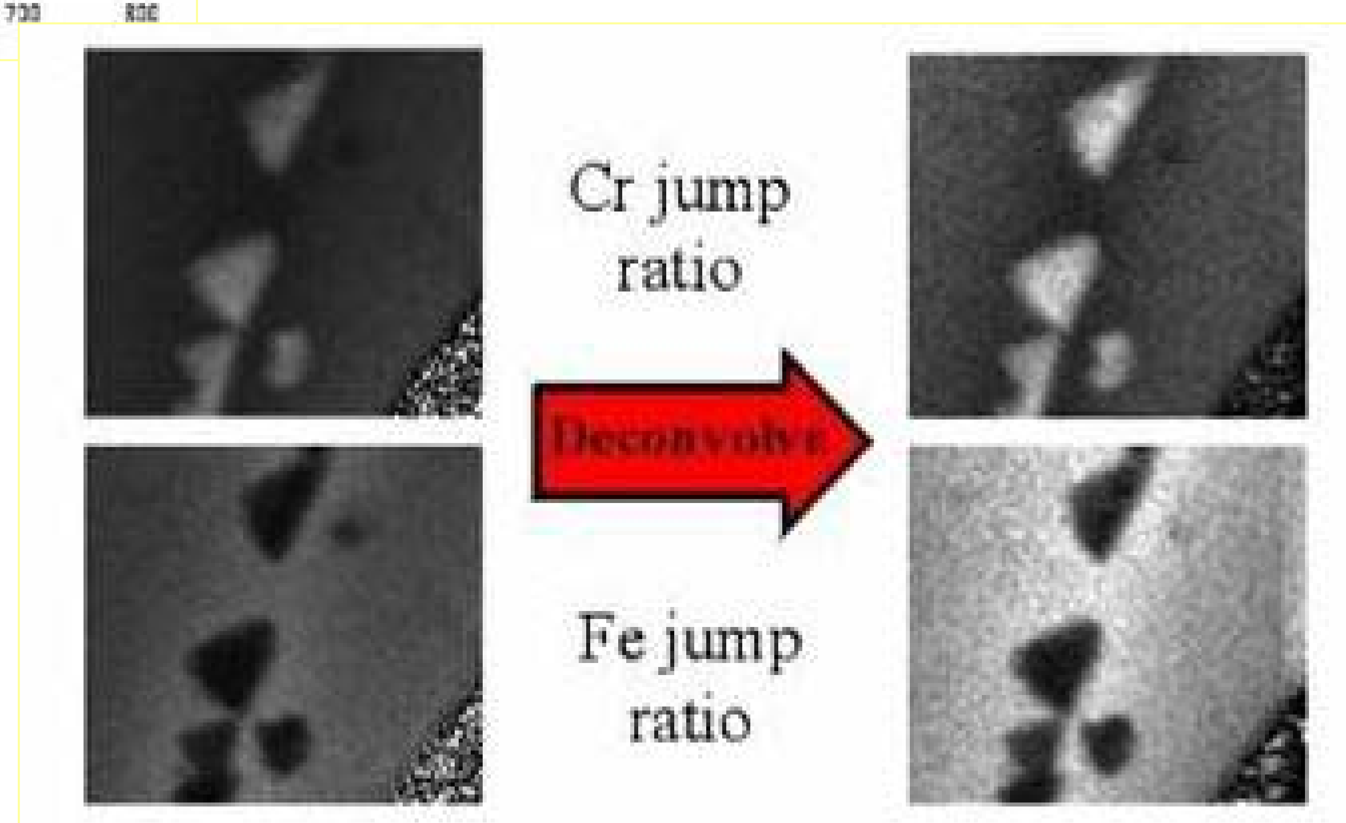

8.5" Adjustable
BIPRISM POWER SUPPLY
NEC

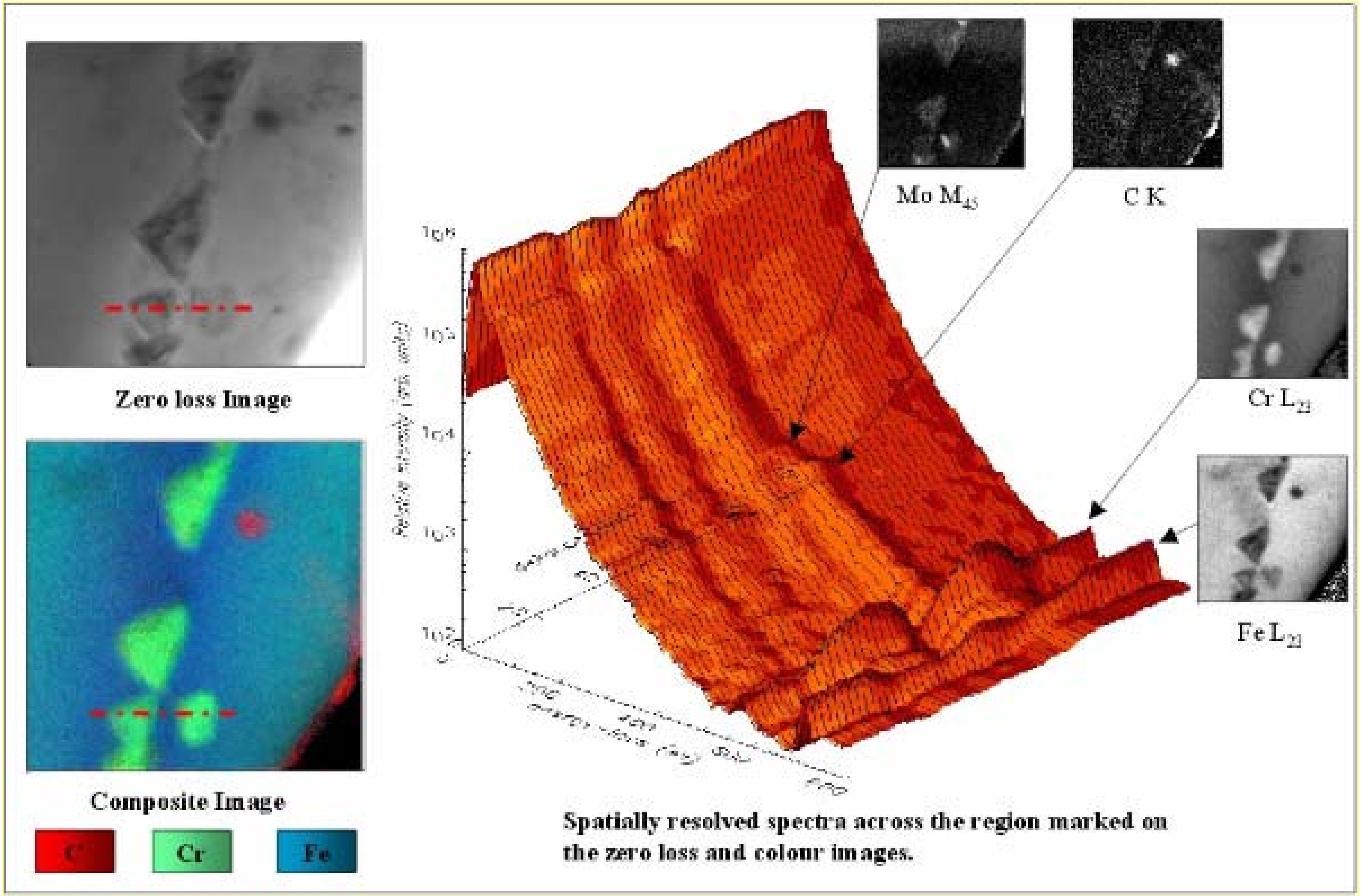


Configuración del GIF (Gatan Imaging Filter) en un TEM

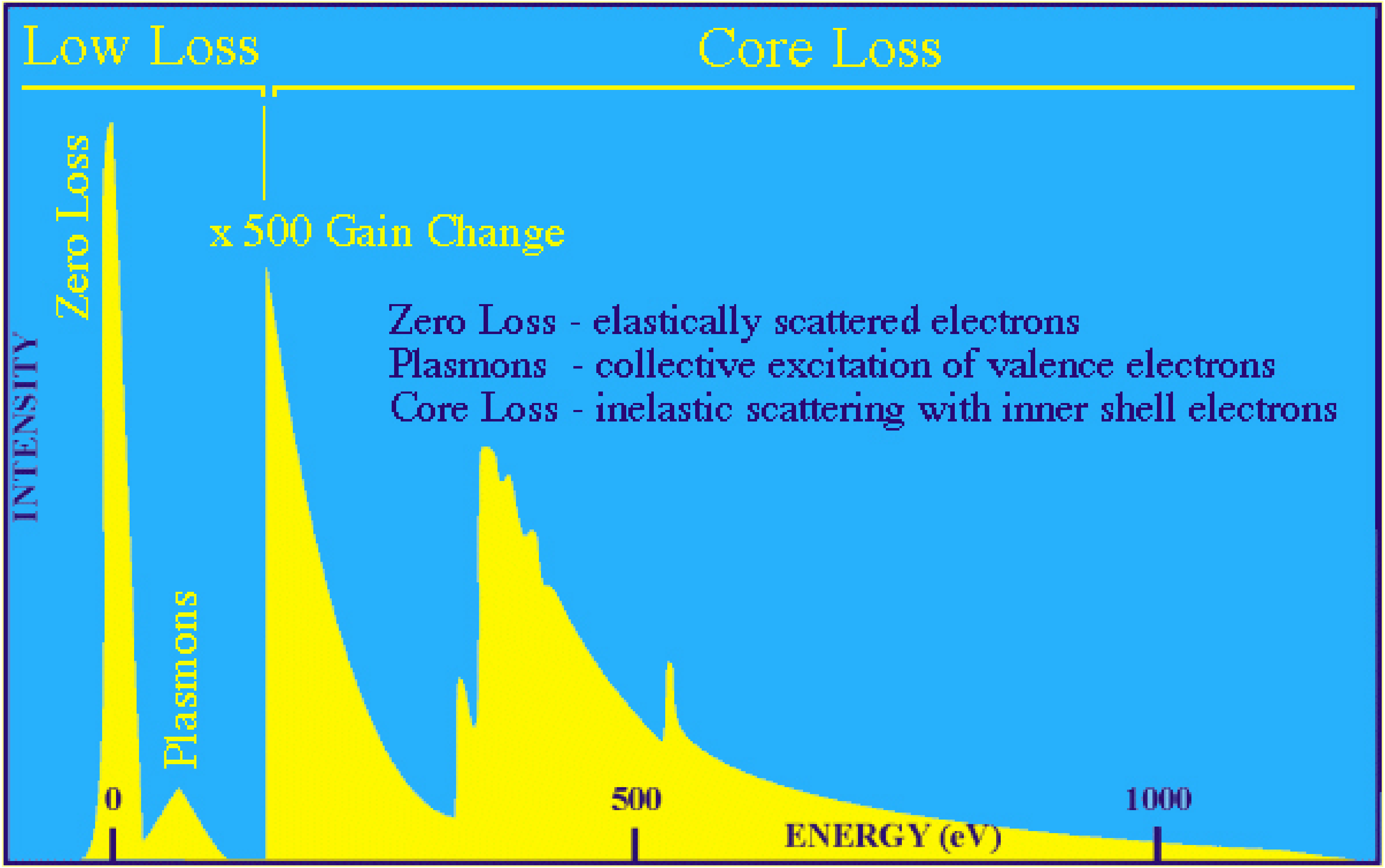


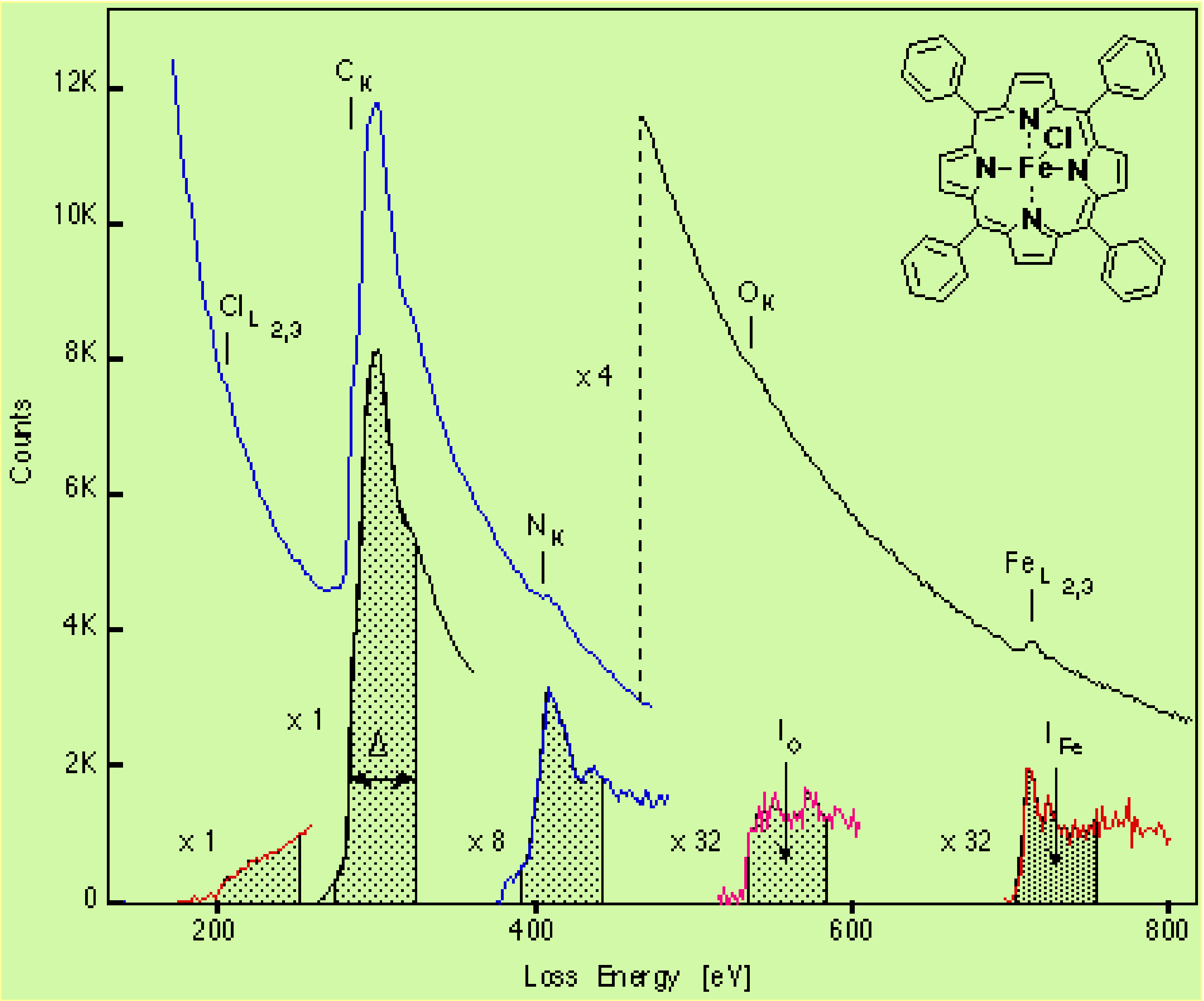
An example of the improvement in the jump ratio achieved using Fourier log deconvolution on the 316 stainless steel series. Examples shown for the iron (Fe) and chromium (Cr) ionization edges.



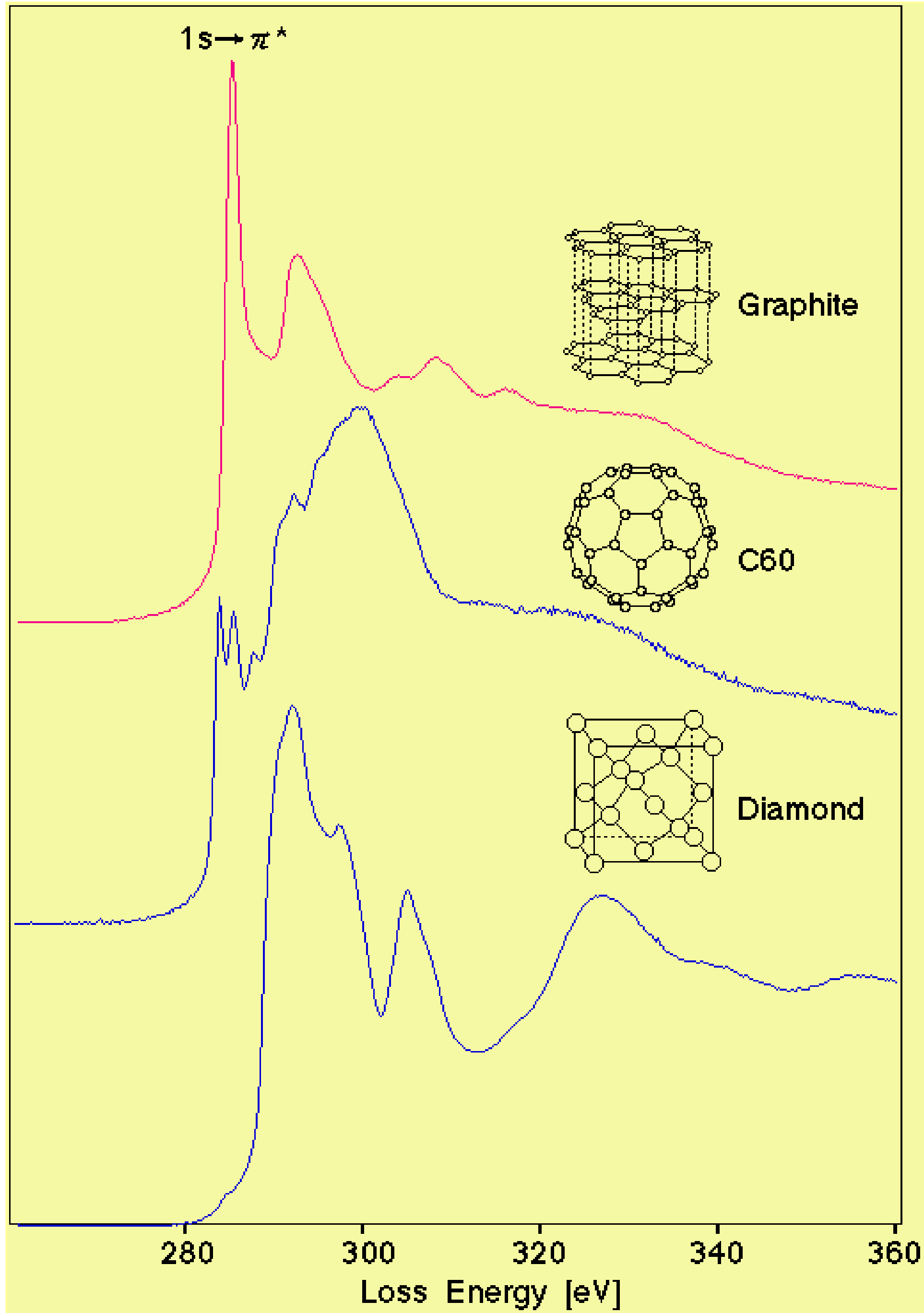


Spatially resolved spectra across the region marked on the zero loss and colour images.

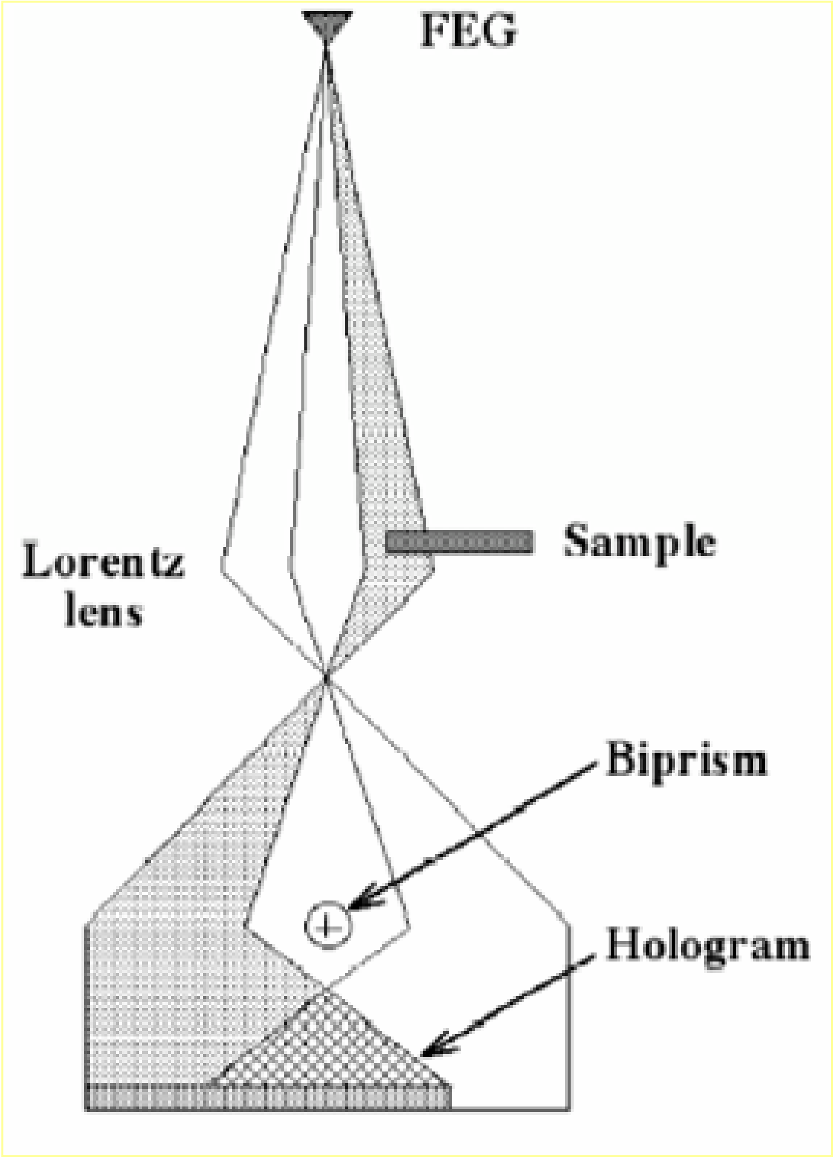

Low Loss
Core Loss
Zero Loss
x 500 Gain Change
Zero Loss - elastically scattered electrons
Plasmons - collective excitation of valence electrons
Core Loss - inelastic scattering with inner shell electrons
INTENSITY
Plasmons
0
500
1000
ENERGY (eV)



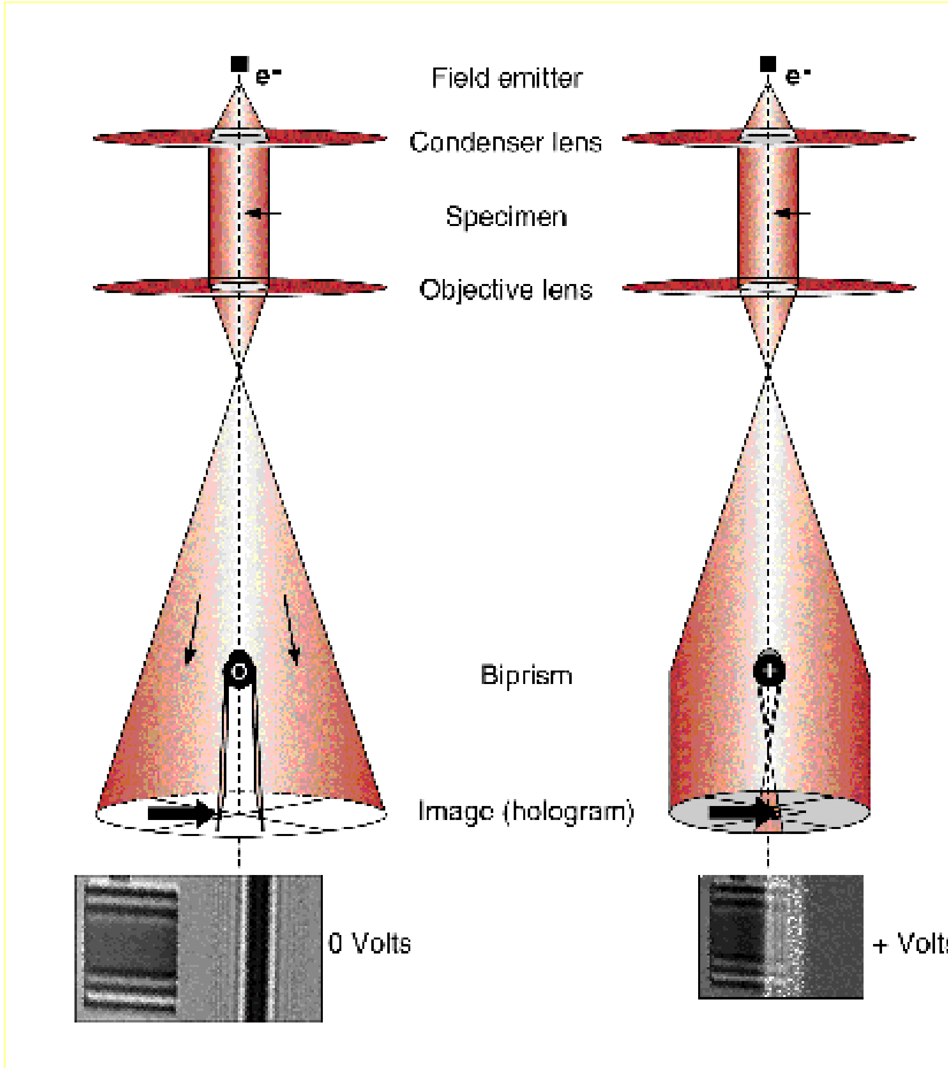
Counts
12K
10K
8K
6K
4K
2K
0
C_K
$Cl_{L\ 2,3}$
x 4
O_K
N_K
$Fe_{L\ 2,3}$
x 1
Δ
I_O
I_{Fe}
x 1
x 8
x 32
x 32
200
400
600
800
Loss Energy [eV]
N
Cl
N
Fe
N
N



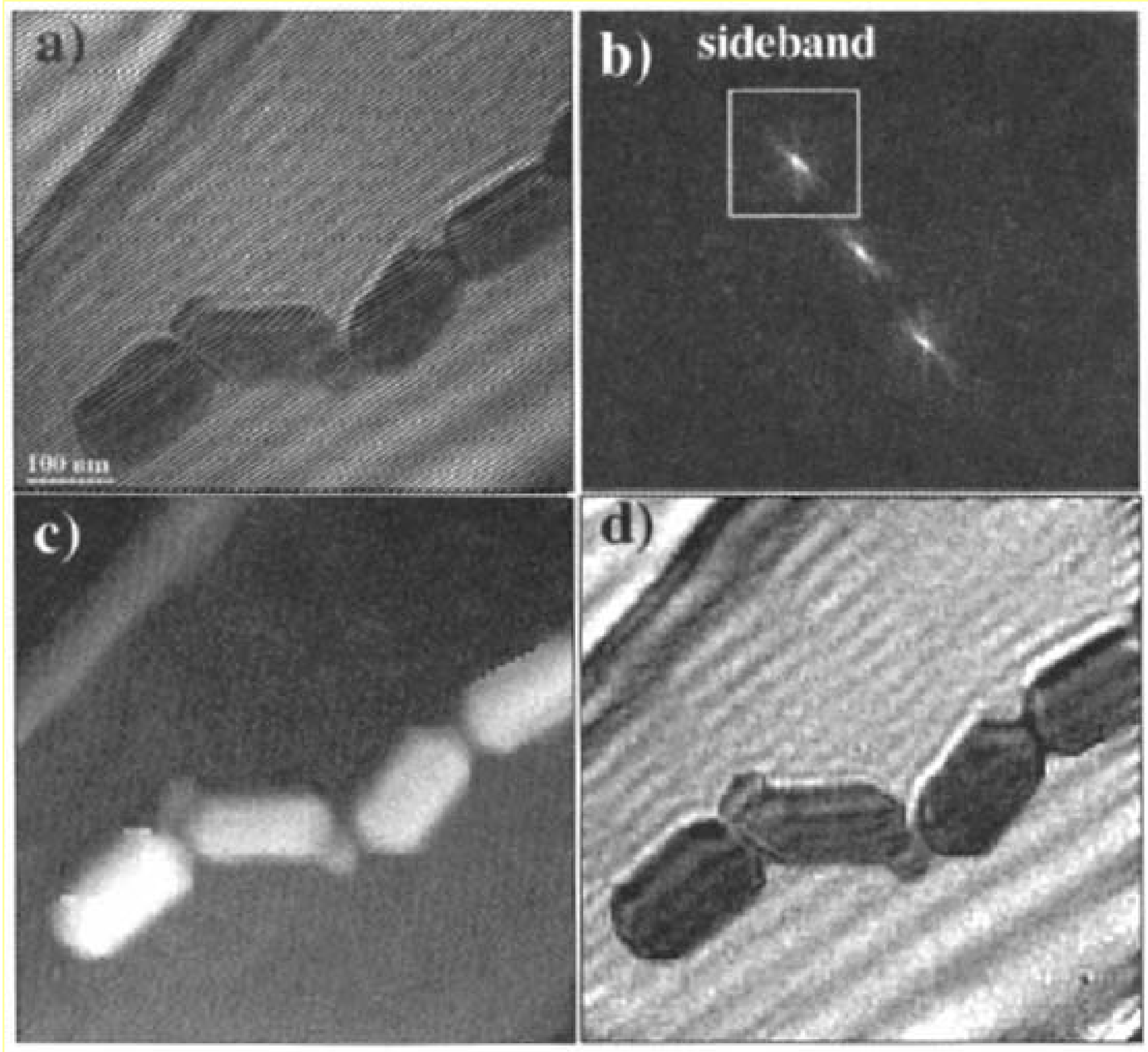
1s→π*
Graphite
C60
Diamond
280
300
320
340
360
Loss Energy [eV]



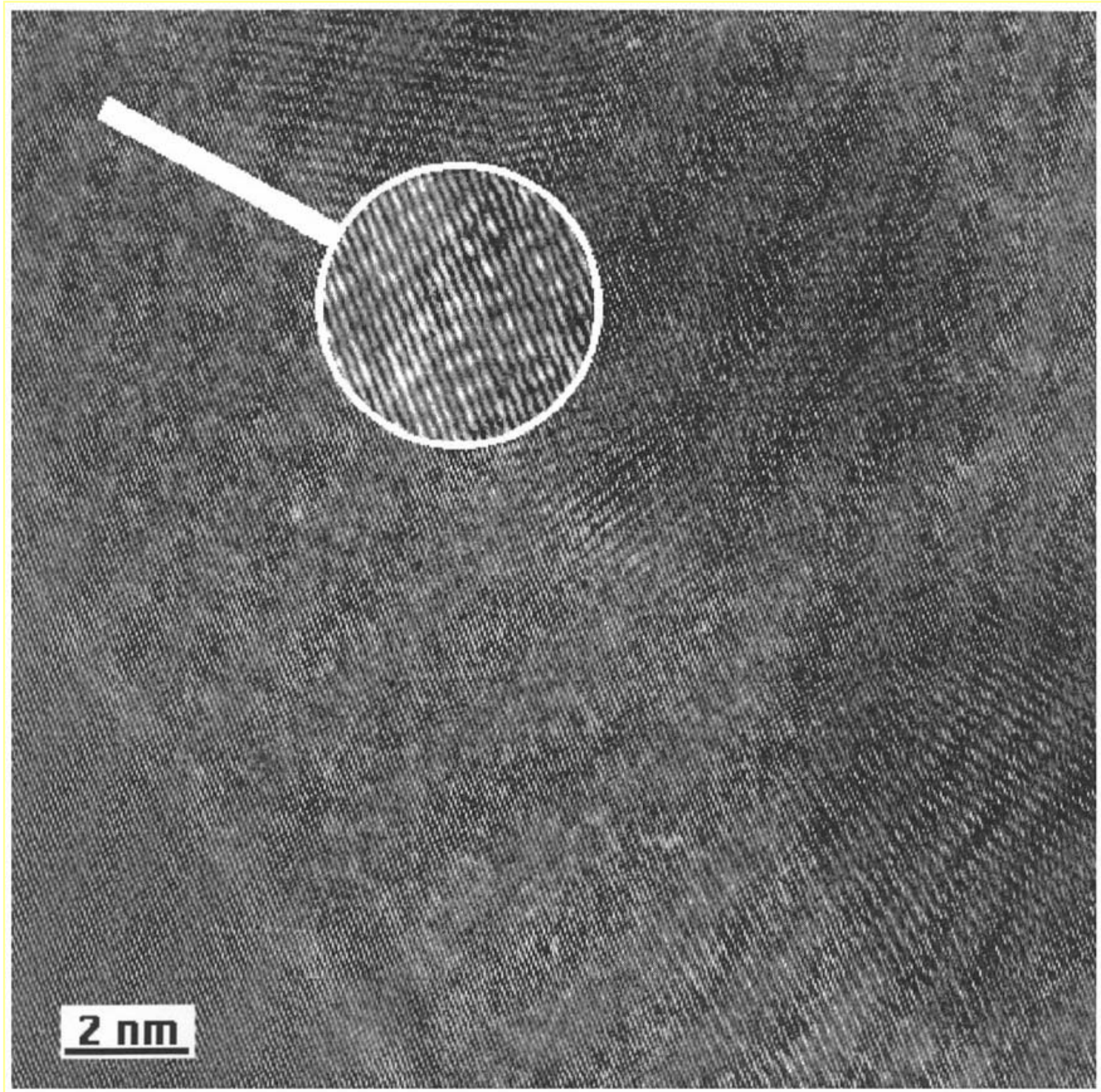
Schematic ray diagram showing setup used for off-axis electron holography in the TEM. Essential components are the field emission electron source (FEG) used to provide coherent illumination and the electrostatic biprism, which causes overlap of object and (vacuum) reference waves.



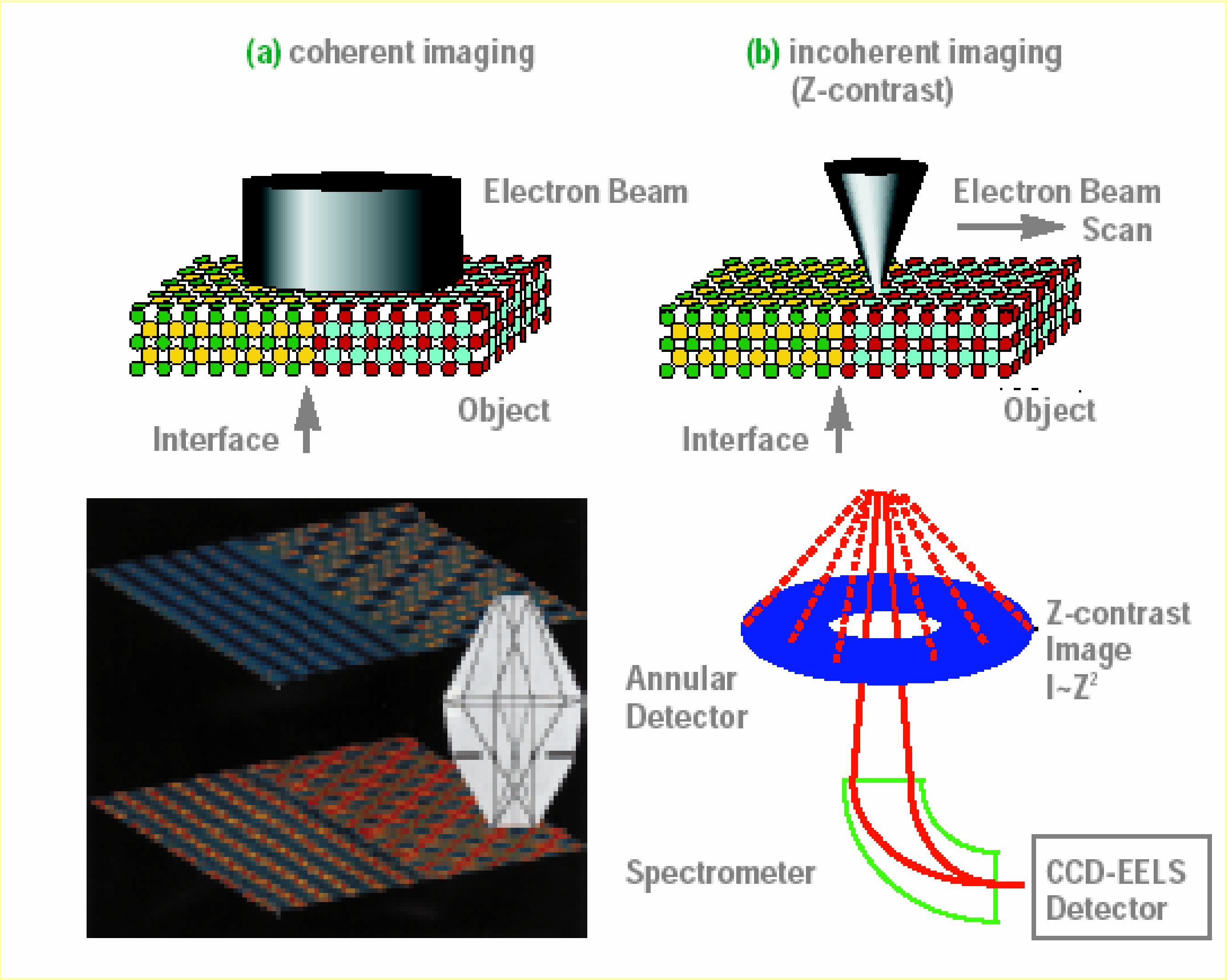
Principios de Holografía con electrones

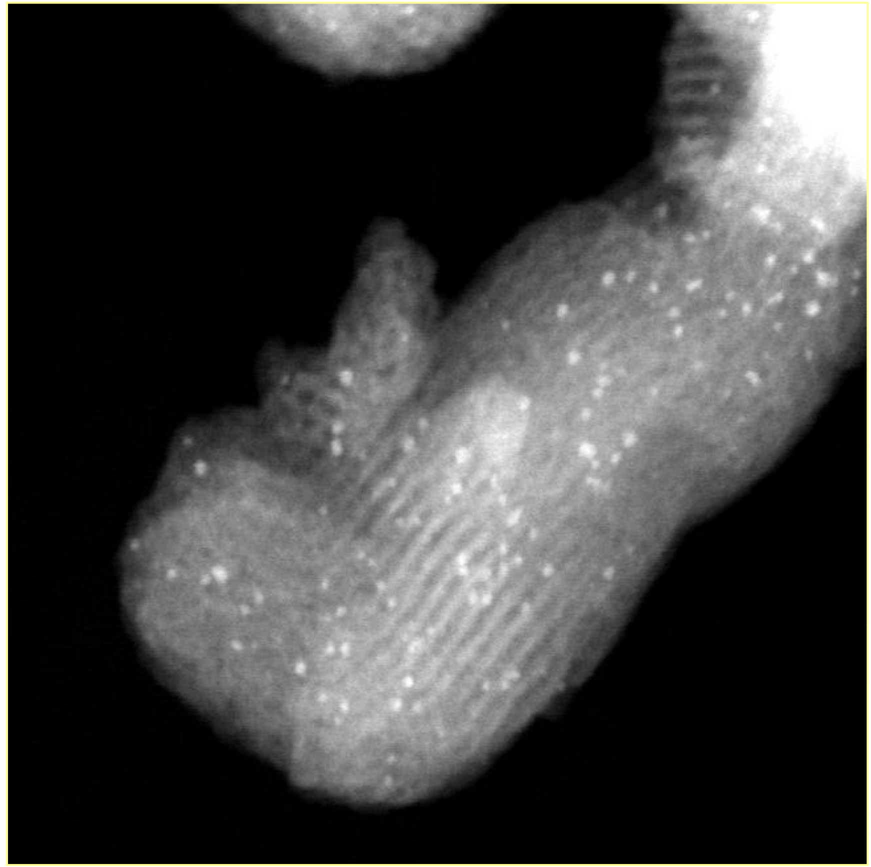


a) Off-axis electron hologram showing chain of magnetite nanocrystals; b) Fourier transform of (a) indicating sideband used in phase reconstruction; c) Reconstructed phase image; d) Reconstructed amplitude image



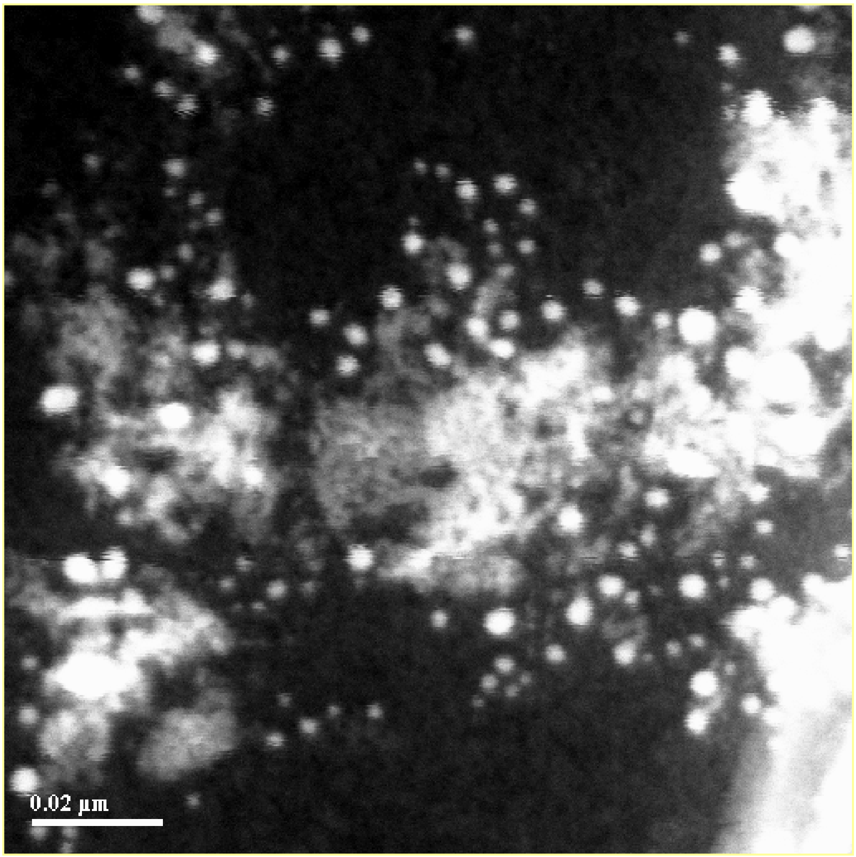
The interference fringes across the gold particles significant fringe bending, while the fringes across the amorphous carbon foil are weakly modulated.

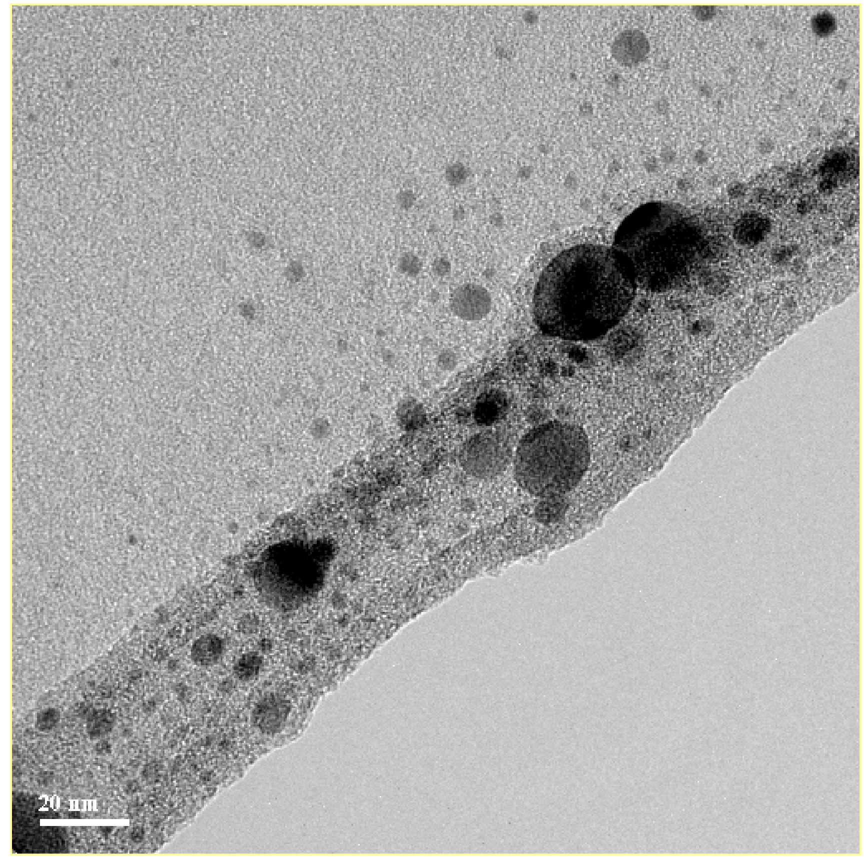

(a) coherent imaging
(b) incoherent imaging
(Z-contrast)
Electron Beam
Electron Beam
Scan
Object
Object
Interface
Interface
Z-contrast
Image
I~Z²
Annular
Detector
Spectrometer
CCD-EELS
Detector



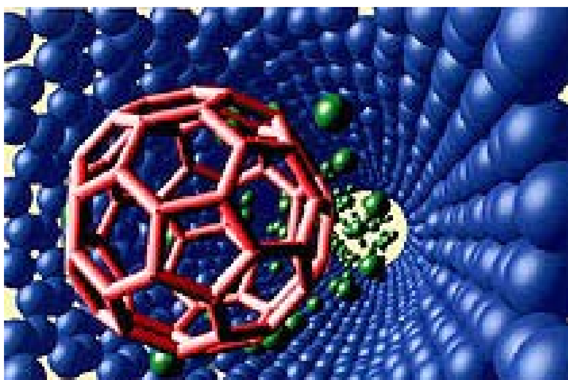
Silica nanoporosa con un diámetro promedio de poro de 3nm y partículas de Pt de 1 a 2 nm de tamaño. Imagen de High angle annular dark field o z-contrast STEM

Imagen por contraste Z de nanoparticulas cristalinas en asfaltenos





Análisis de materiales unidimensionales para aplicaciones en nanotecnología



rge A. Ascencio

ascencio@imp.mx

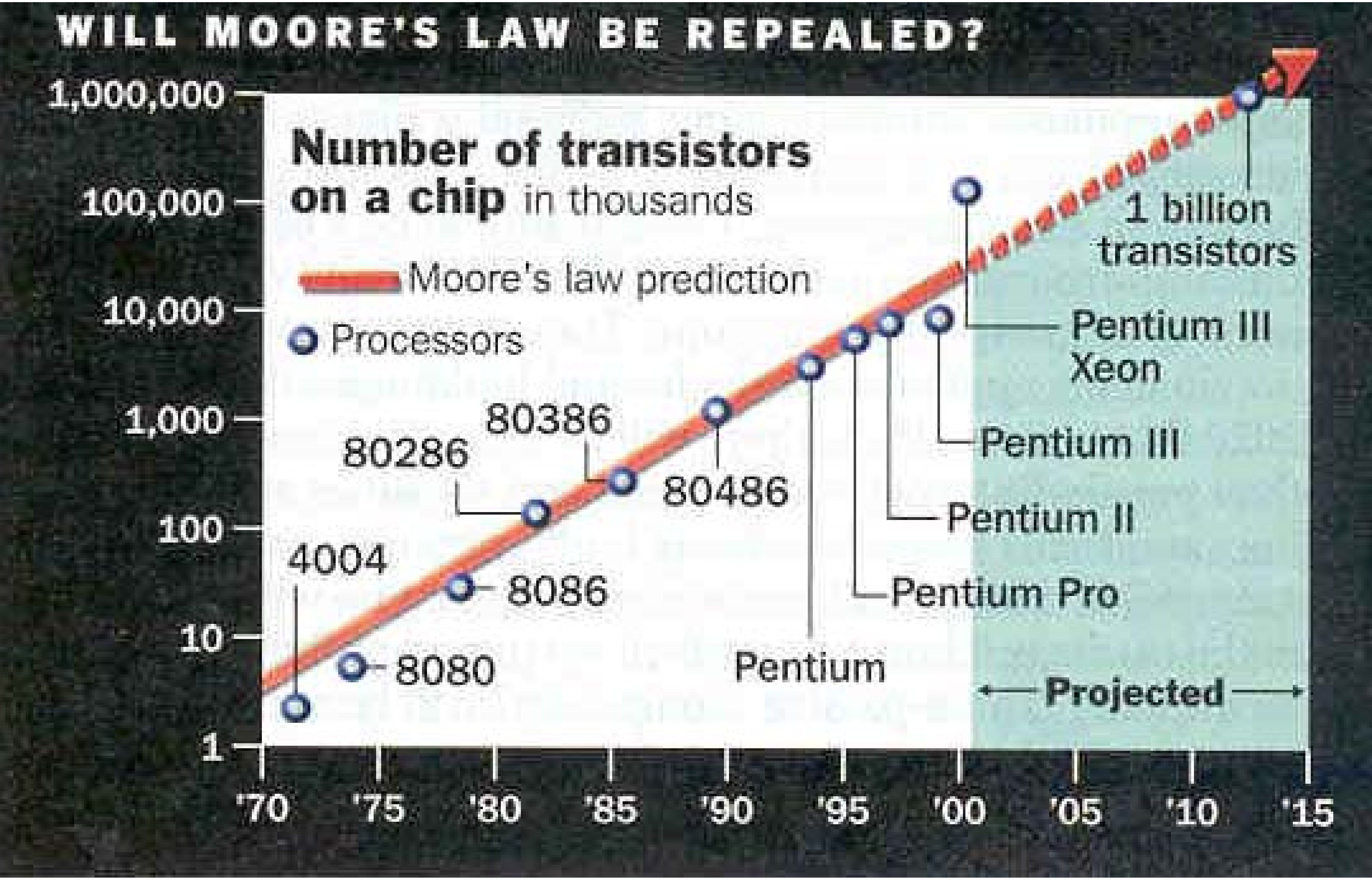
<u>01 55 30036414</u>

<u>y 30036440</u>

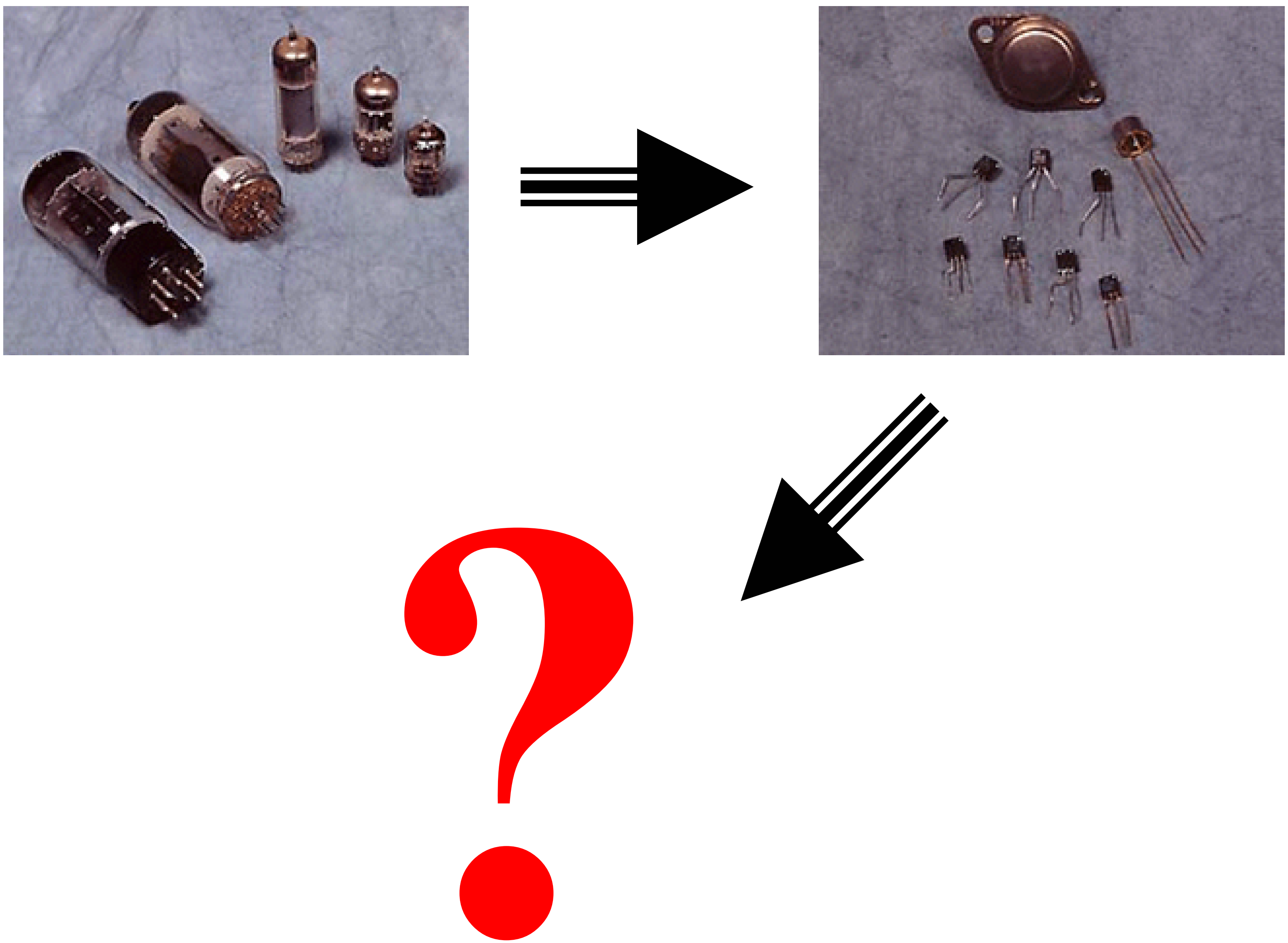
El tamaño si importa

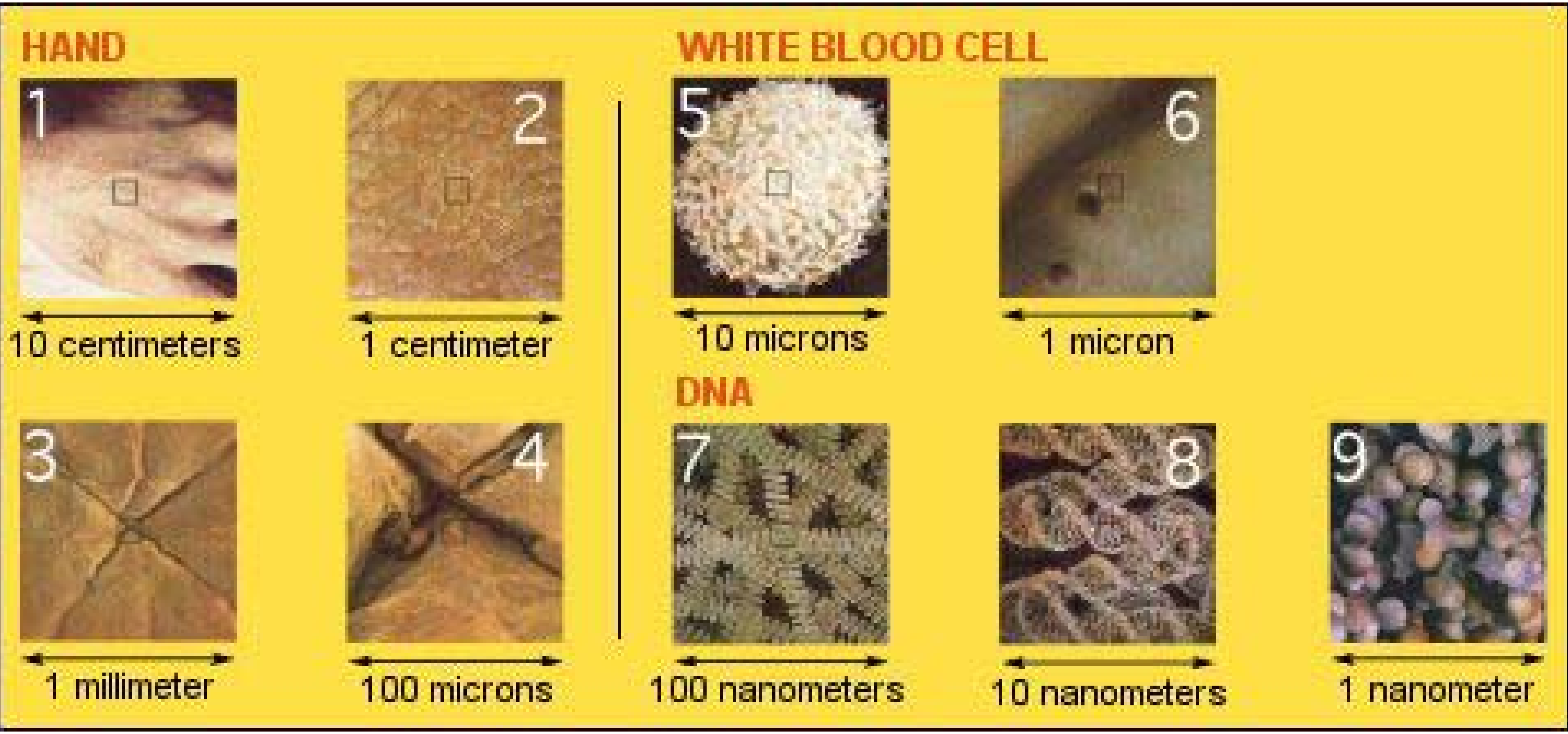
…

..y la habilidad para usarlo también…

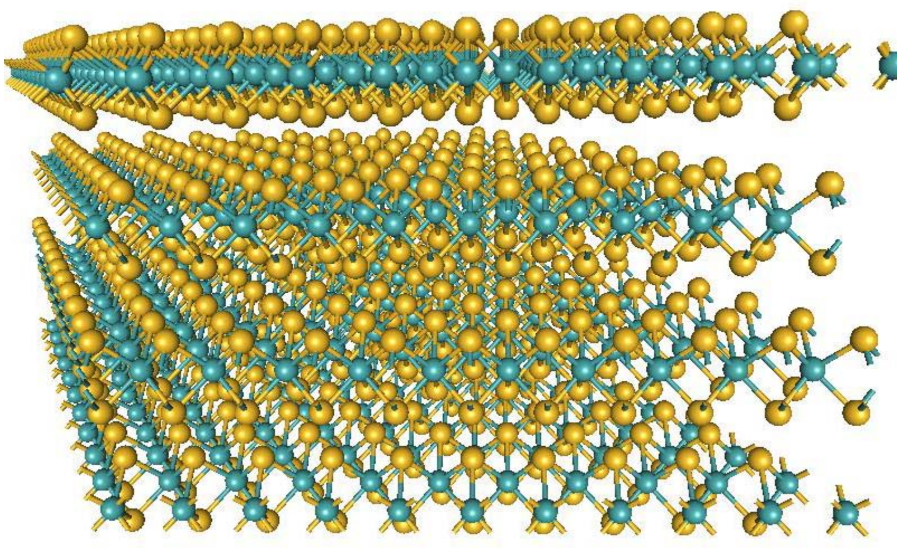


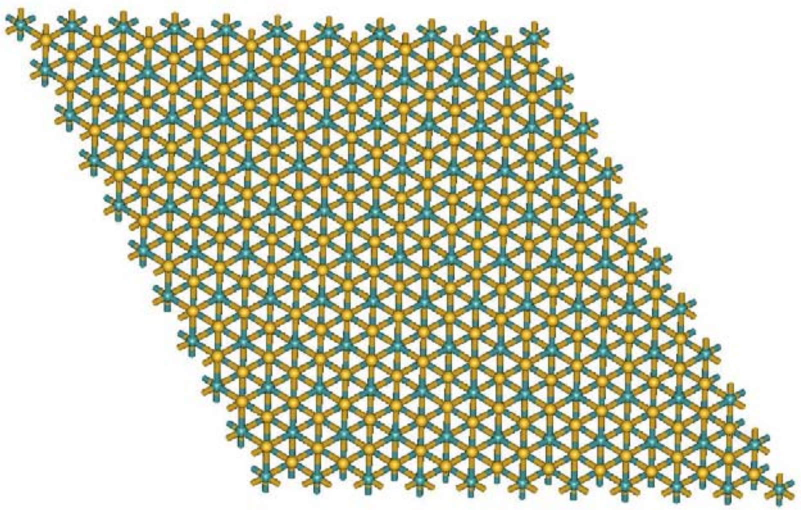
WILL MOORE'S LAW BE REPEALED?
Number of transistors on a chip in thousands
Moore's law prediction
Processors
1,000,000
100,000
10,000
1,000
100
10
1
4004
8080
8086
80286
80386
80486
Pentium
Pentium Pro
Pentium II
Pentium III
Pentium III Xeon
1 billion transistors
Projected
'70
'75
'80
'85
'90
'95
'00
'05
'10
'15



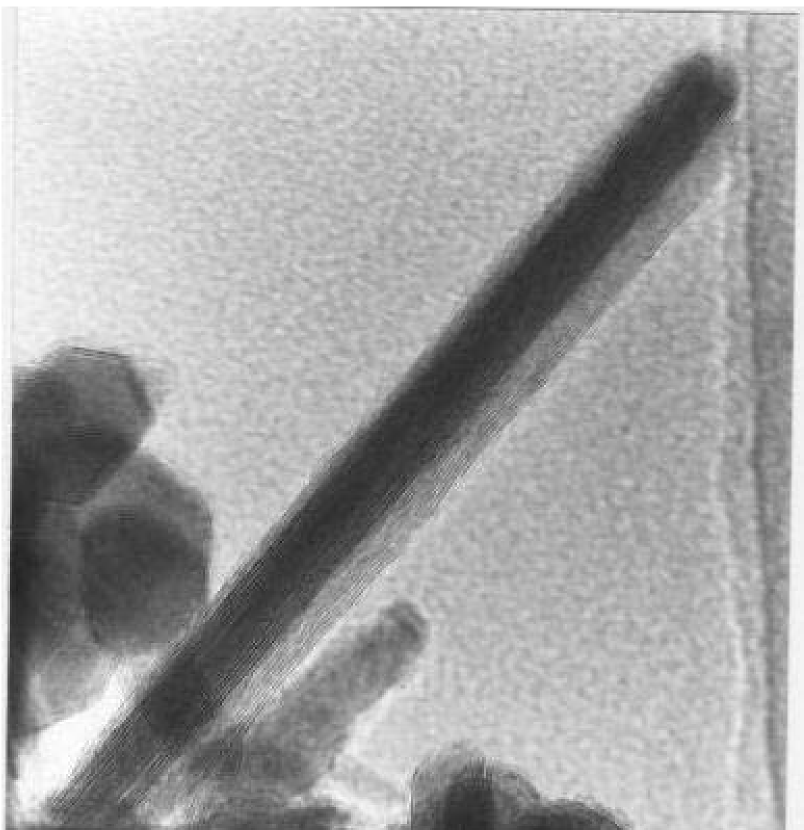

HAND
1
2
10 centimeters
1 centimeter
3
4
1 millimeter
100 microns
WHITE BLOOD CELL
5
6
10 microns
1 micron
DNA
7
8
9
100 nanometers
10 nanometers
1 nanometer

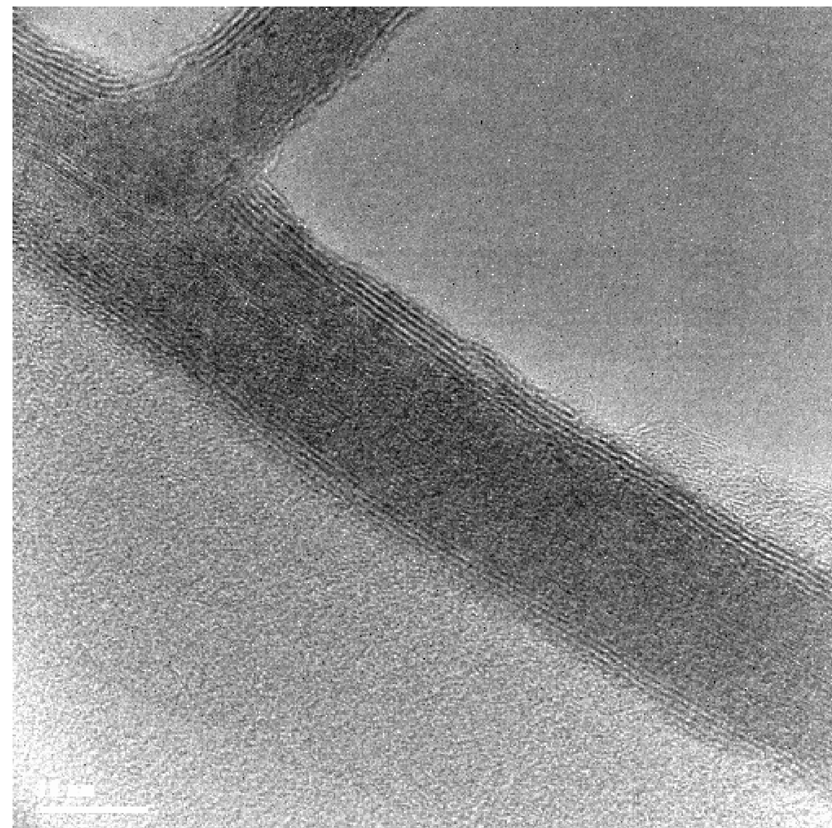
Layered Materials MoS_2



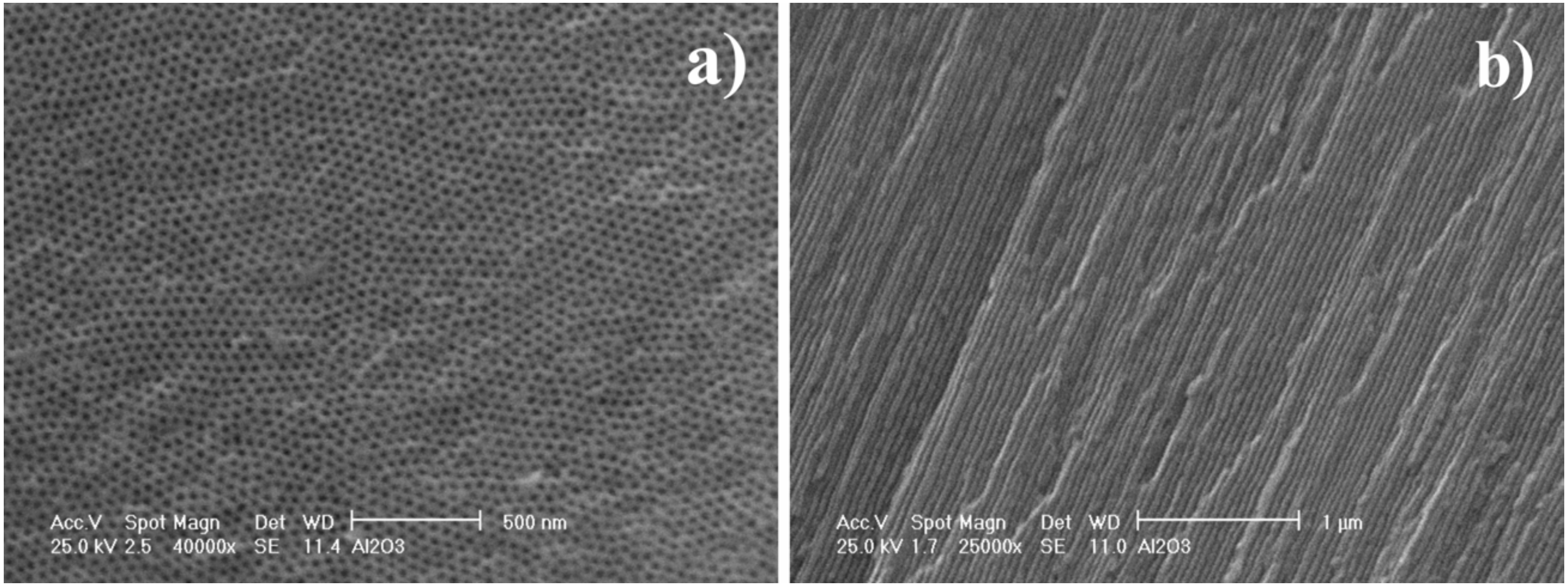


Layered Materials Nanotubes

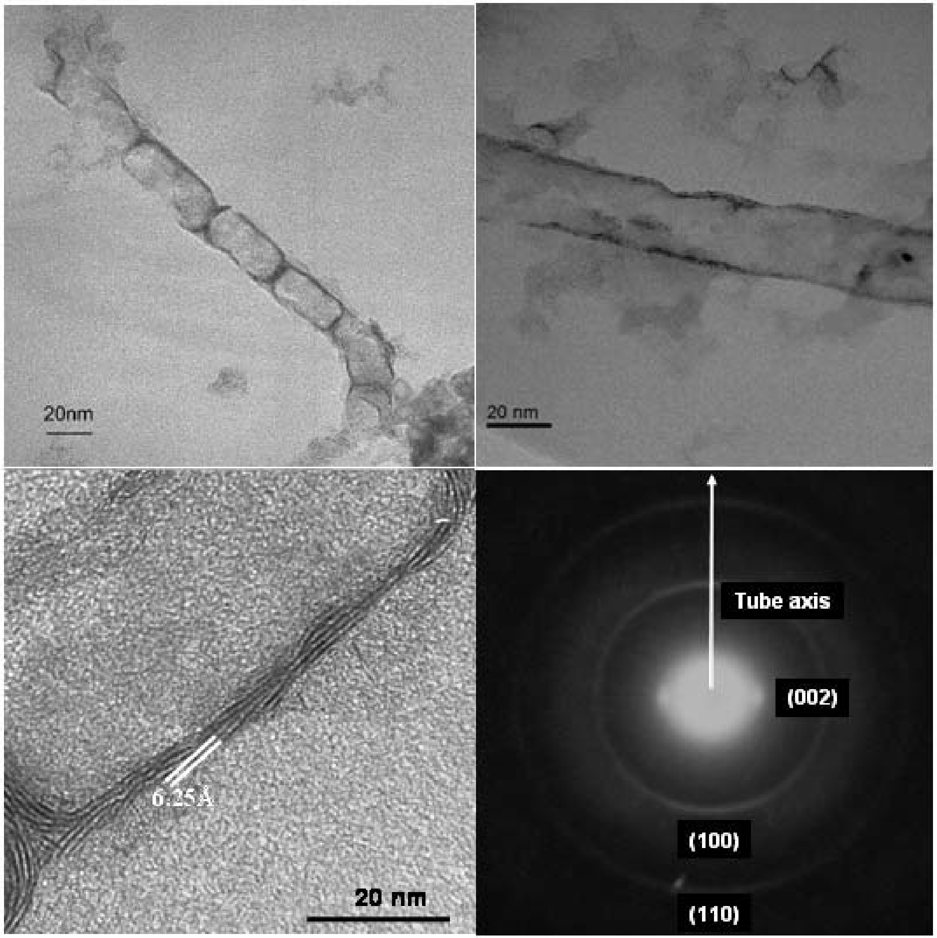




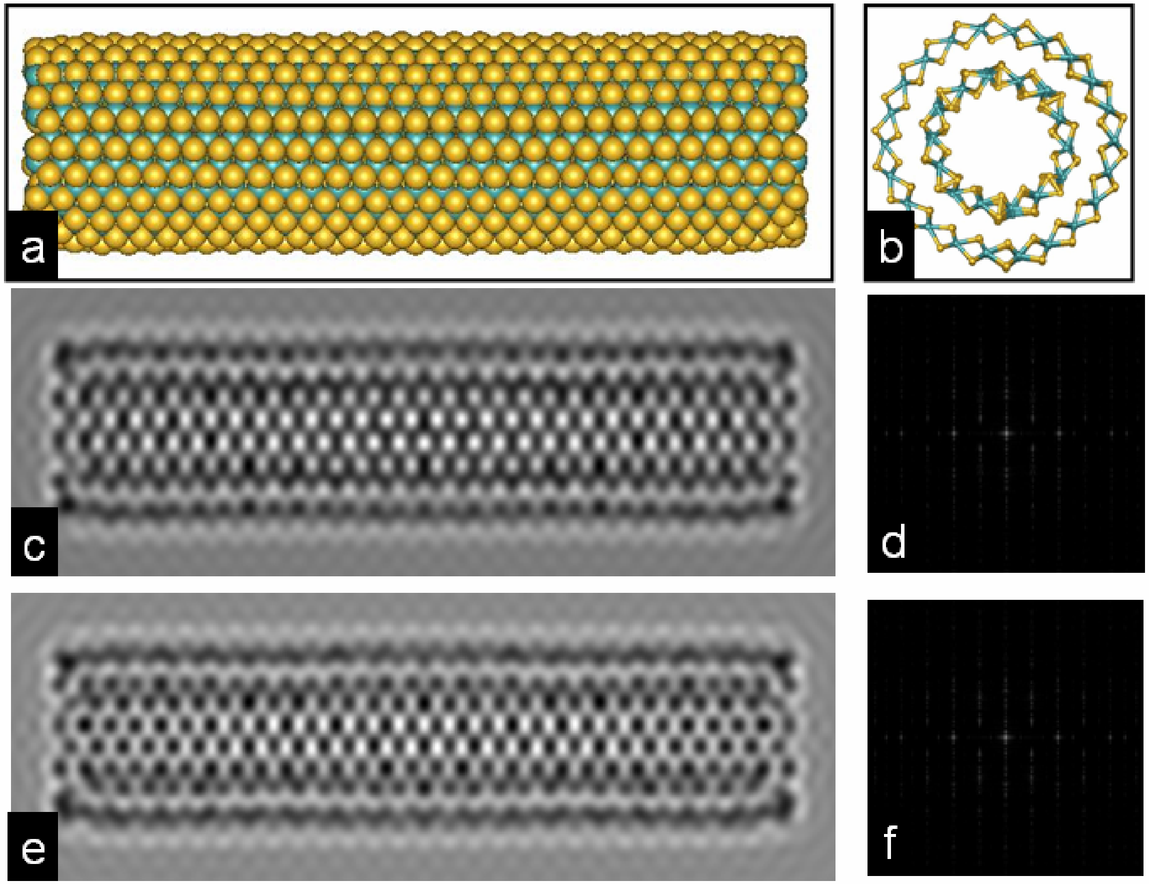
Layered Materials Nanotubes



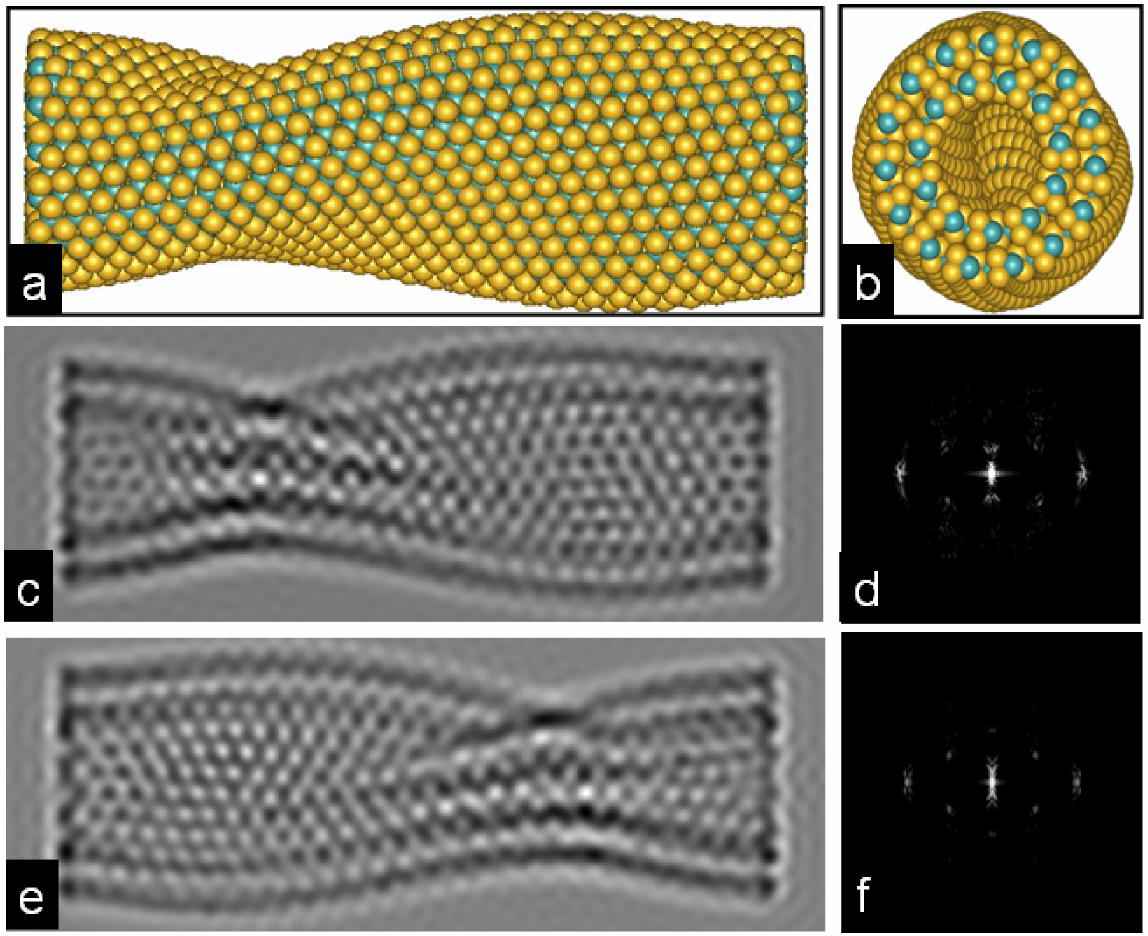
Layered Materials Nanotubes



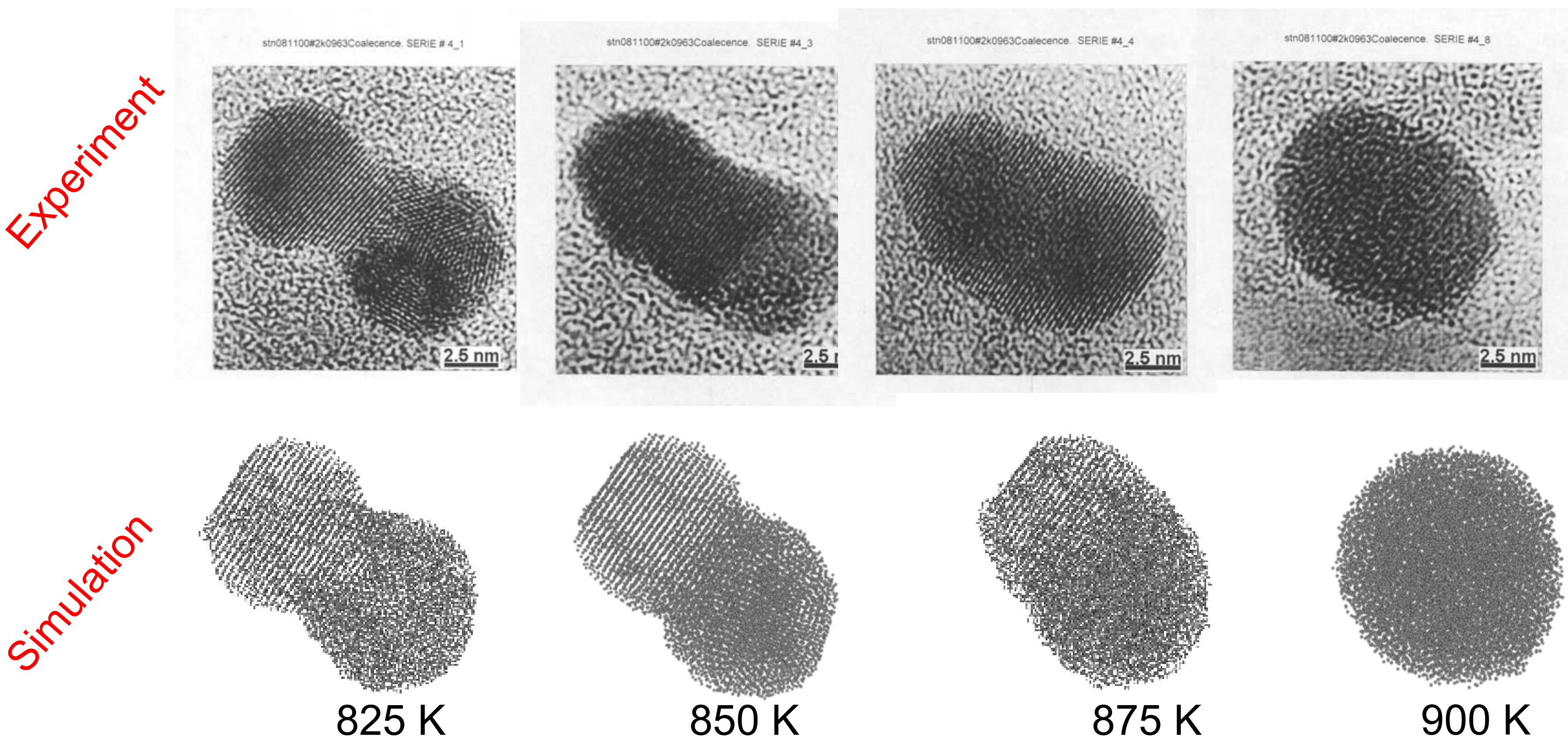
Layered Materials Nanotubes



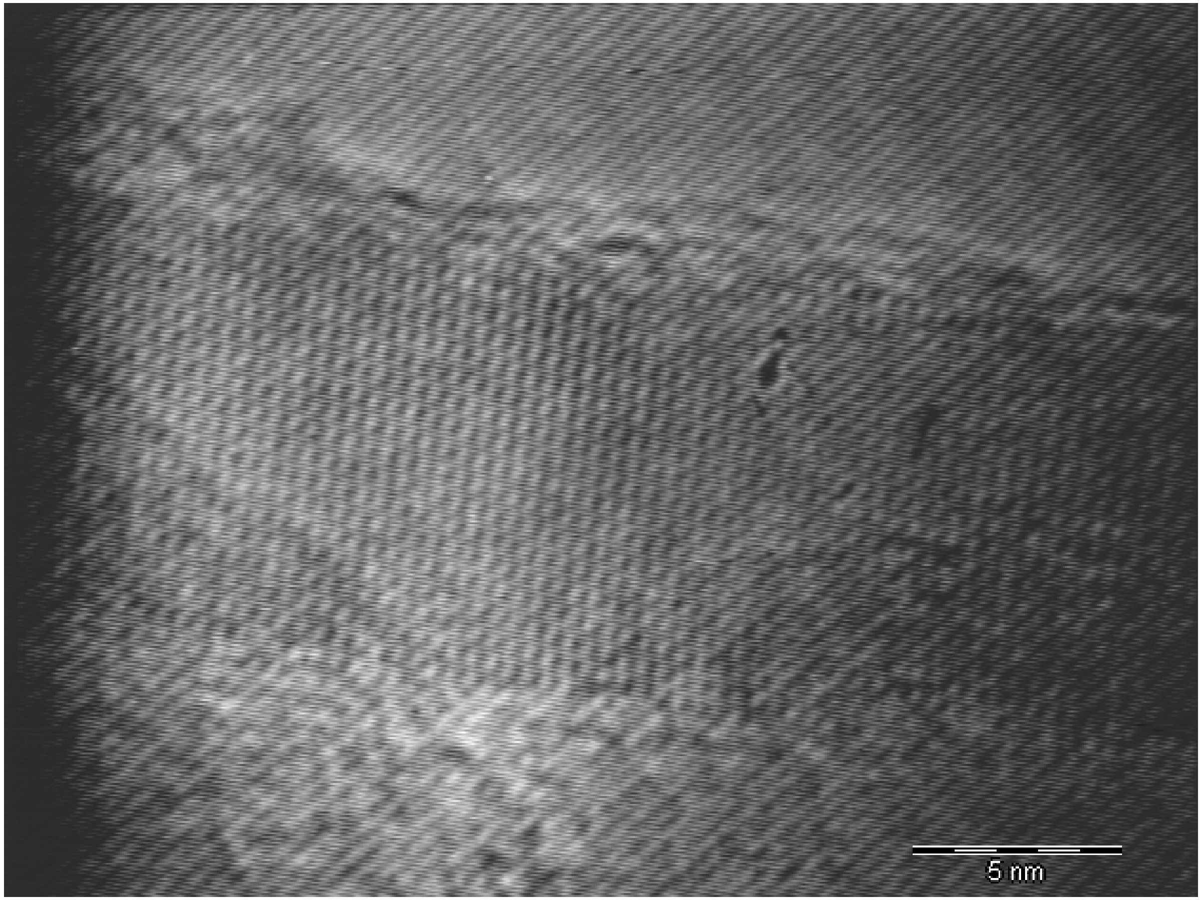
Layered Materials Nanotubes



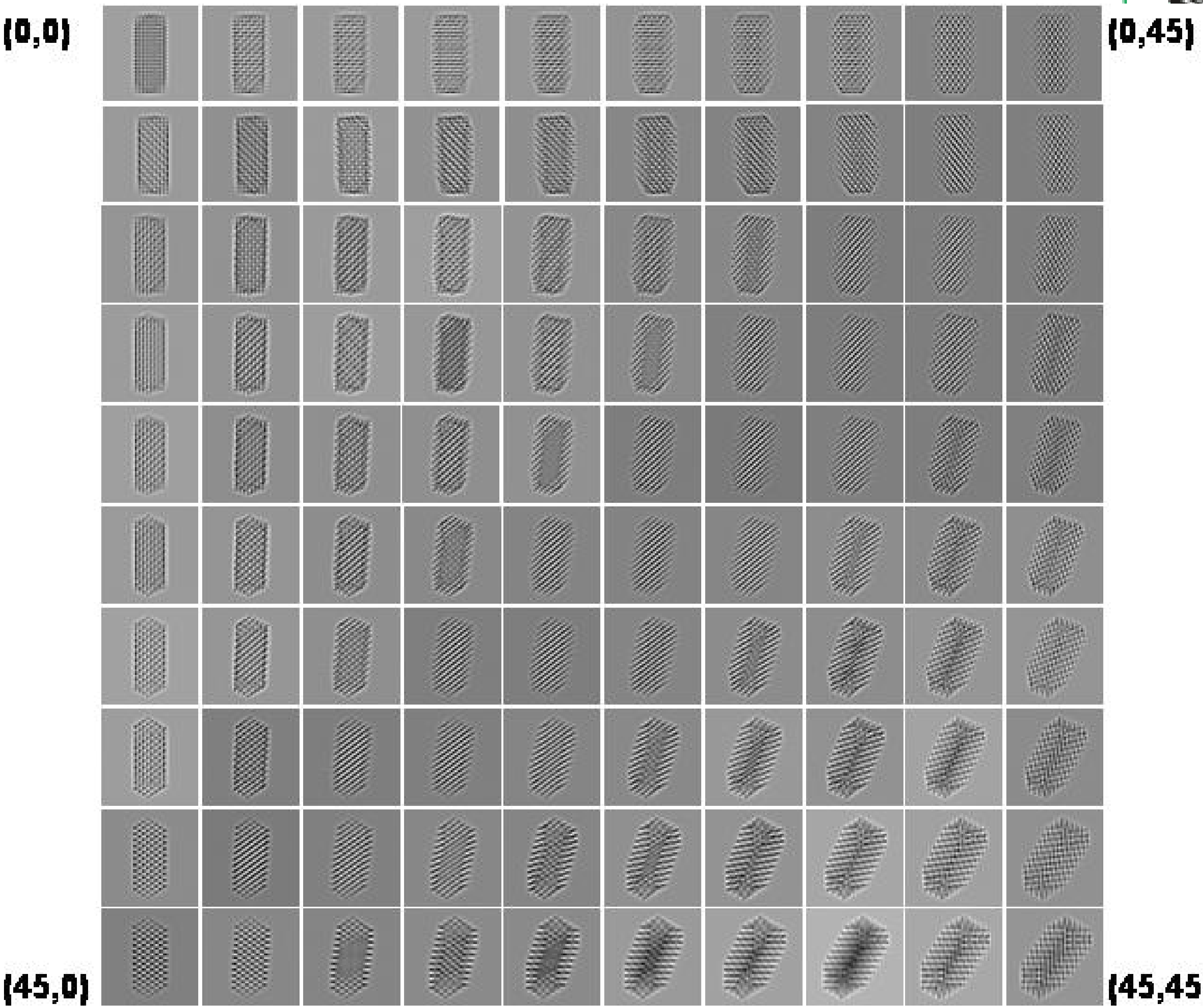
Comparison between experiment and simulation



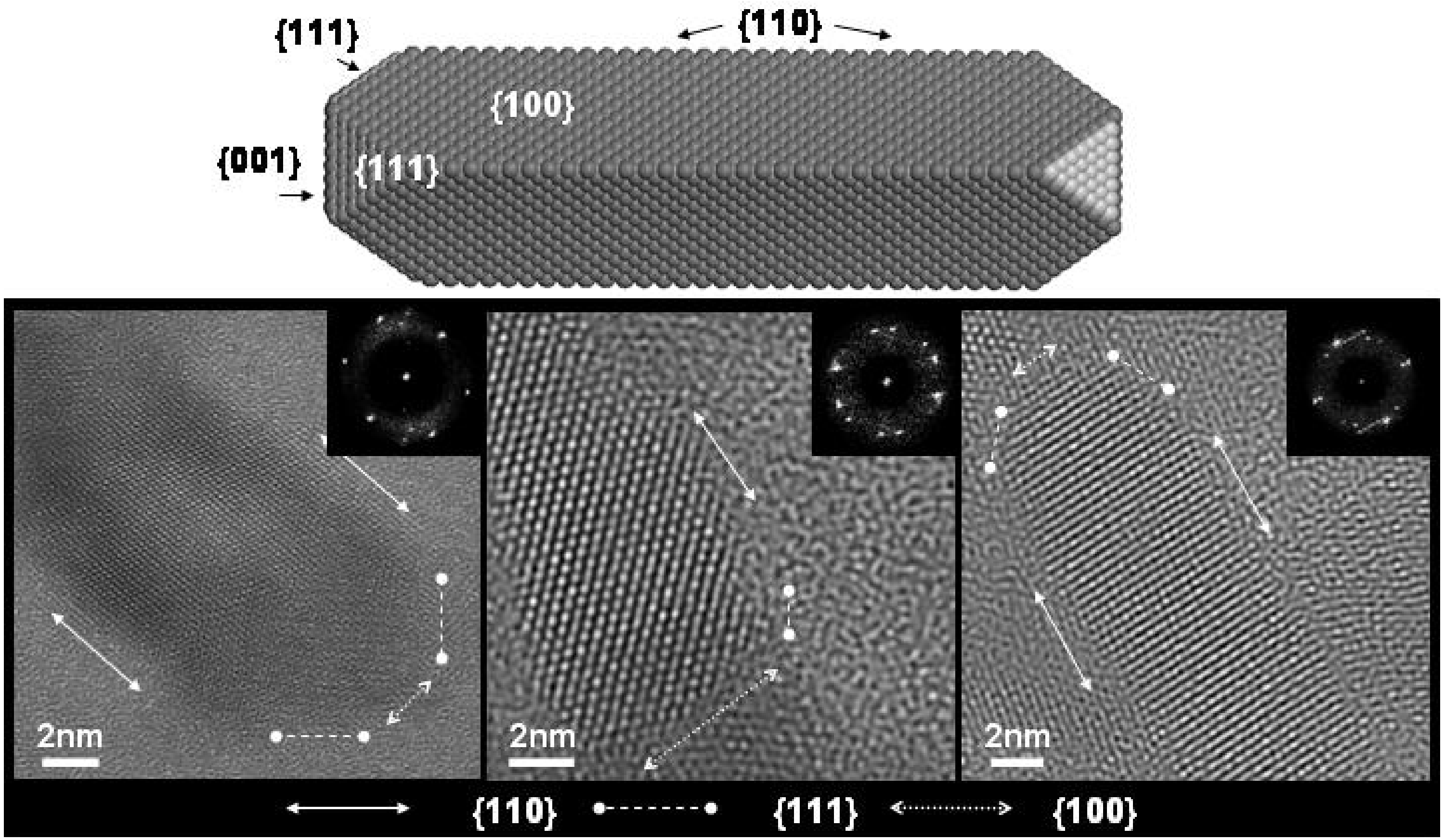
CdS Nanorods



CdS Nanorods

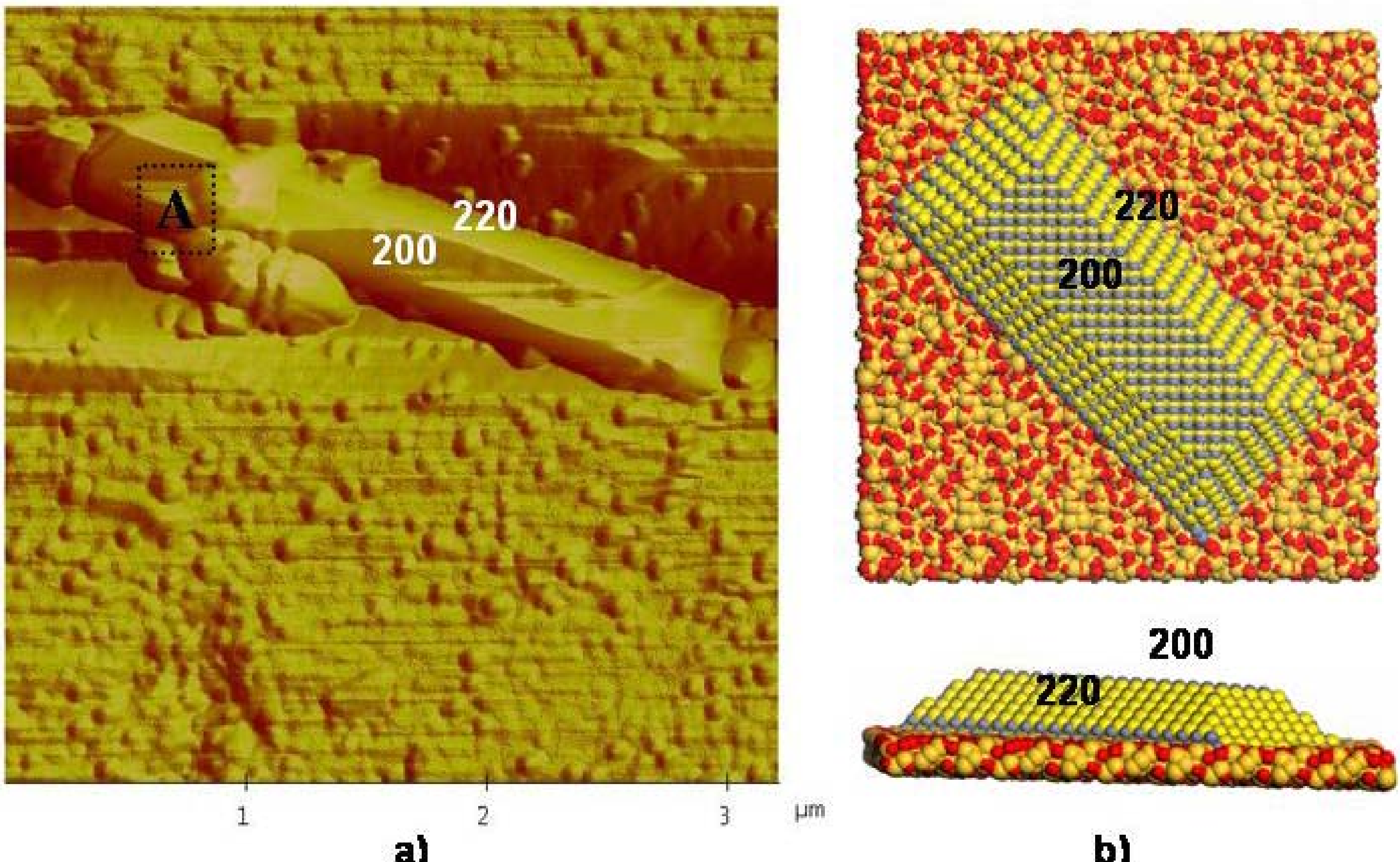


CdS Nanorods



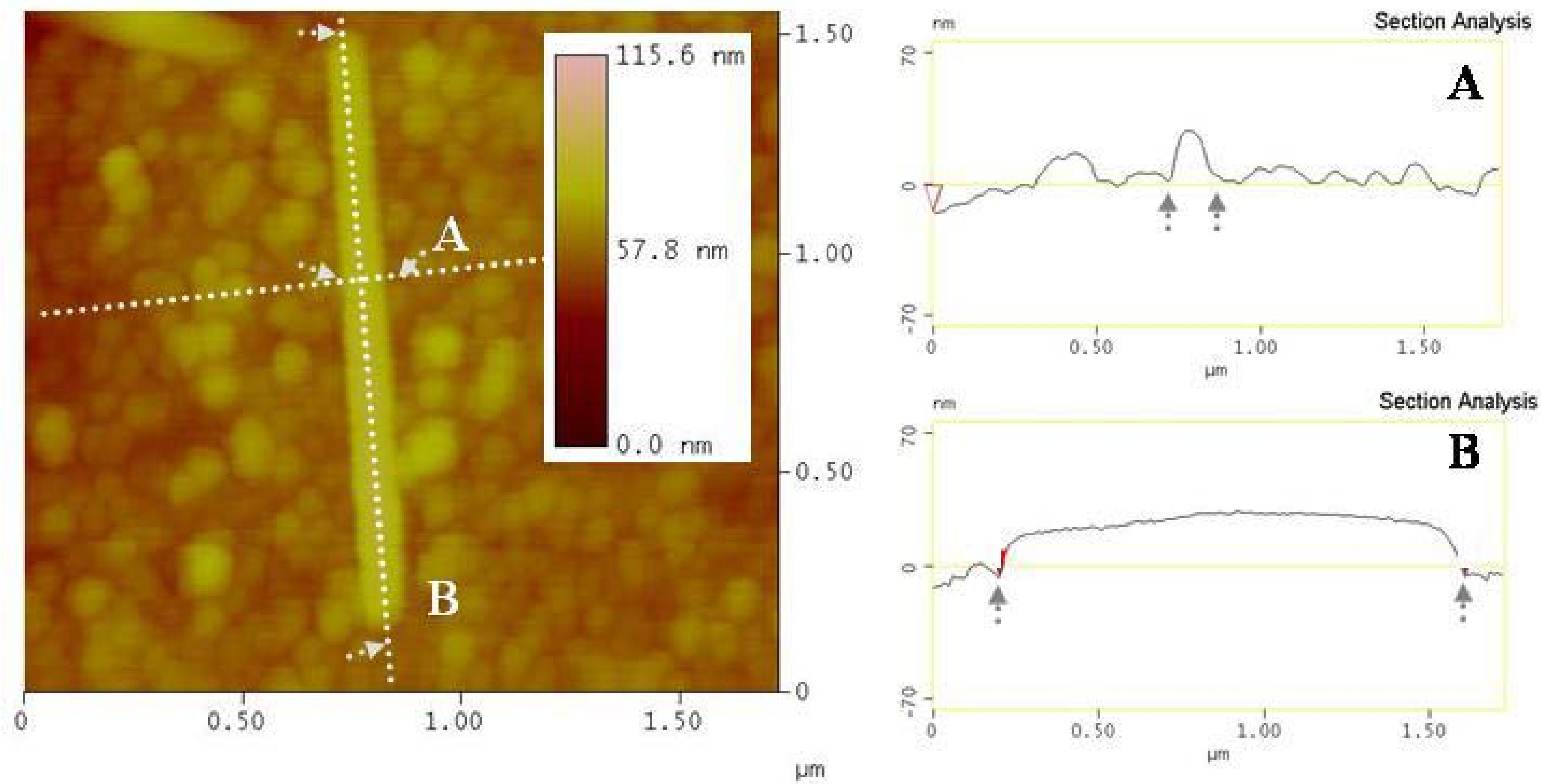
J. A. Ascencio, P. Santiago, L. Rendon and U. Pal. *Structural basis for homogenous CdS nanorods: Synthesis and HREM characterization.* **Enviado a J. of Nanostructured Materials.**

ZnS Nanorods

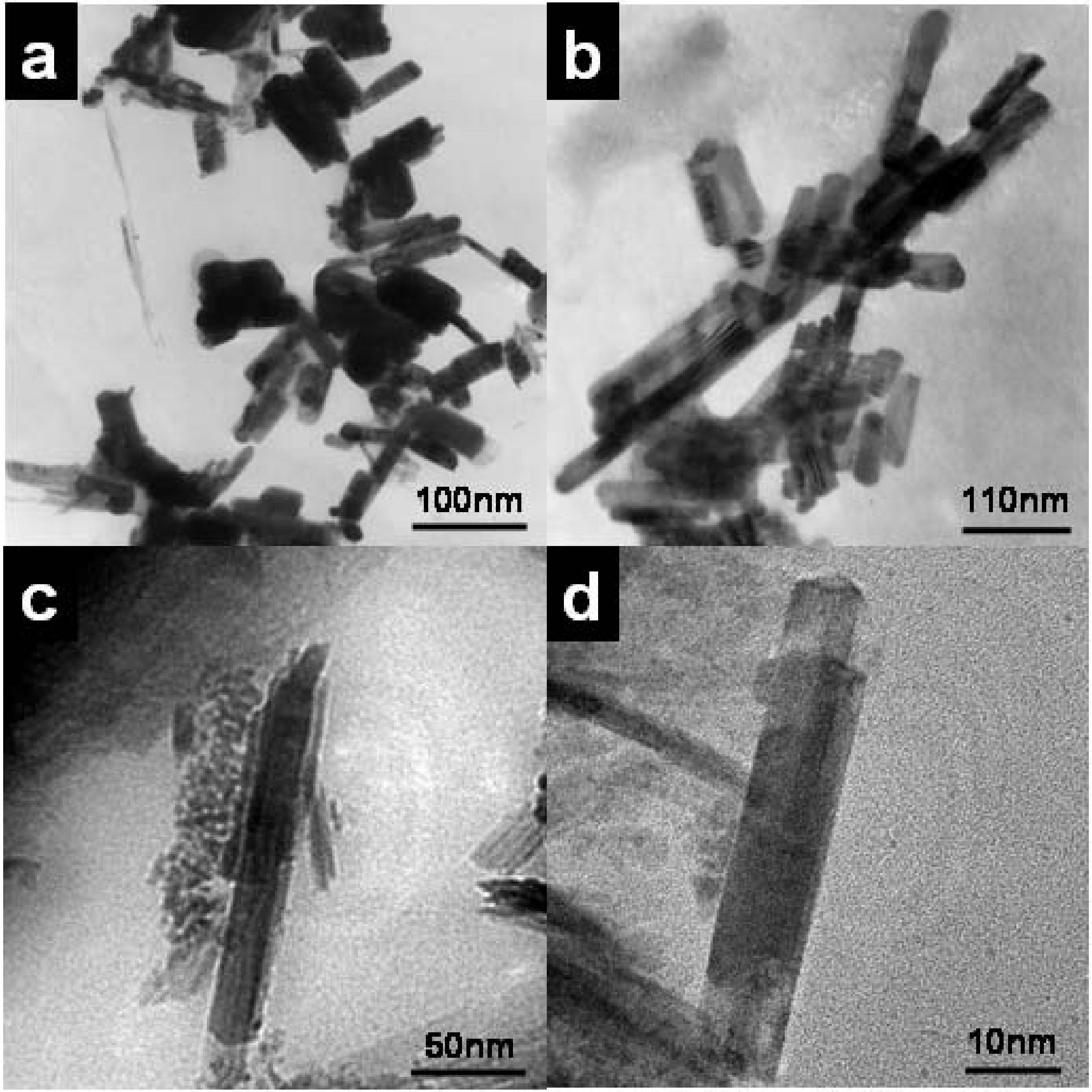


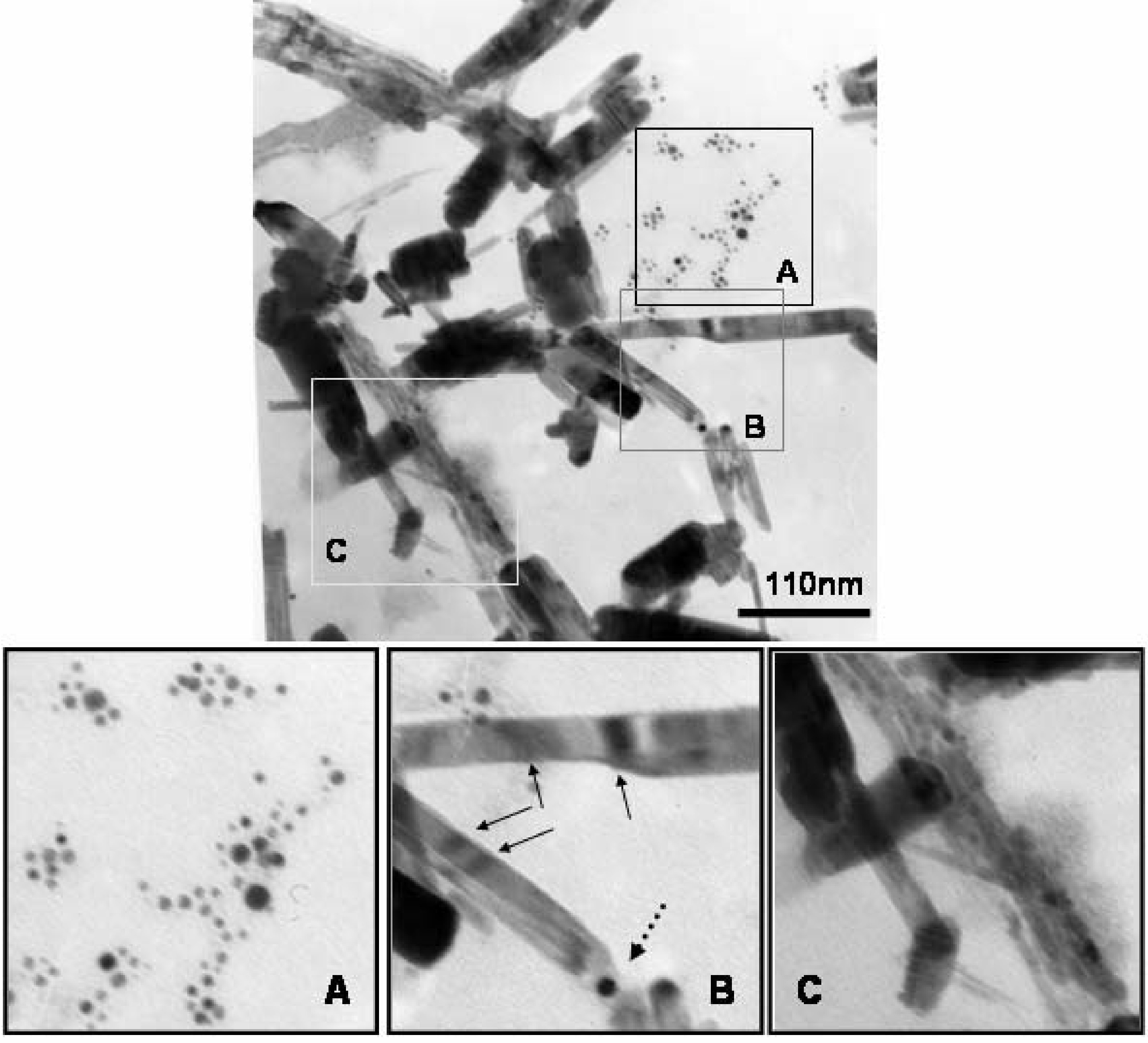
S.Velumani and J.A.Ascencio, *Formation of ZnS nanorods by simple evaporation technique*, enviado a **Applied Physics A.**

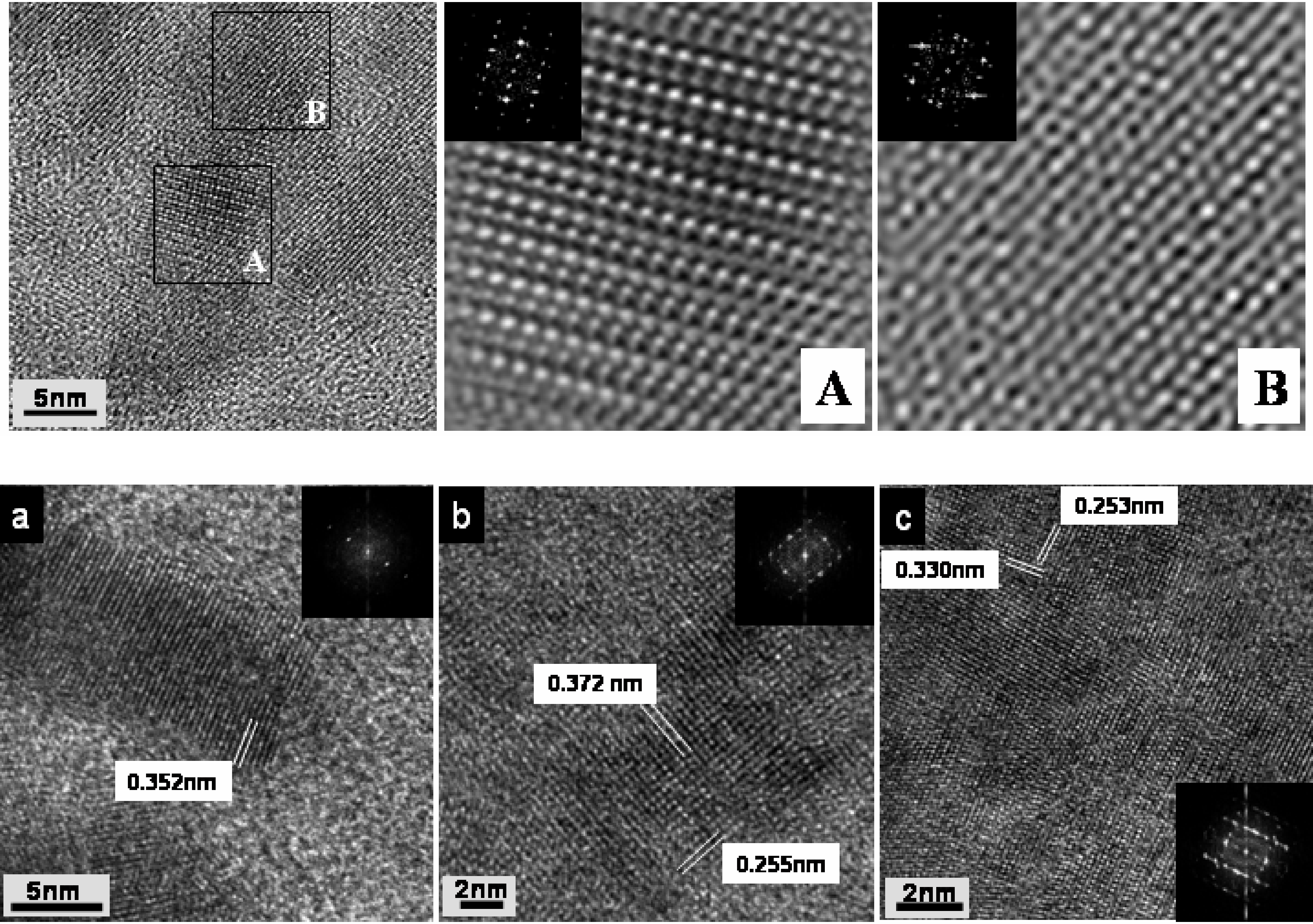
ZnS Nanorods

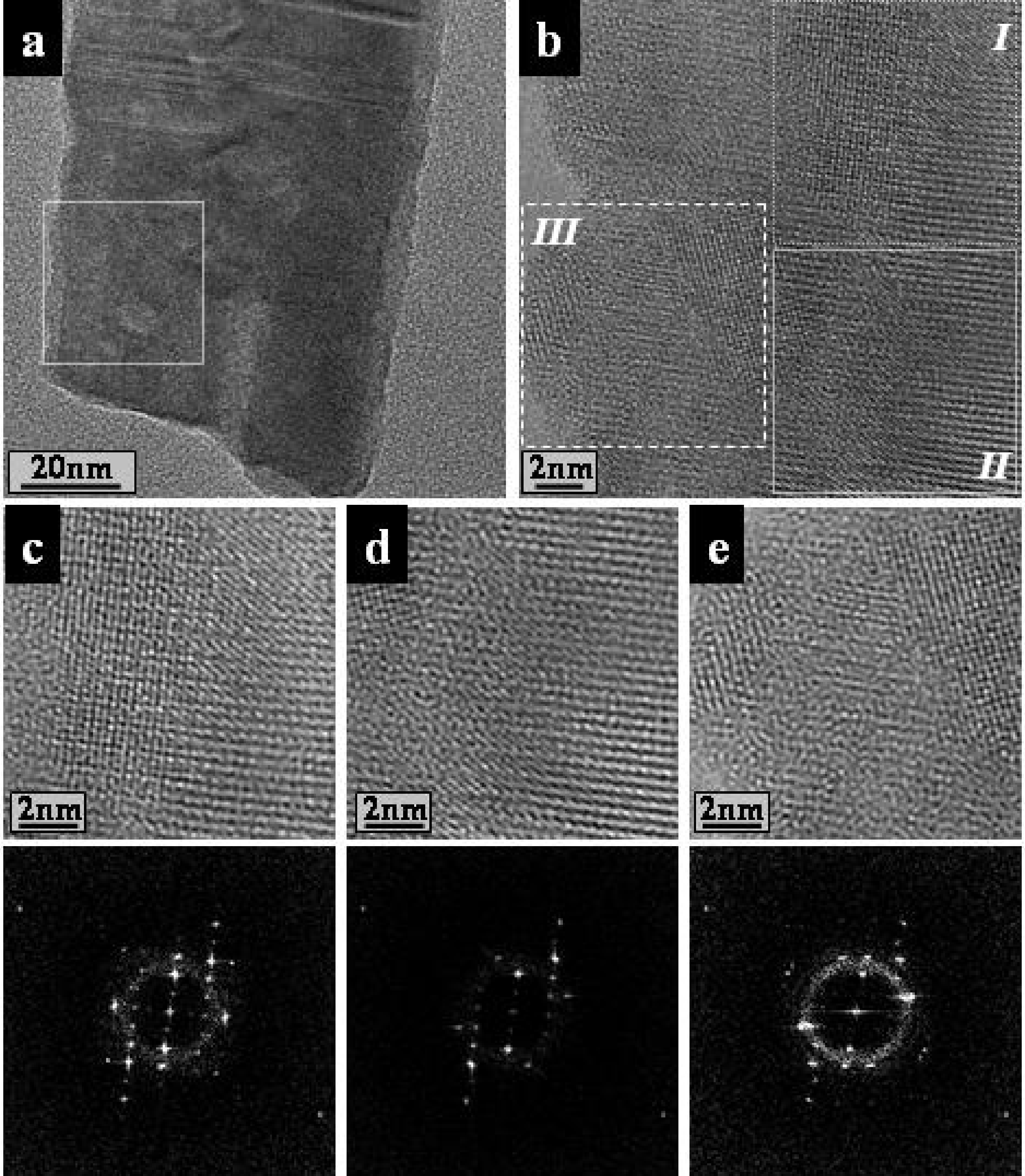


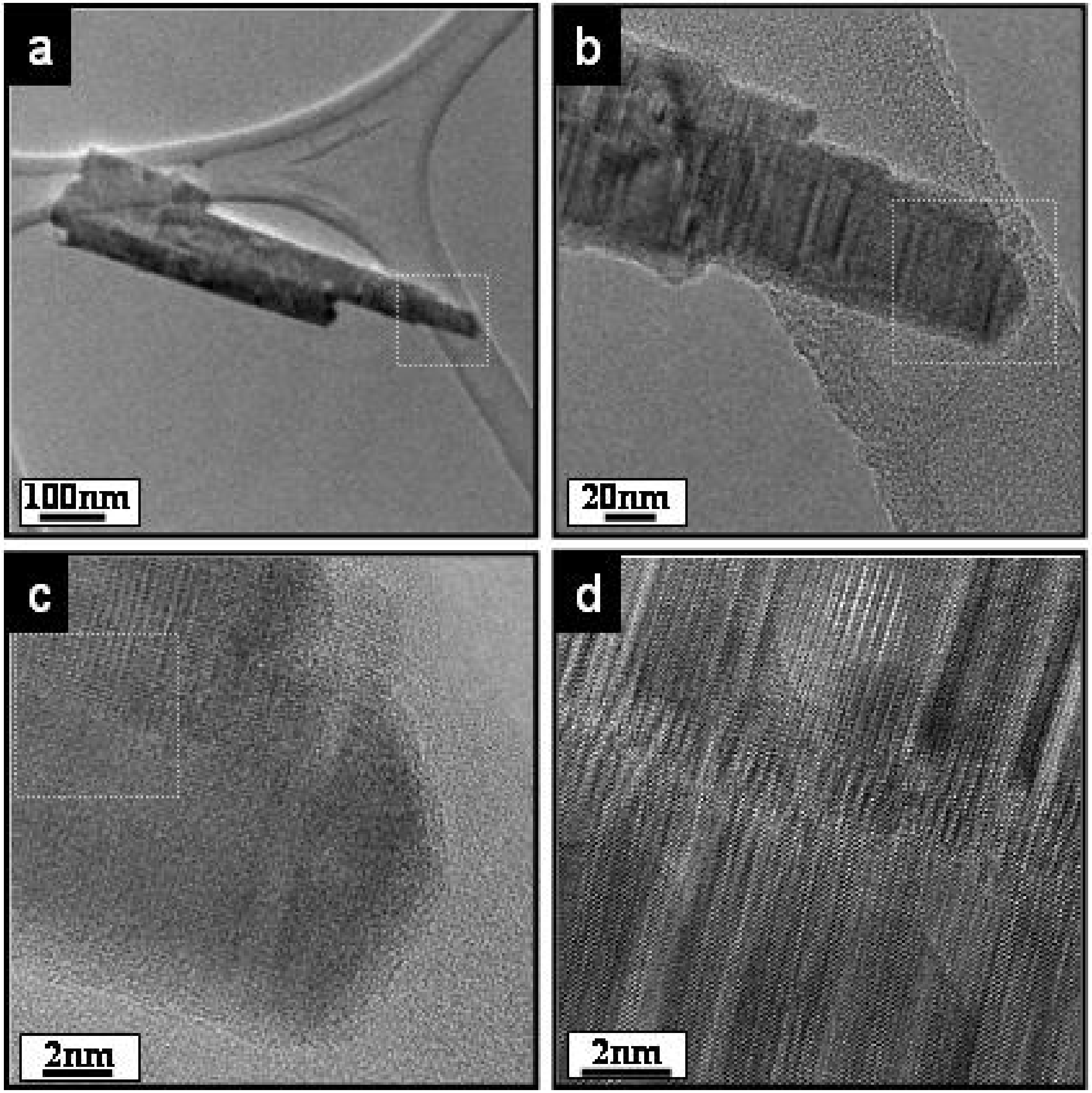
S.Velumani and J.A.Ascencio, *Formation of ZnS nanorods by simple evaporation technique*, enviado a **Applied Physics A.**

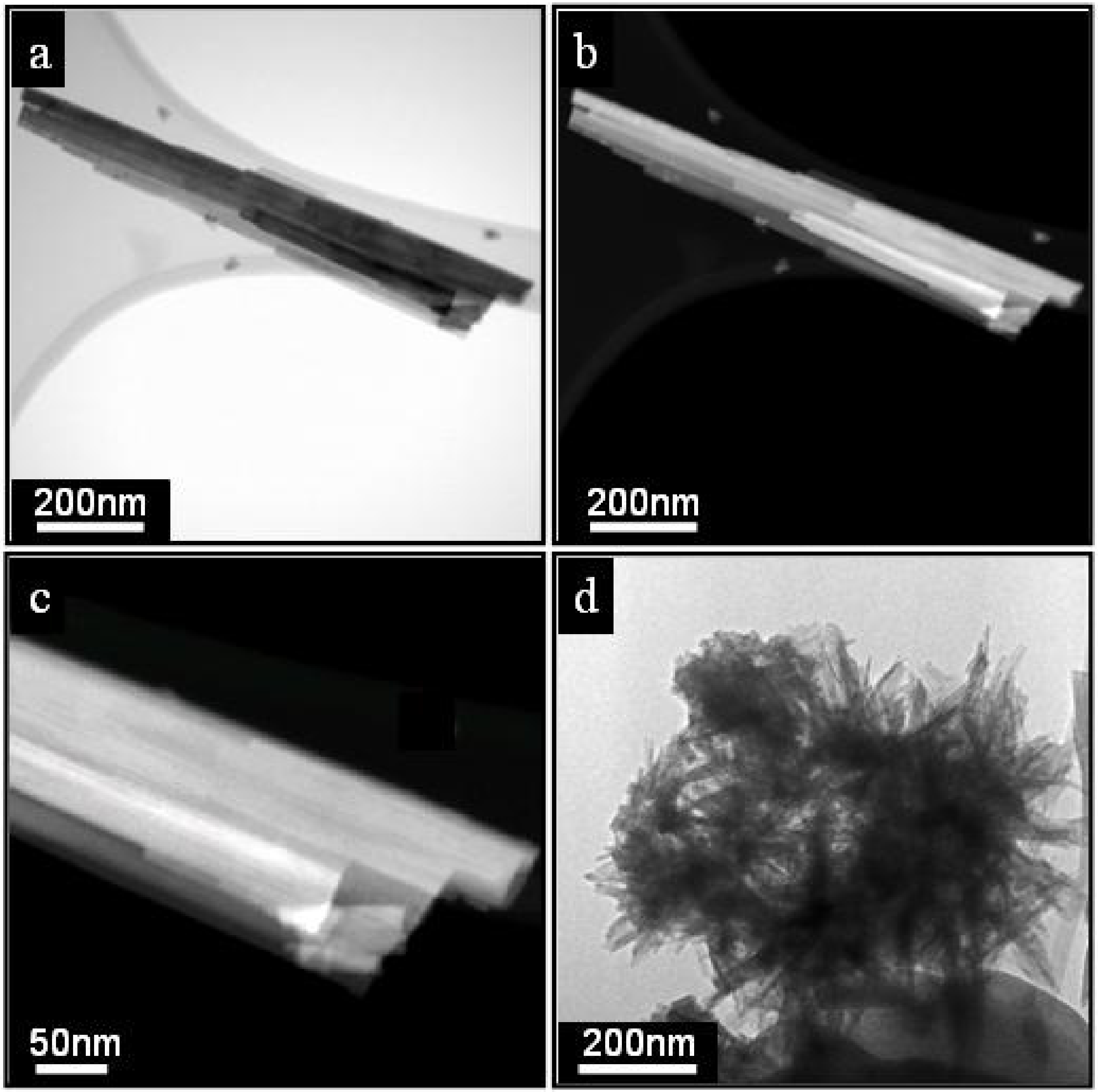

a
100nm
b
110nm
c
50nm
d
10nm

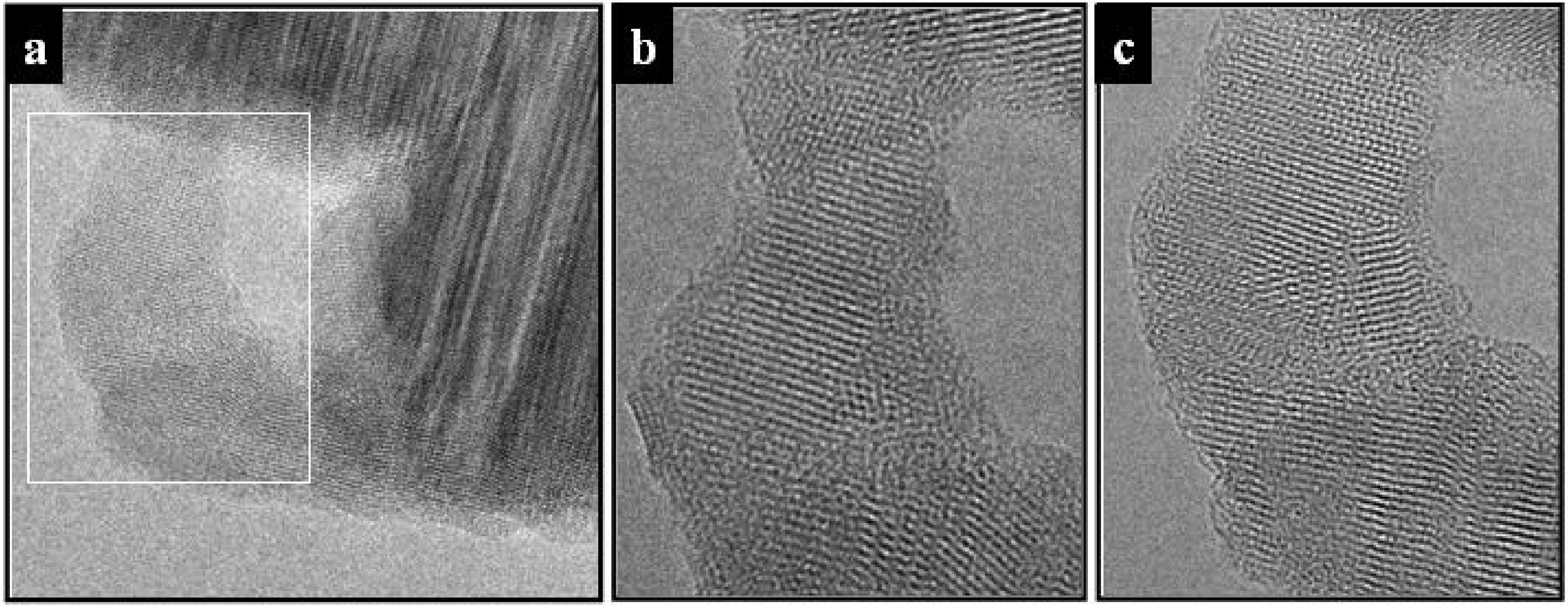

A
B
C
110nm
A
B
C


B
A
5nm
A
B
a
0.352nm
5nm
b
0.372 nm
0.255nm
2nm
c
0.253nm
0.330nm
2nm


a
20nm
b
I
III
II
2nm
c
2nm
d
2nm
e
2nm


a
100nm
b
20nm
c
2nm
d
2nm


a
200nm
b
200nm
c
50nm
d
200nm


a
b
c

Publicaciones asociadas al proyecto y las tareas citadas

- A. B. Flores, L. A. Robles, M. O. Arias, and J. A. Ascencio. *Small Metal Nanoparticles Recognition By Using Digital Image Analysis And High Resolution Electron Microscopy.* **Micron.** 34, 109-118, (2003).
- H.E: Troiani, G.A. Camacho-Bragado, M. Miki-Yoshida, M.A.L. Marquez, A. Rubio, J.A. Ascencio and M. Jose-Yacaman. Directo observation of the mechanical properties of single wall carbon nanotubes and their heterojunctions at the atomic level. **Nanoletters**. 3, 751-757, (2003).
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- Cabe señalar que en comparación con esfuerzos precedentes a la implementación de estos métodos de análisis remoto, se multiplico en tres veces la productividad del grupo y se alcanzaron metas de colaboración y discusión de ideas no contempladas con anterioridad. Sin duda la eficiencia del grupo se incremento en forma significativa, pero también se redujeron de amplia forma las habilidades informáticas de los participantes y se abrieron opciones para estudiantes que ahora se integran a la participación en ambas instituciones participantes y en otras foráneas, donde se plantea implementar estos mecanismos de colaboración y ya existen los primeros avances como es el caso del Instituto de Física de la BUAP en Puebla y el Instituto de Investigaciones Metalúrgicas de la UMSNH en Morelia.