

NANOSCIENZA: UNA RIVOLUZIONE SCIENTIFICA E CULTURLE

D. Peddis

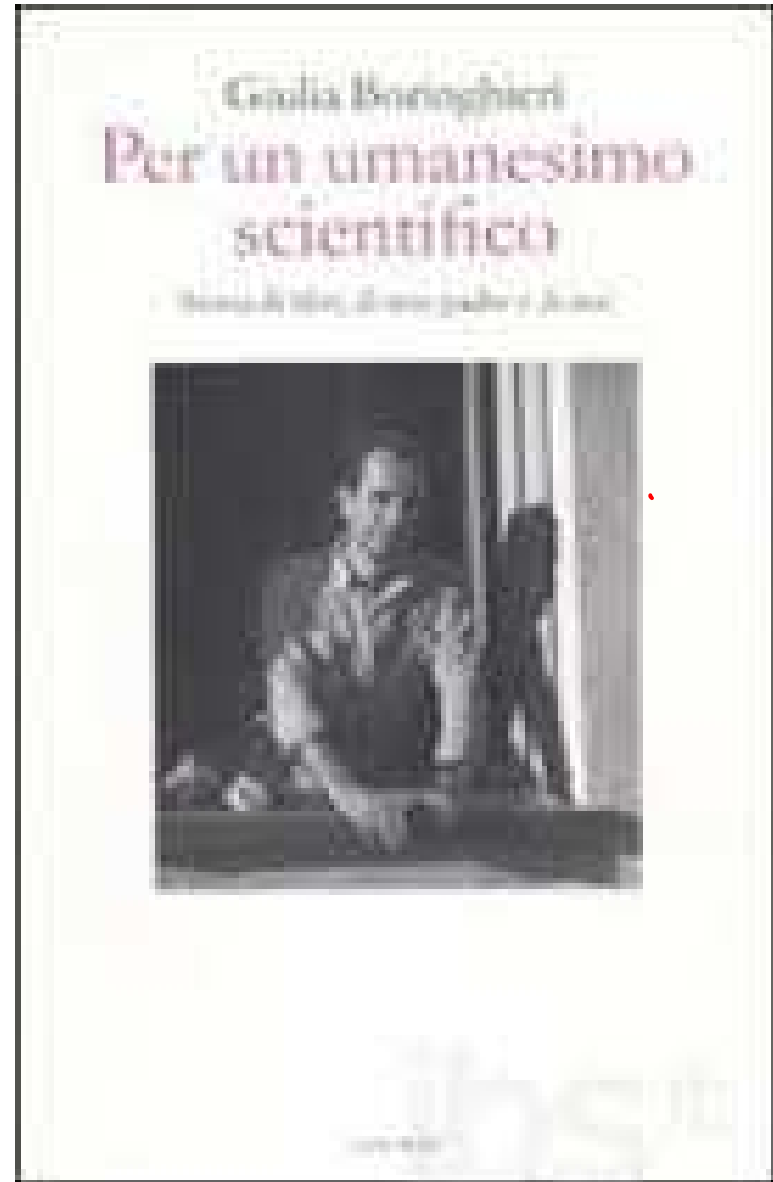
DCCI, Università di Genova, Via Dodecaneso 31, I-16146 Genova, Italy



UNIVERSITÀ DEGLI STUDI
DI GENOVA



Bollati Boringhieri



La divulgazione scientifica, secondo me, è il frutto più delicato di una società in cui è coltivata la scienza. E' la pietra di paragone degli scienziati che riescono a comunicare le idee che stanno alla base della loro ricerca: non tanto il risultato particolare quanto la struttura mentale che condiziona tutta la ricerca scientifica. Direi che solo se questo obiettivo è raggiunto la scienza diventa un fatto culturale, diventa un elemento che entra nell'orizzonte dell'uomo colto.

Paolo Boringhieri



A B C D E F

G H I J K L

M N O P Q R

S T U V W

X Y Z

487 lettere

76 parole

lettere (a, b, c, ...)

alfabeto

insieme di lettere (atctiecbil)



LOGICA UMANA

parole (bicicletta)

frasi

paragrafi

capitoli di un libro

libri

collane di libri

biblioteche

A B C D E F

G H I J K L

M N O P Q R

S T U V W

X Y Z

Tavola Periodica degli Elementi

Metalli alcalini
 Metalli alcalino terrosi
 Metalli del blocco d
 Lantanidi
 Attinidi
 Metalli del blocco p
 Nonmetalli
 Gas nobili
C Solidi
Br Liquidi
H Gas
Tc Artificiali

Le masse atomiche tra sono quelle degli isotopi più stabili o più comuni.

Nota il sotto gruppo del numero 1-18 è stato adottato nel 1984 dalla International Union of Pure and Applied Chemistry (IUPAC). I nomi degli elementi 112-118 sono gli equivalenti latini di quei nomi.



lettere (a, b, c, ...)

alfabeto

insieme di lettere (atctiecbil)



LOGICA UMANA

parole (bicicletta)

frasi

paragrafi

capitoli di un libro

libri

collane di libri

biblioteche

atomi (C, H, O, ...)

tavola periodica

insieme di atomi (CHHHCNHHOO)



LOGICA NATURALE

molecole (*glicina*, $\text{NH}_2\text{CH}_2\text{COOH}$)

supermolecole semplici

supermolecole complesse (*enzimi*)

organi intracellulari (*mitocondri*)

organismi unicellulari (*protozoi*)

organismi pluricellulari semplici

organismi pluricellulari complessi (*uomo*)

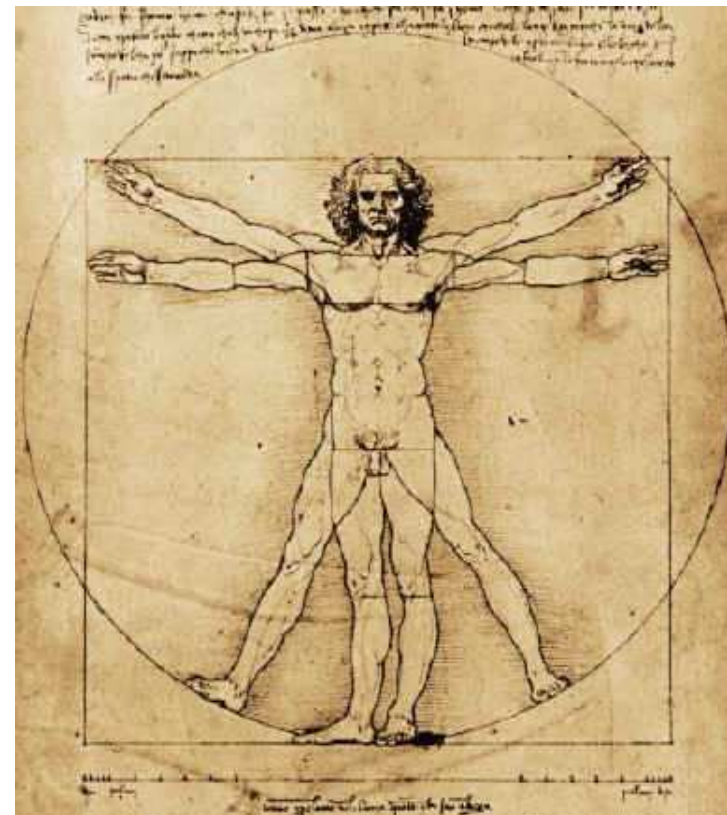
V. Balzani





10^{13} lettere

10^{28} atomi



Slide 7

u1

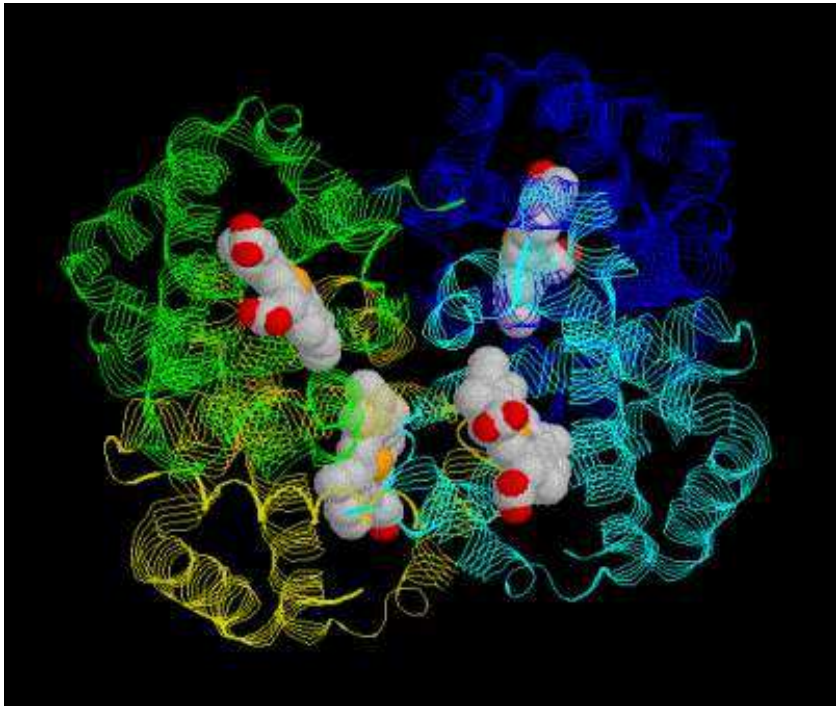
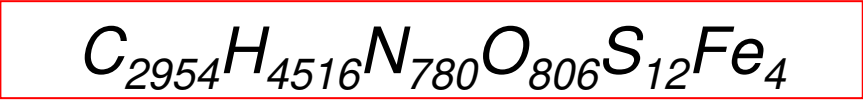
La biblioteca di pargi è forse la più grande la mondo e contiene 10 milioni di volumi per un totale 1013 lettere

utente; 14/01/2014



8987

9072 atomi

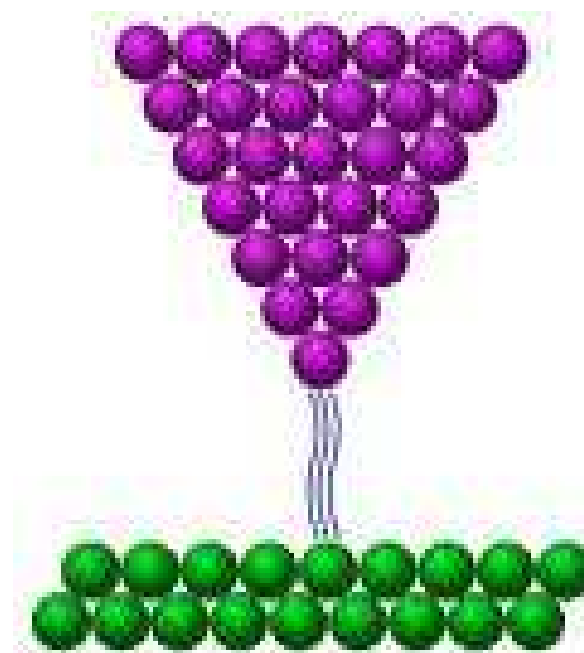
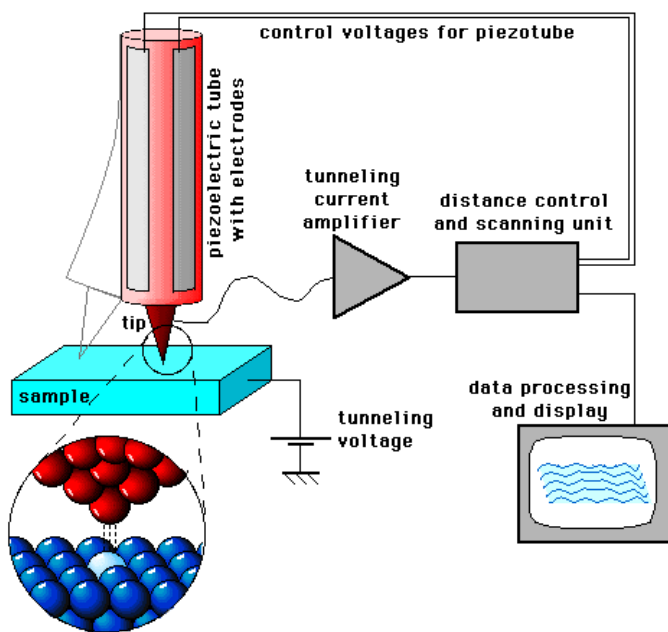


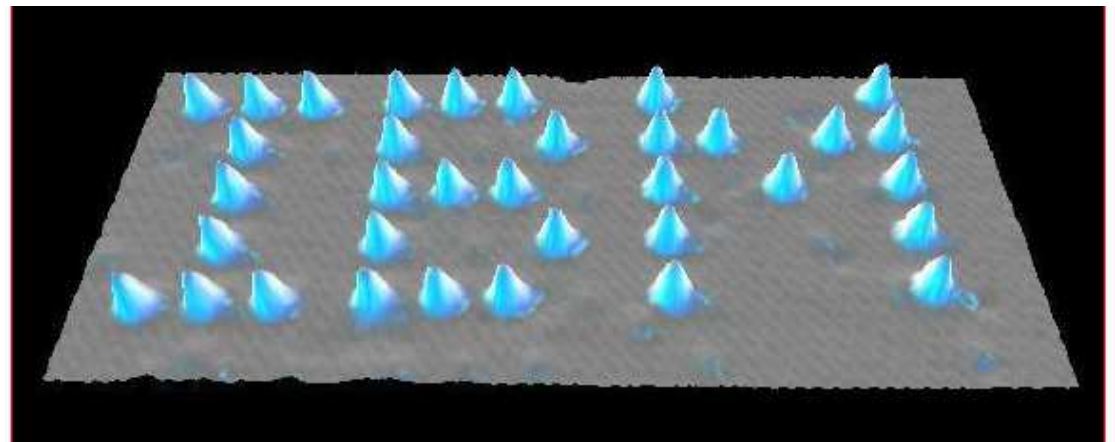
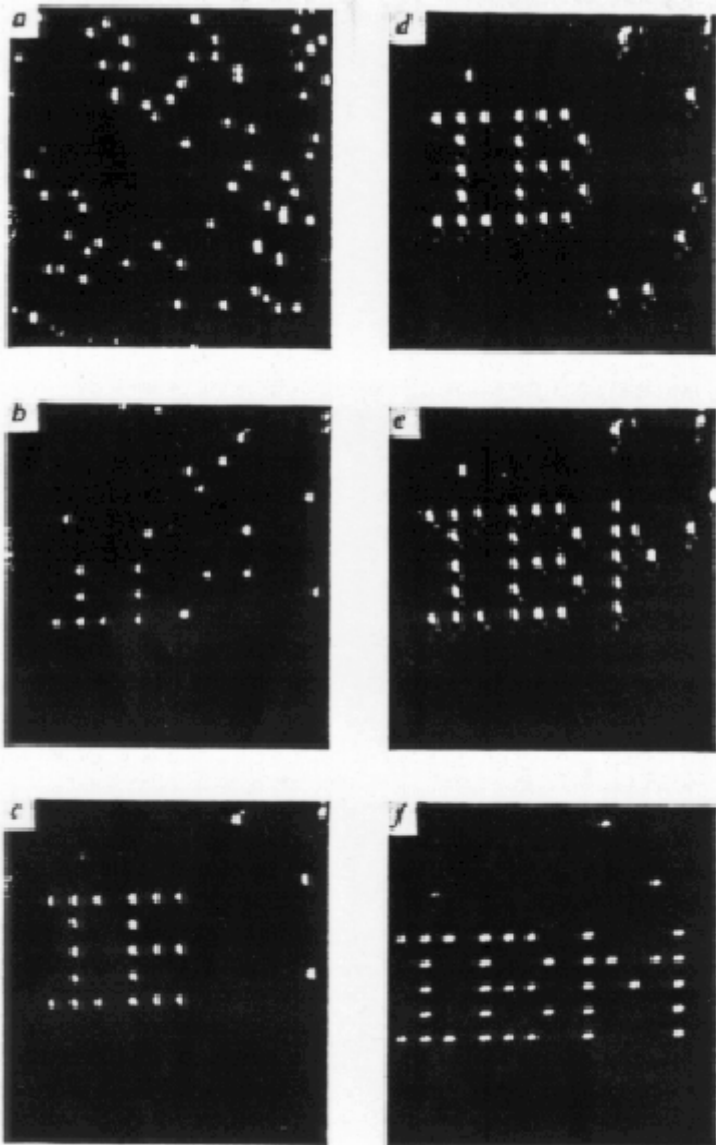
1981



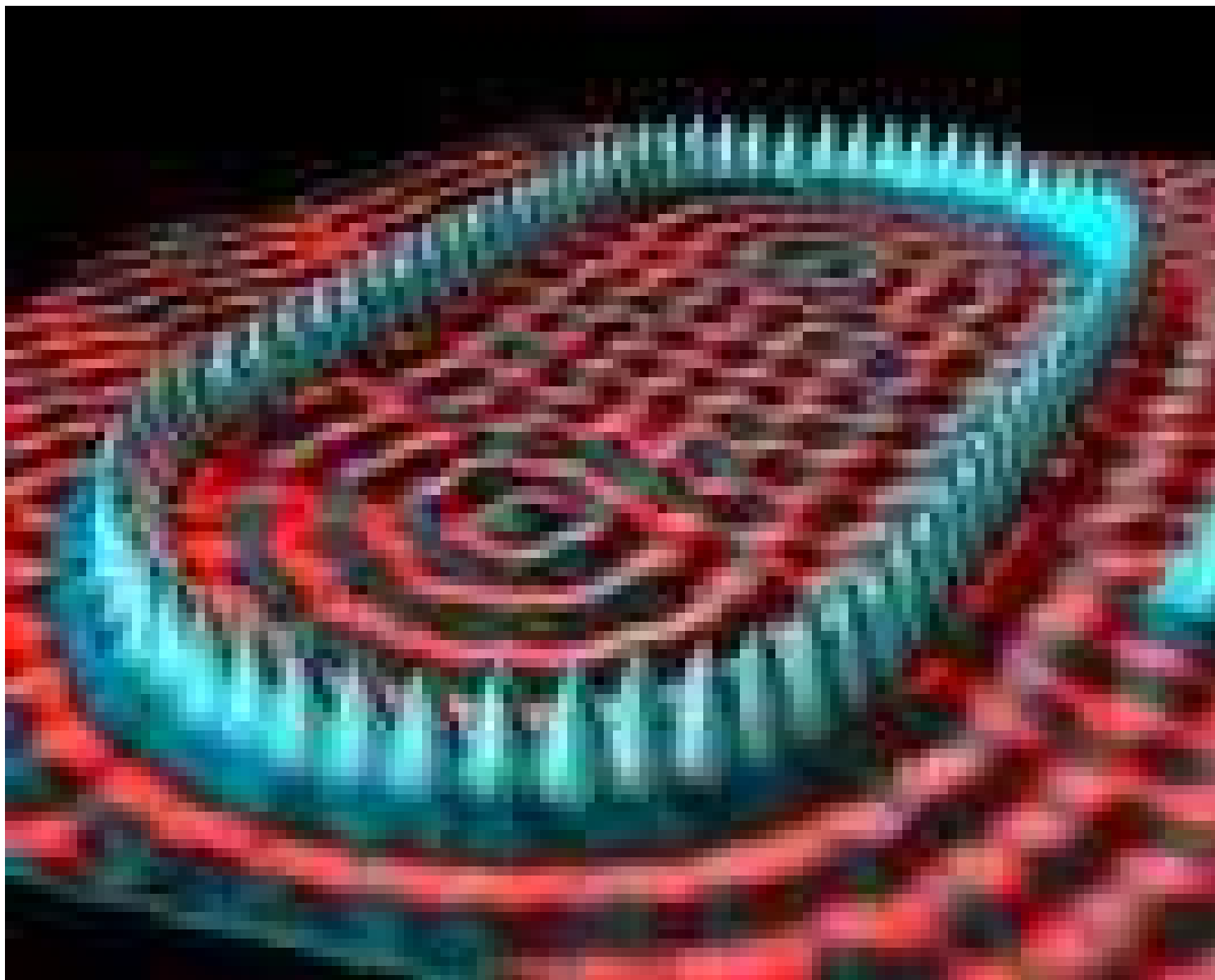
Gerd Binnig e Heinrich Rohrer (IBM Zürich Research Laboratory) Inventano il microscopio a effetto tunnel

Premio Nobel nel 1986





Atomi di xenon su nichel



Atomi di ferro su rame

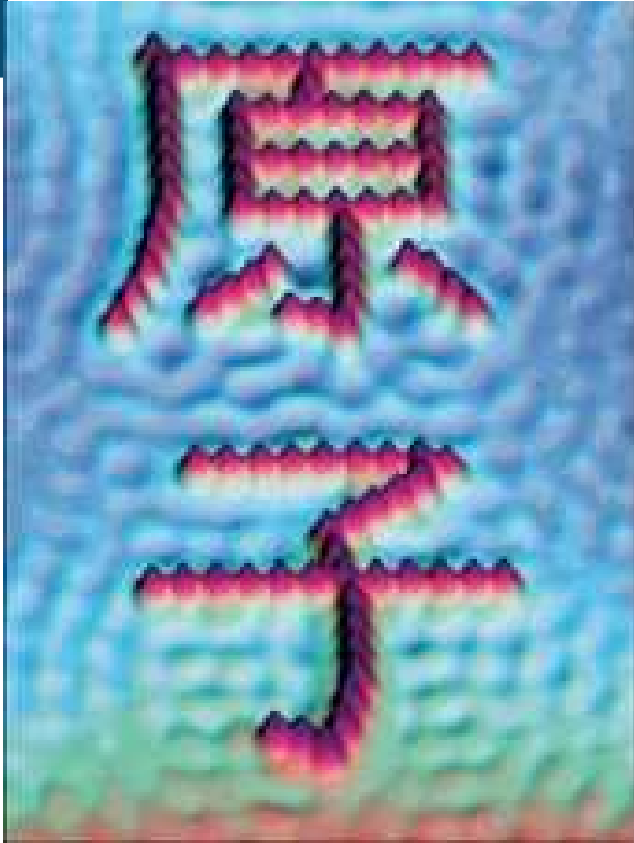


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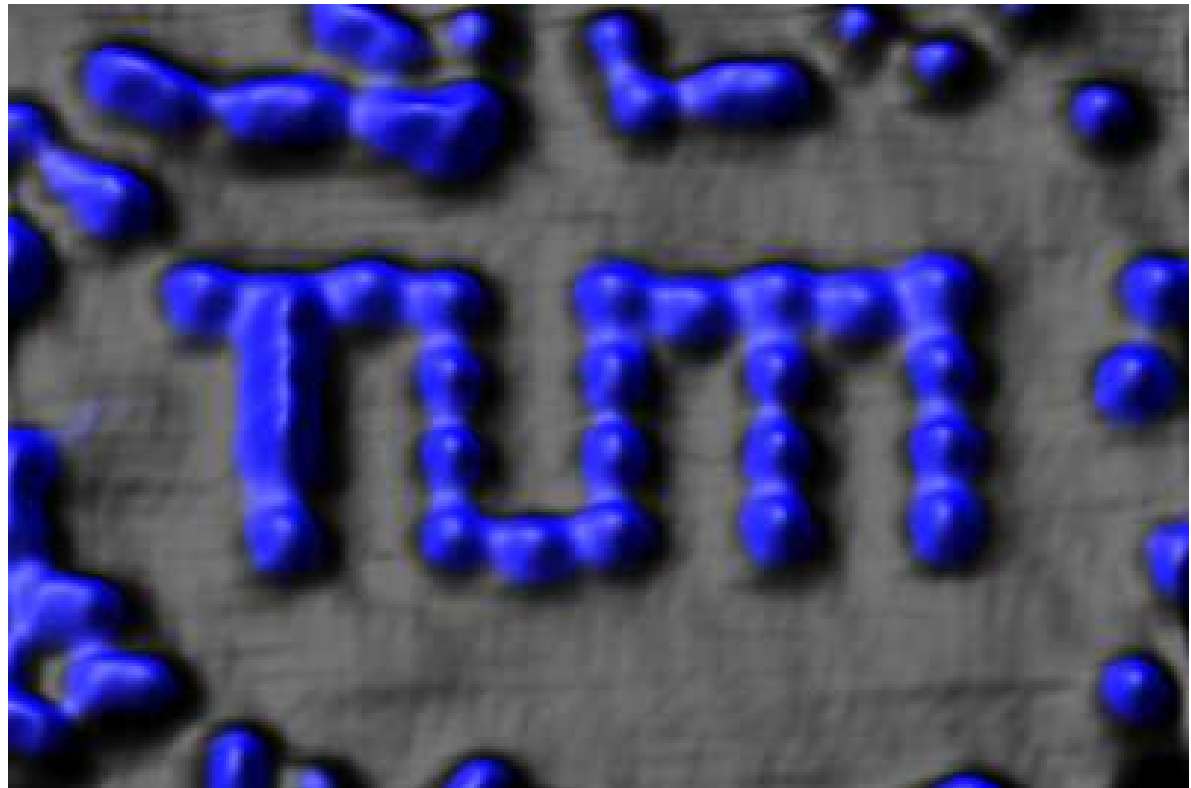
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Slide | 1

Atomi di ferro su rame



L'ideogramma significa
“Atomo”



TUM, Acronimo di **T**echnische **U**niversität **M**ünchen



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At the nanolevel is a new ball game

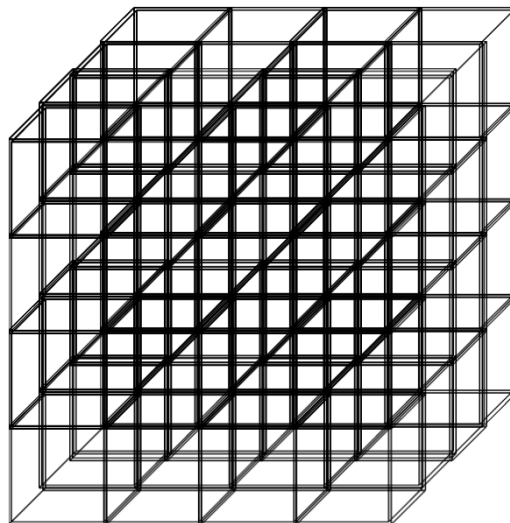




1 cristallo di lato di 1 cm



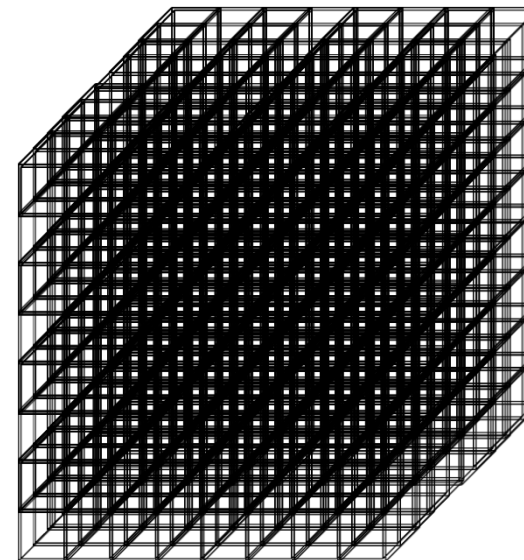
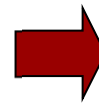
Superficie laterale
 $6 \text{ cm}^2 = 6 \times 10^{-4} \text{ m}^2$



10⁹ cristalli di lato di 10⁻³ cm



Superficie laterale
 $6 \times 10^3 \text{ cm}^2 = 6 \times 10^{-1} \text{ m}^2$

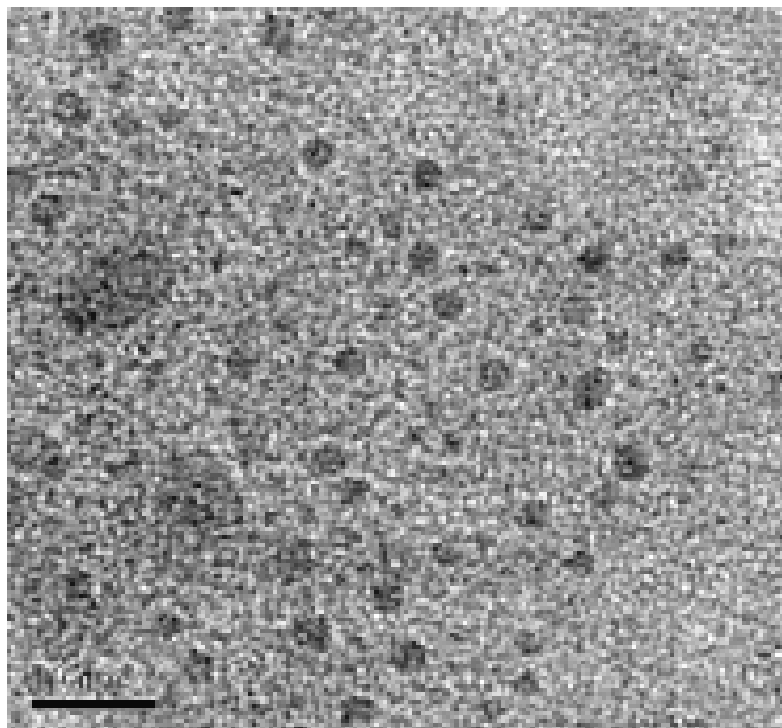


10¹⁸ cristalli di lato di 10⁻⁶ cm



Superficie laterale
 $6 \times 10^6 \text{ cm}^2 = 600 \text{ m}^2$





Particelle Fe_3O_4 (8 nm)

Area Superficiale: 80 m² /g



SUPERFICIE, SUPERFICIE, SUPERFICIE



“God made the bulk;
surfaces were invented by
the devil”

Wolfgang Pauli (attributed)

COMMENTARY

Surfaces — lost and found

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*e-mail: paparazzo@ism.cnr.it

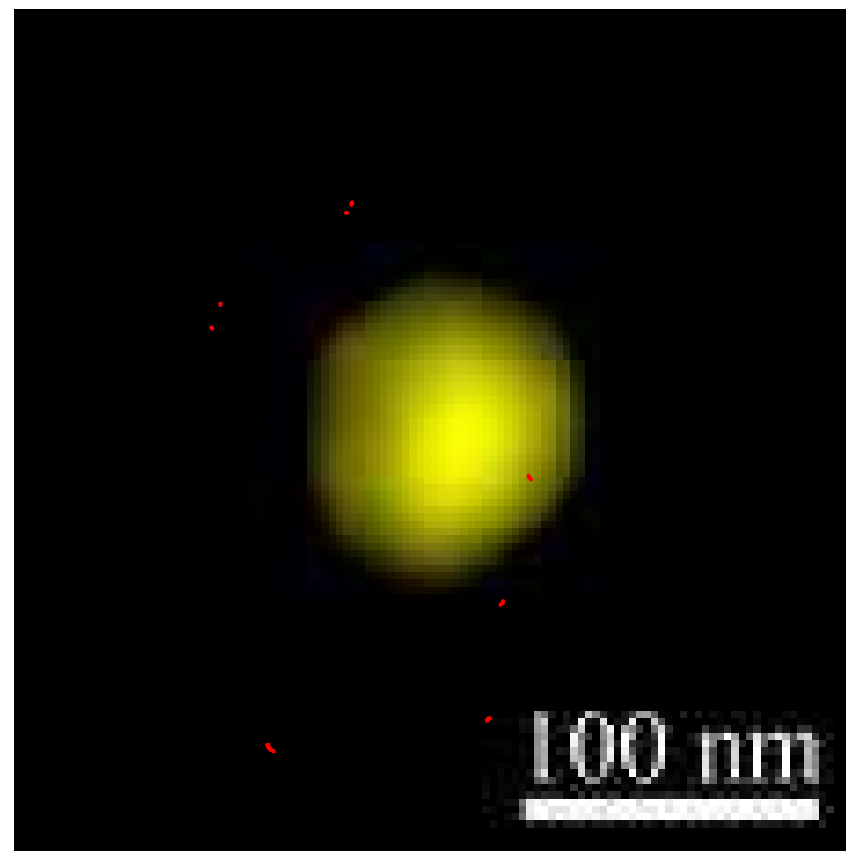
Surfaces were a topic of active debate among ancient philosophers, some of which continues to this day. Can modern surface science settle the question of whether surfaces exist or not?

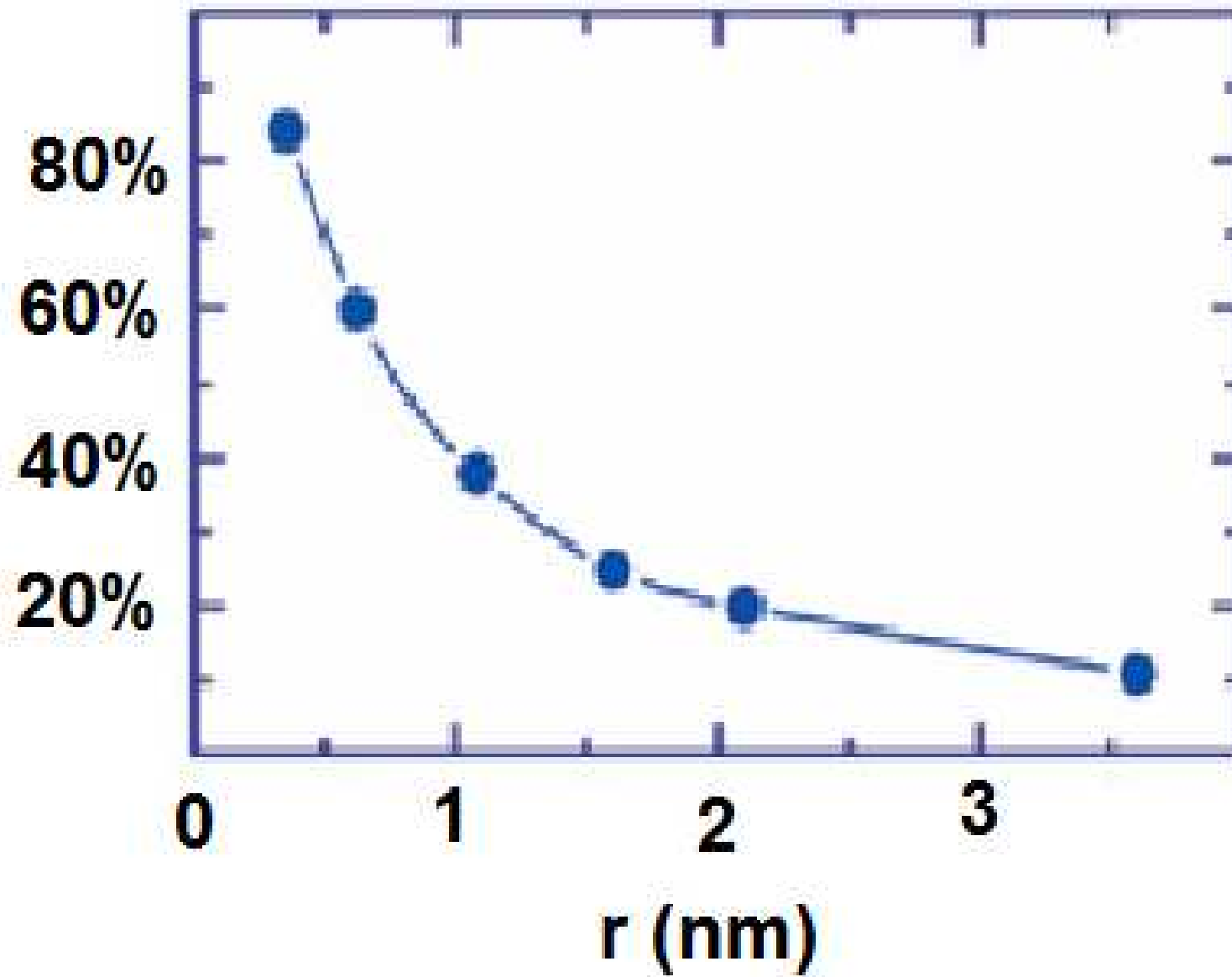
E. Paparazzo *Nature Materials*, 2, 351 2013



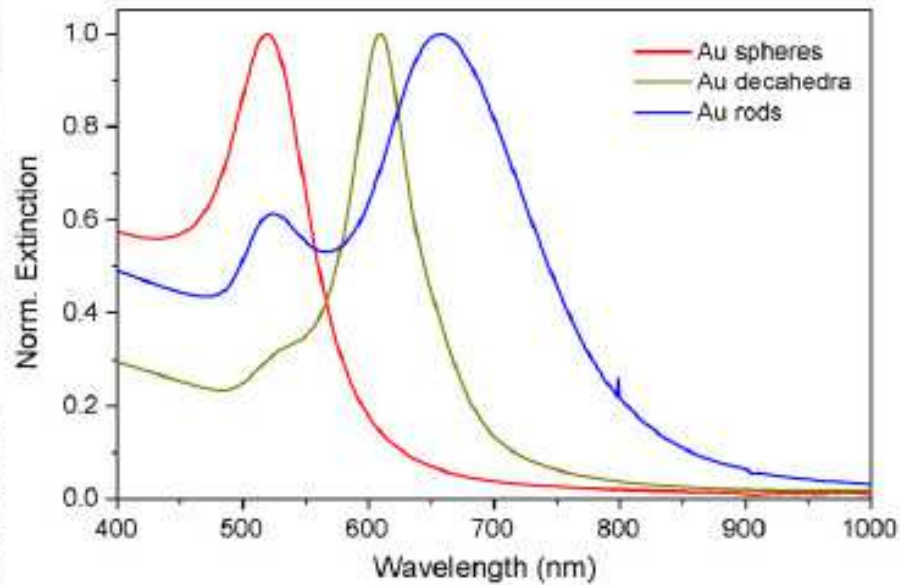
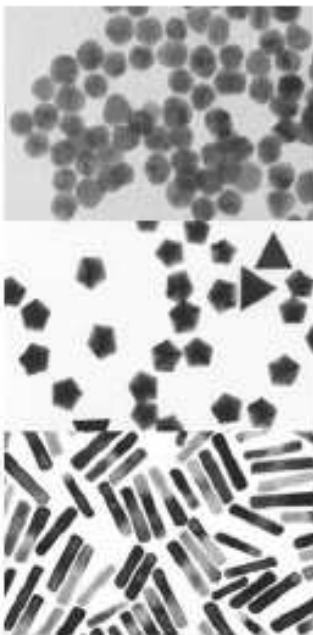
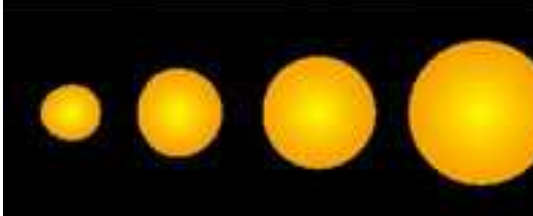
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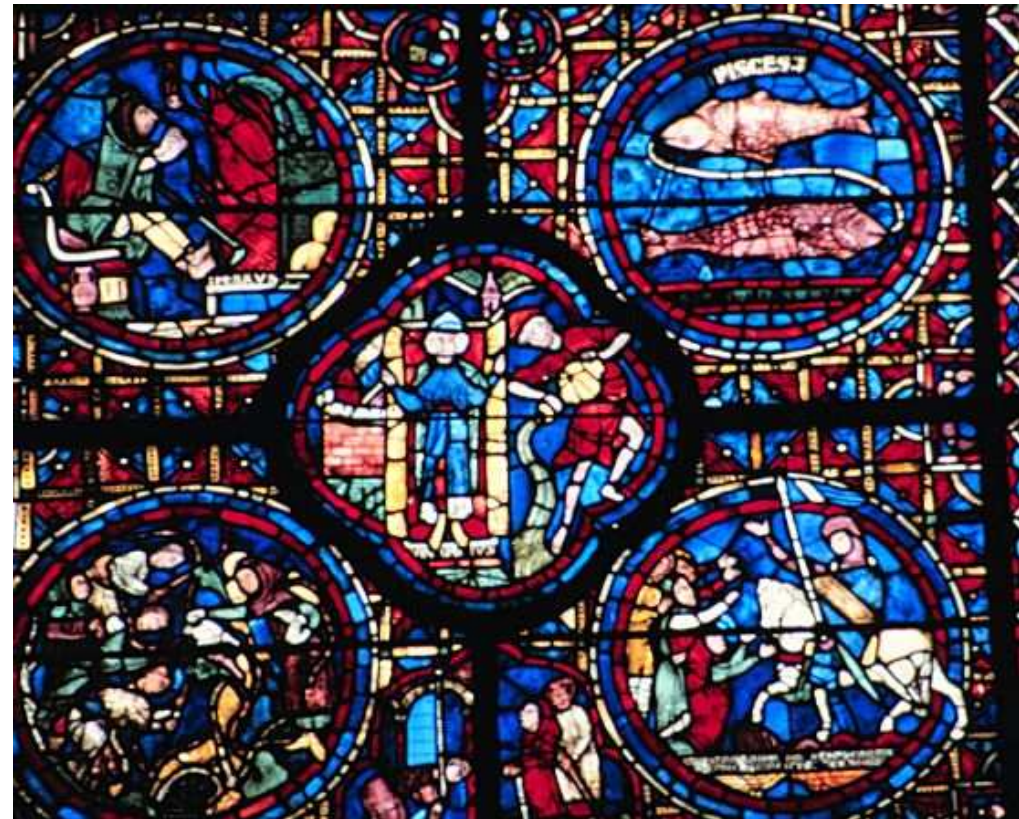


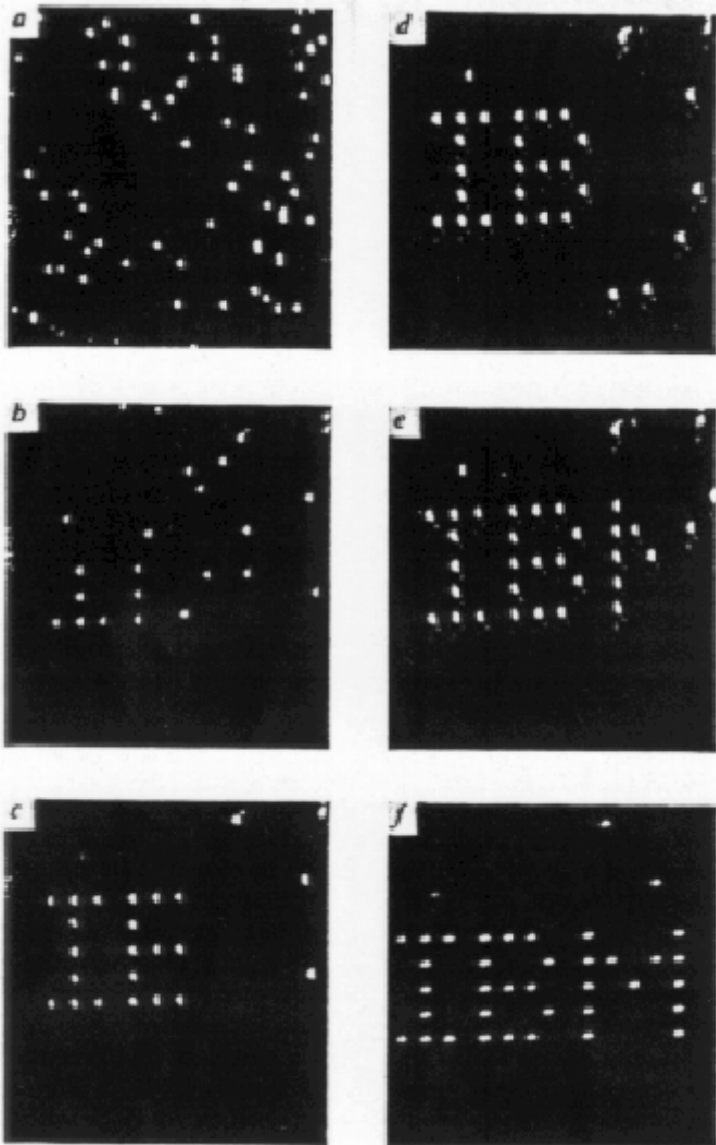


Risonanza Localizzata Sulla Superficie Plasmonica

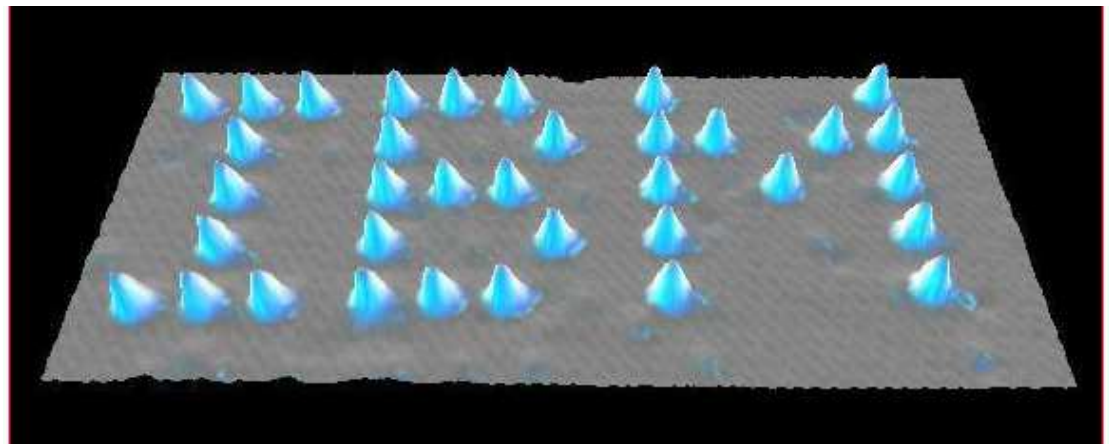


NANOTECNOLOGIA ANTE-LITTERAM





lettere (a, b, c, ...)	atomi (C, H, O, ...)
alfabeto	tavola periodica
insieme di lettere (atctiecbil)	insieme di atomi (CHHHCNHHOO)
↓ LOGICA UMANA	↓ LOGICA NATURALE
parole (bicicletta)	molecole (<i>glicina</i> , $\text{NH}_2\text{CH}_2\text{COOH}$)
frasi	supermolecole semplici
paragrafi	supermolecole complesse (<i>enzimi</i>)
capitoli di un libro	organi intracellulari (<i>mitocondri</i>)
libri	organismi unicellulari (<i>protozoi</i>)
collane di libri	organismi pluricellulari semplici
biblioteche	organismi pluricellulari complessi (<i>uomo</i>)



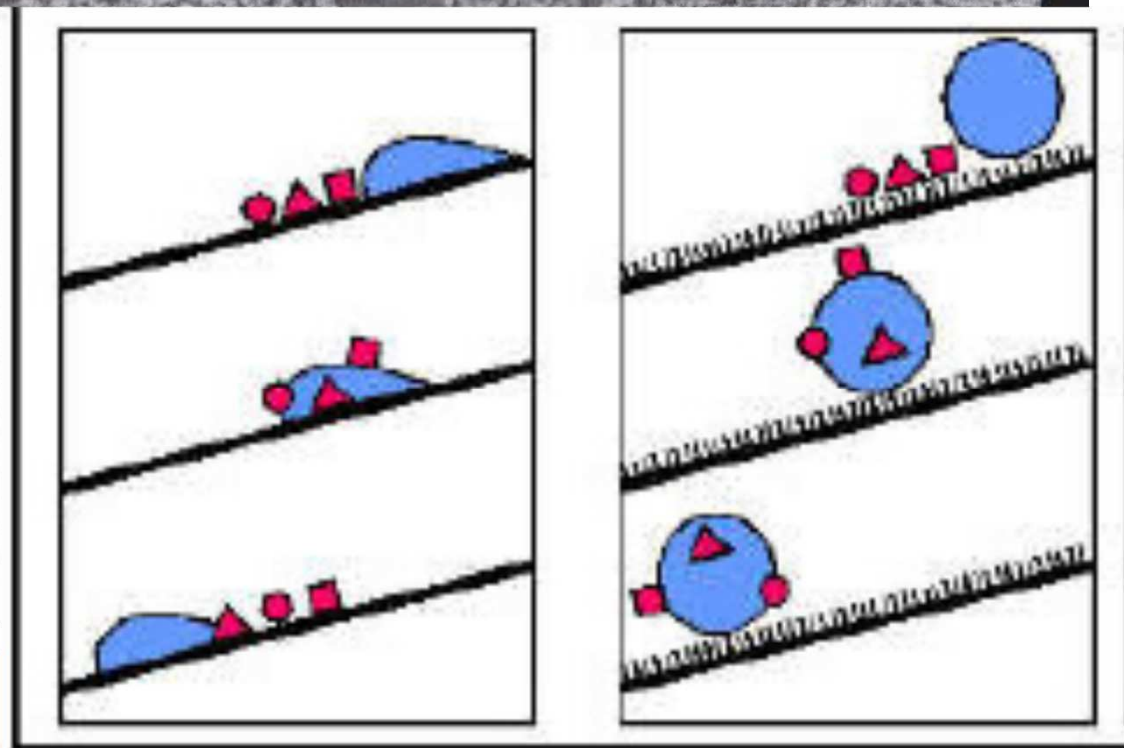
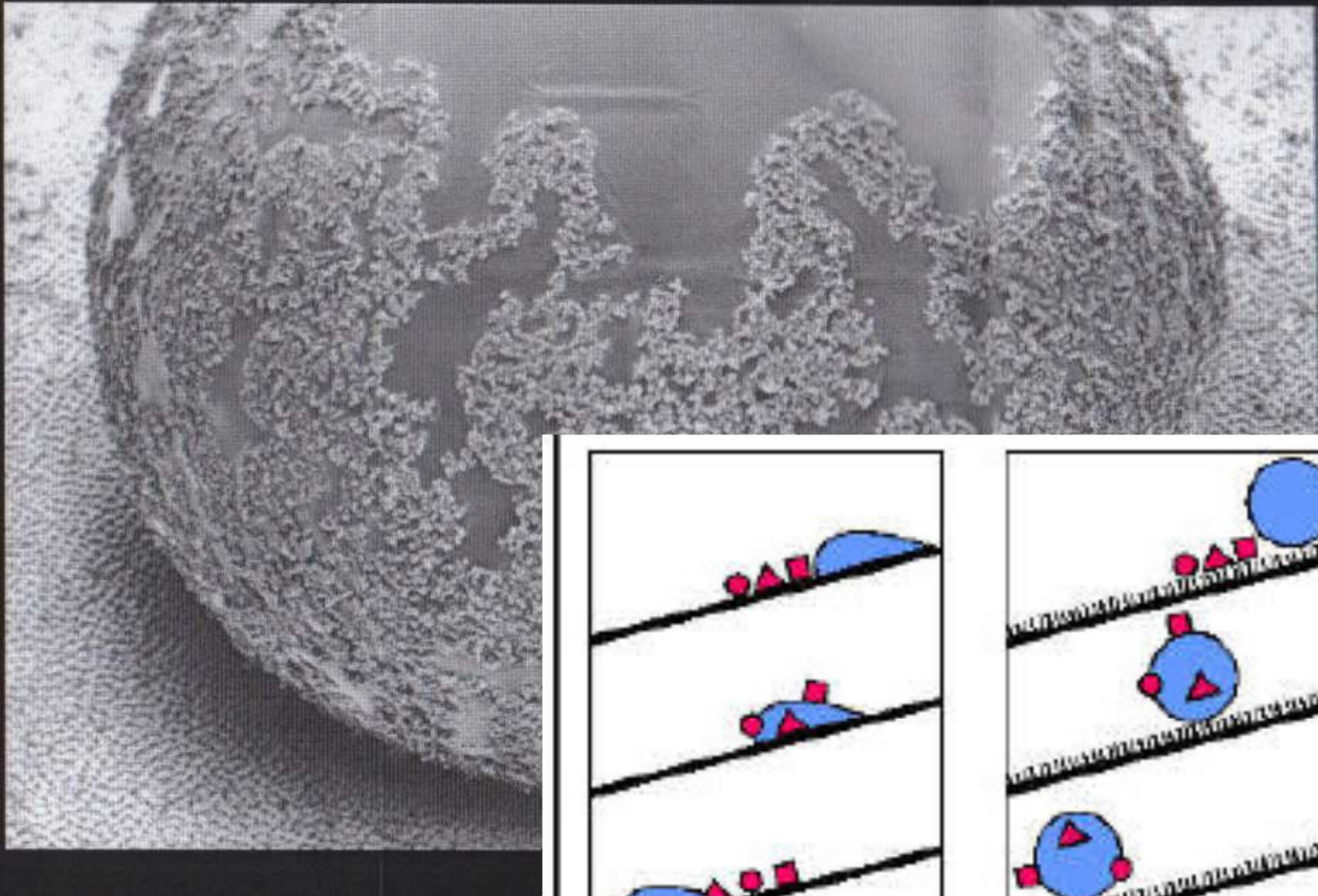
Atomi di xenon su nichel



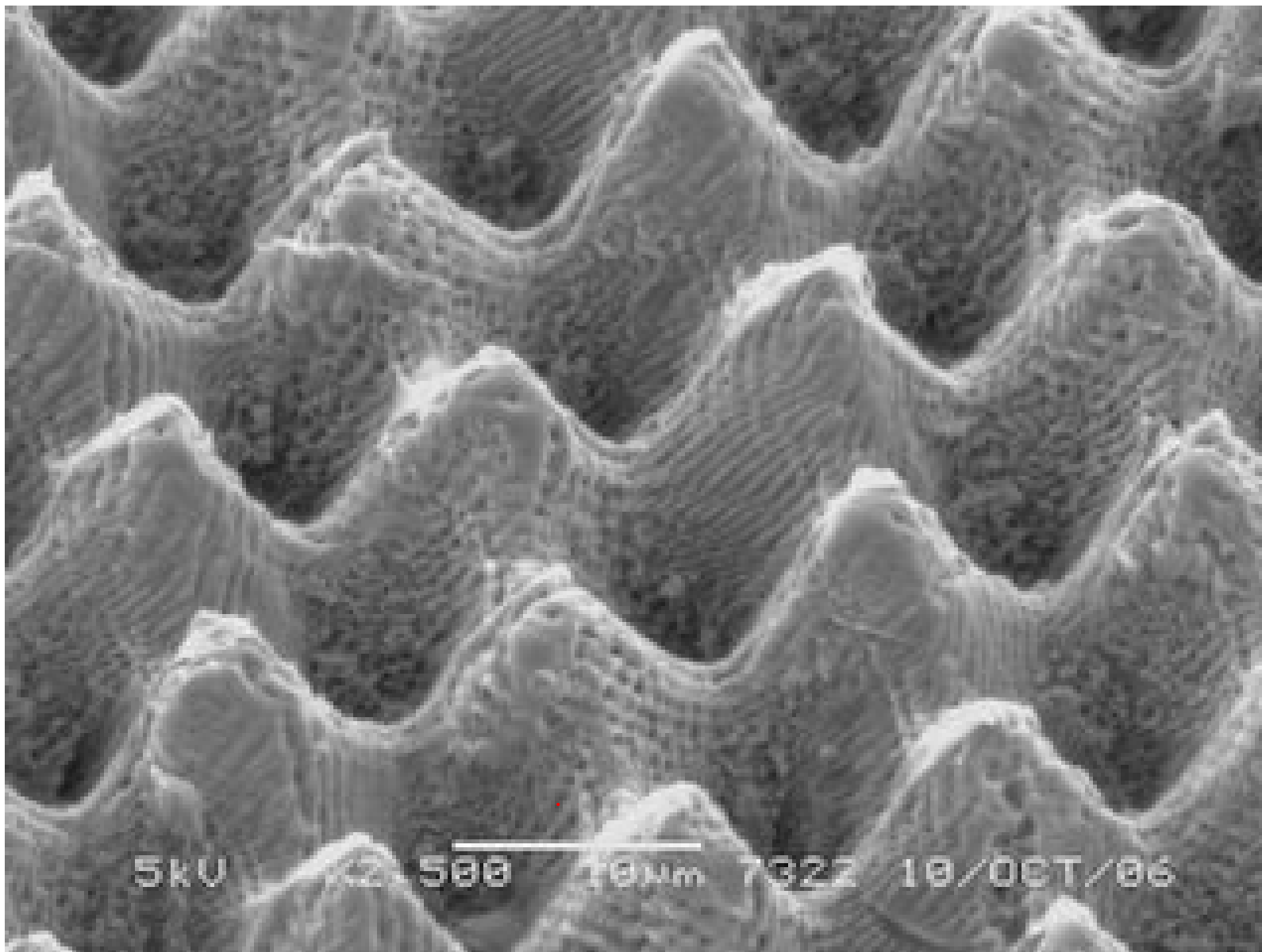


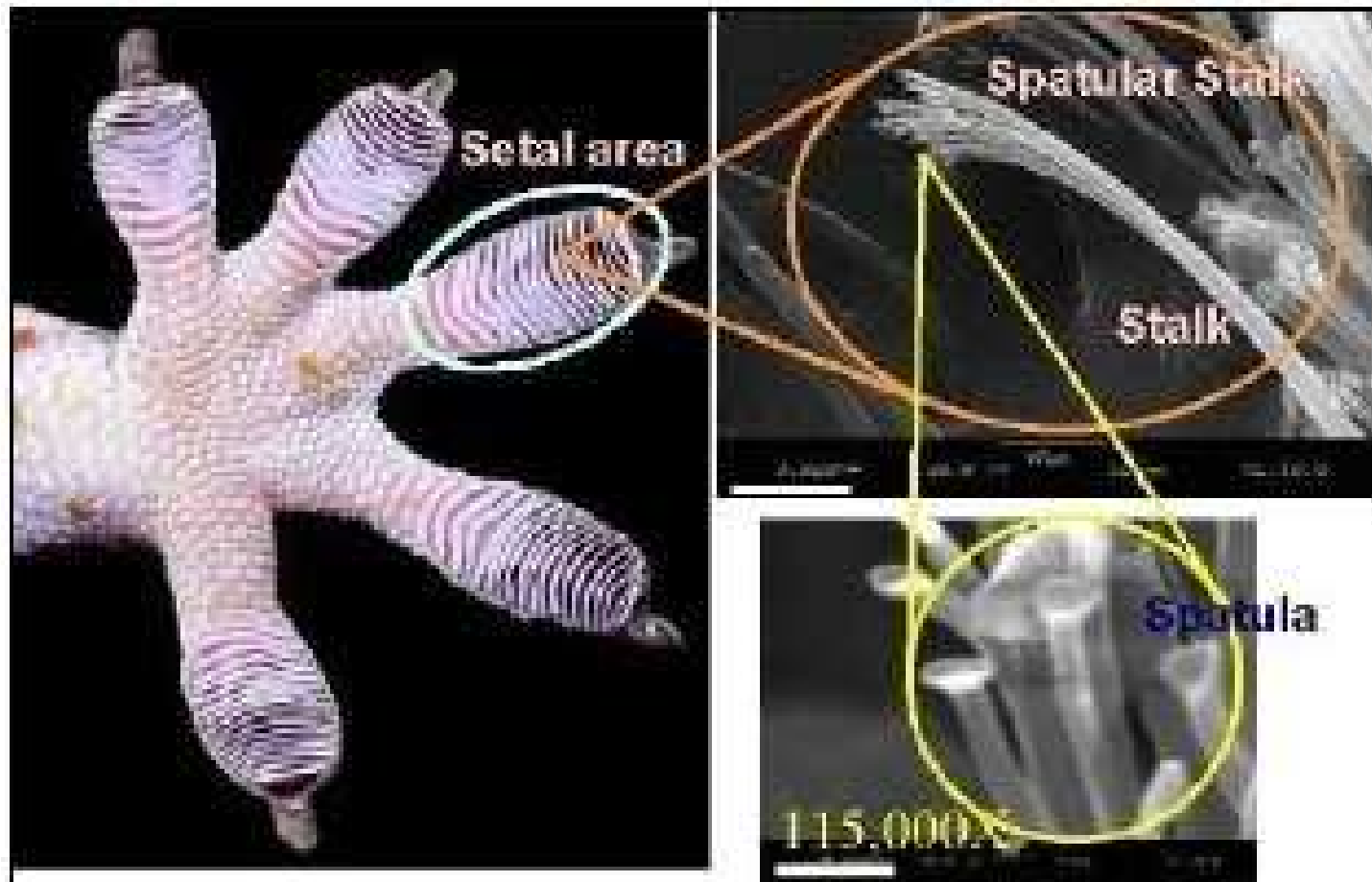
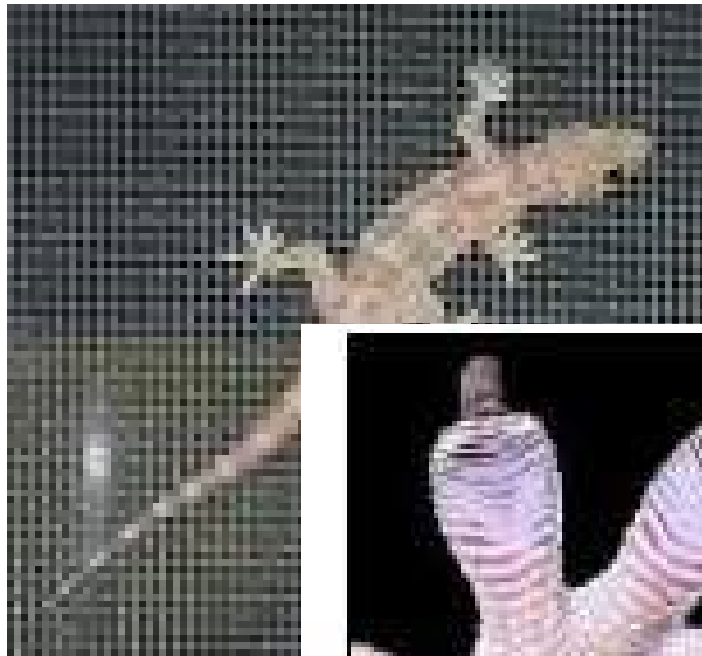


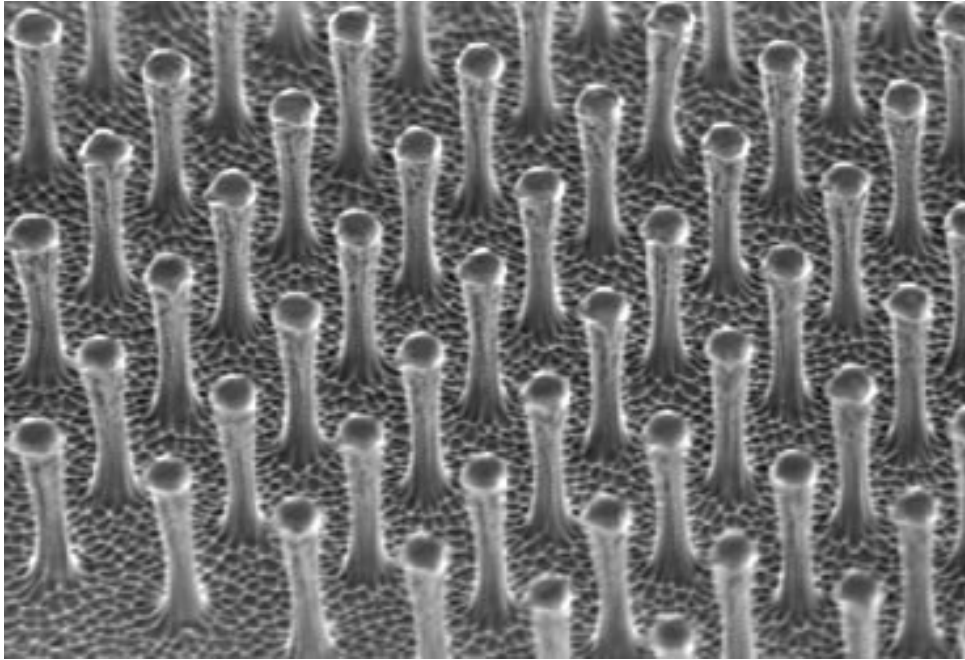




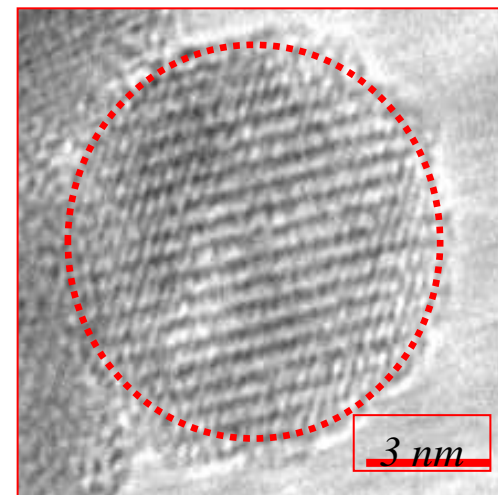
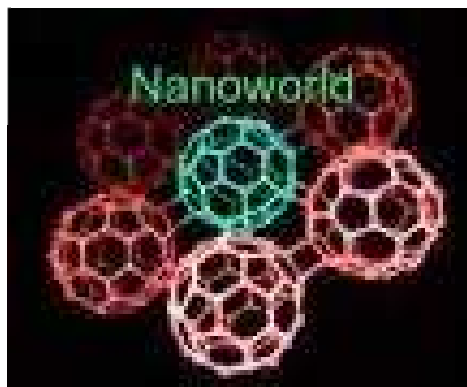
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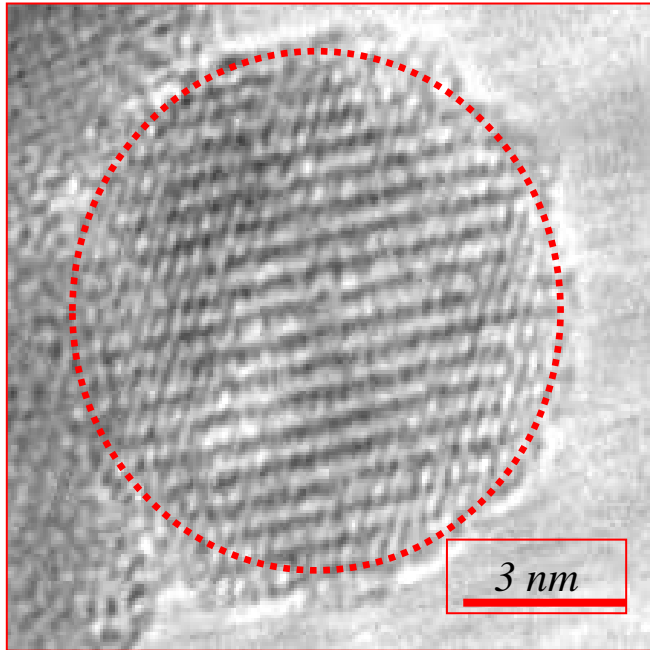






“Synthetic Gecko”, polimero in grado di mantenere sollevata da terra un’automobile familiare, grazie a un solo metro quadrato di materiale. (Bae System, Bristol)





Fe_3O_4 (Diametro: 10 nm)





Sabbia



Ceramiche



Marte



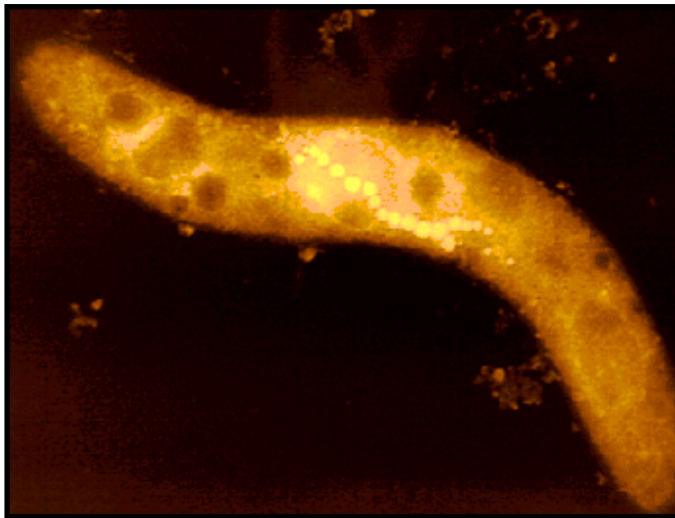
Ossidiana



INSETTI

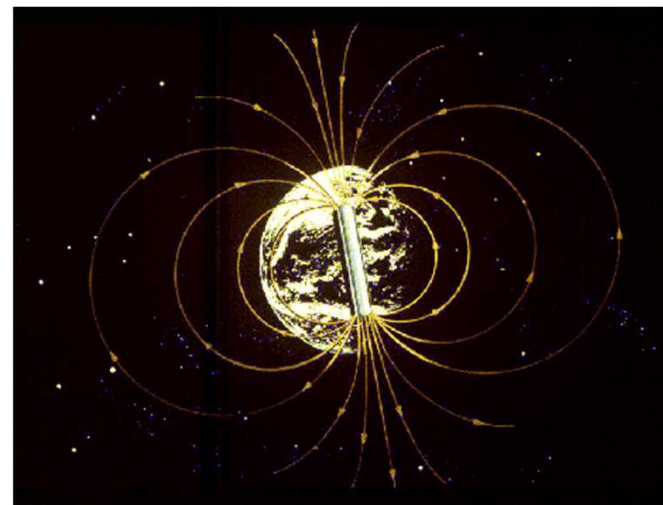
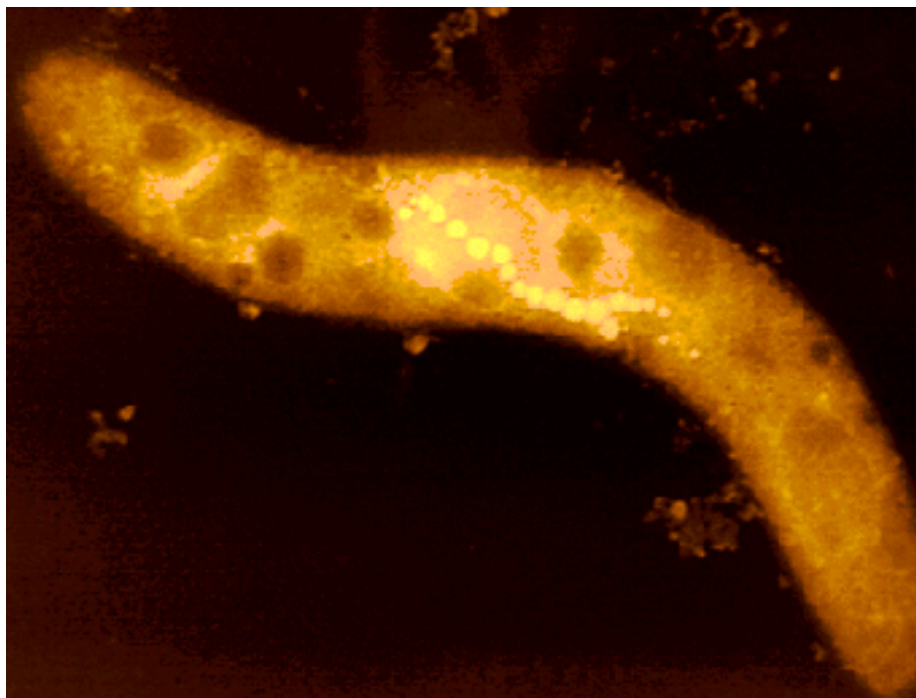


PESCI

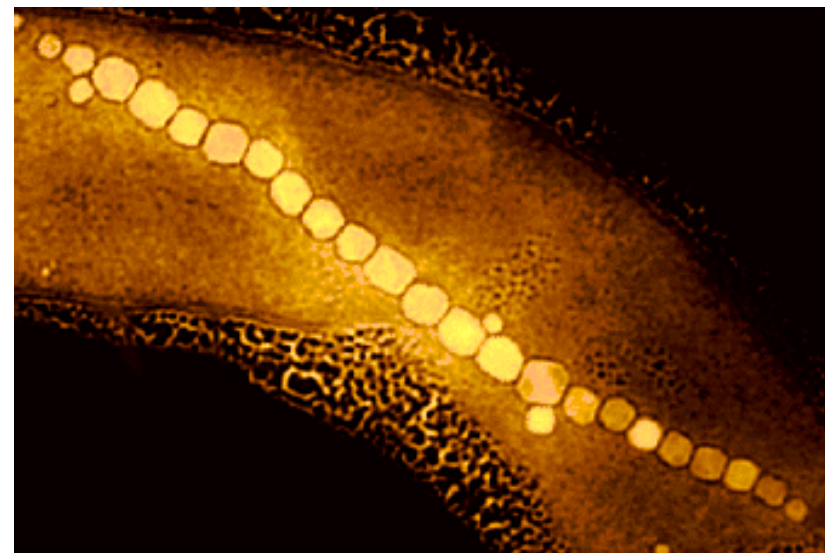


BATTERI

BATTERI MAGNETICI



Fe_3O_4 (35 – 120 nm)



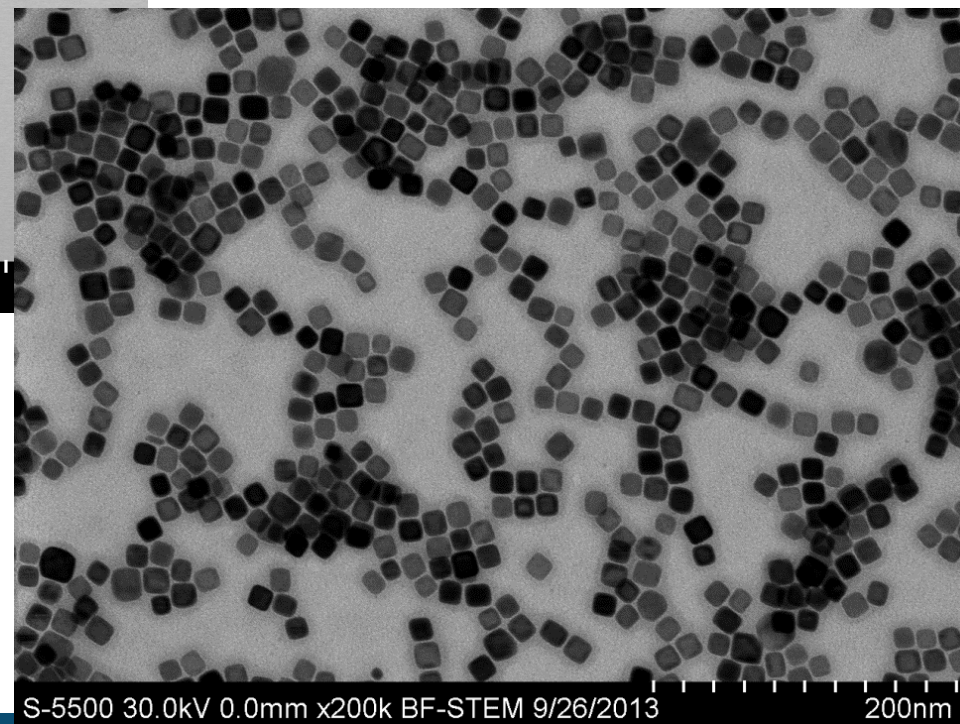
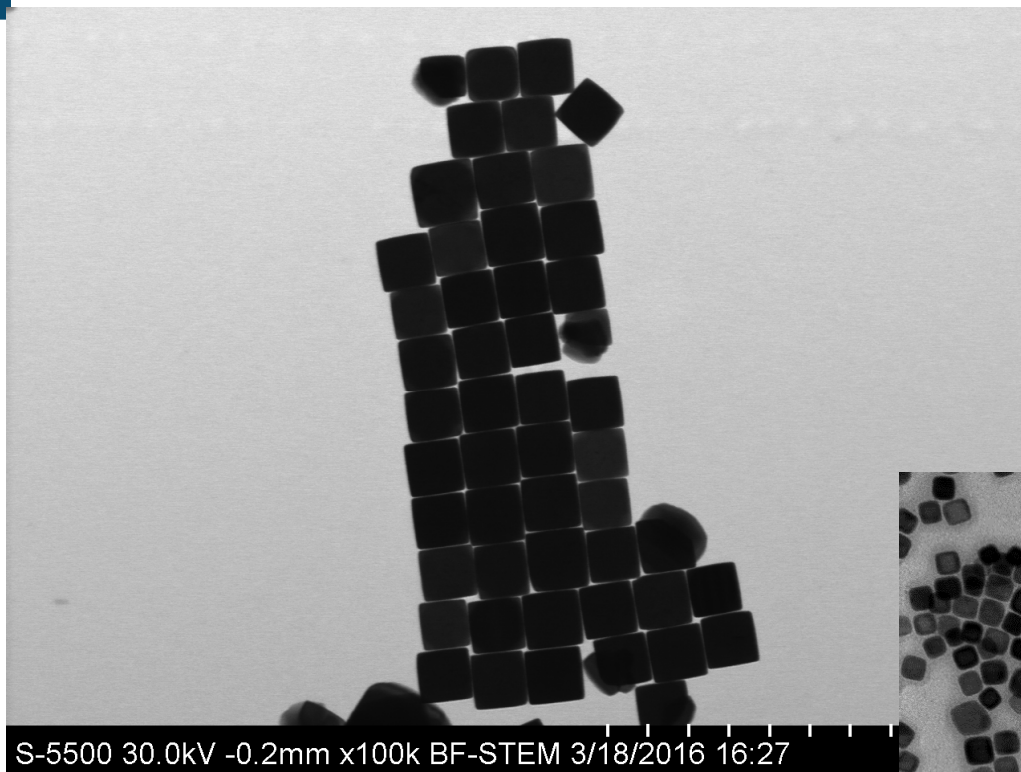
<http://www.energy.soton.ac.uk/pollution/bacteria.html>



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GIOCANDO CON LE FORME



*A. Mrakovic, E. Illes, N. Knezevic, G. Singh,
[et all] D. Peddis , in preparation*

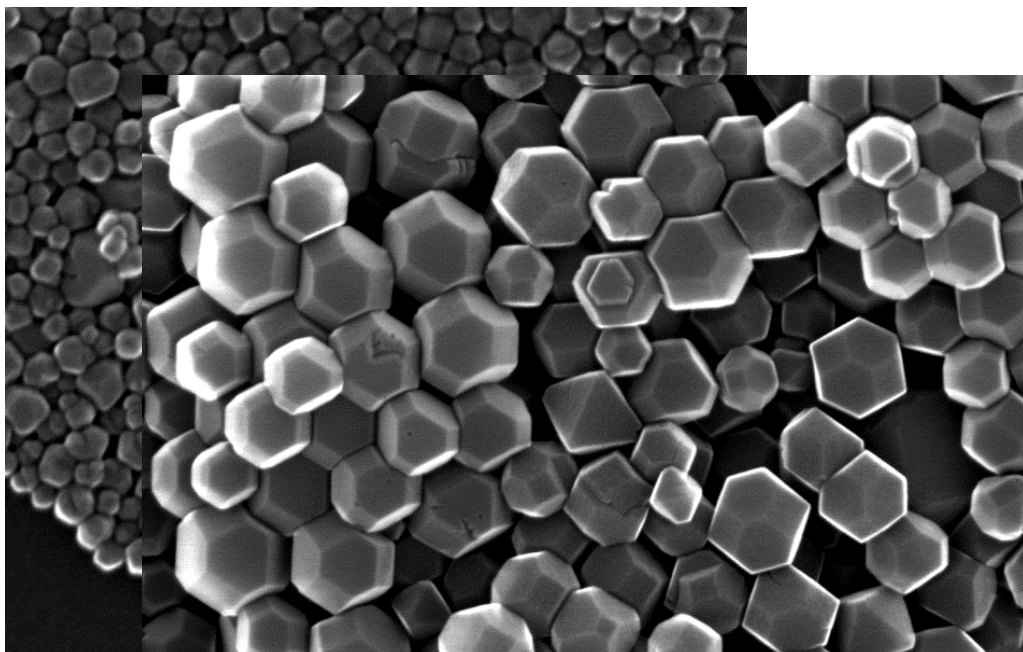


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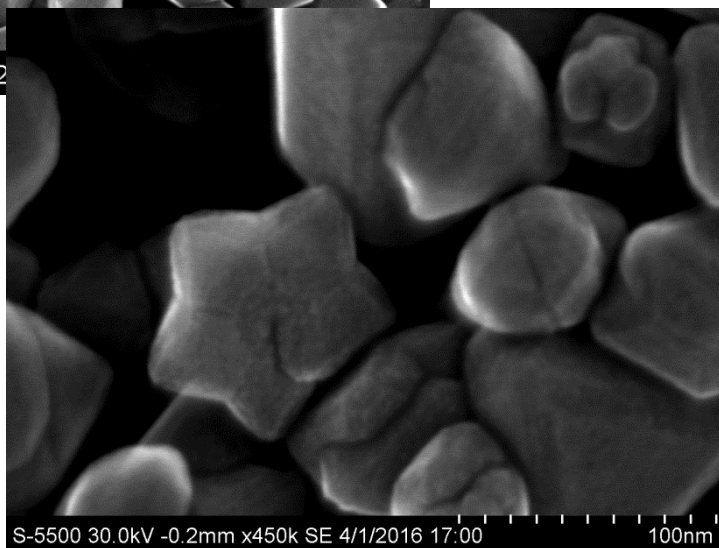
Slide 34

GIOCANDO CON LA FORMA

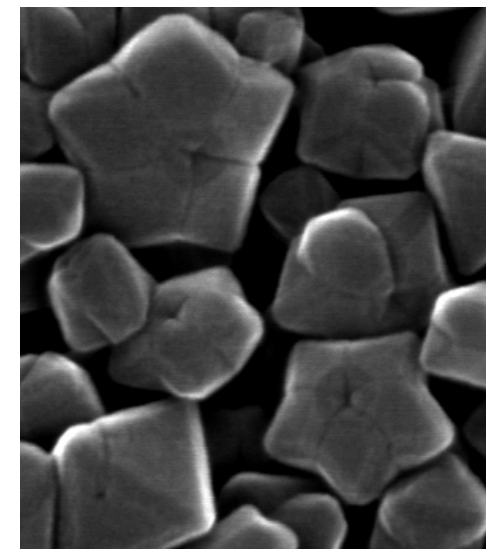


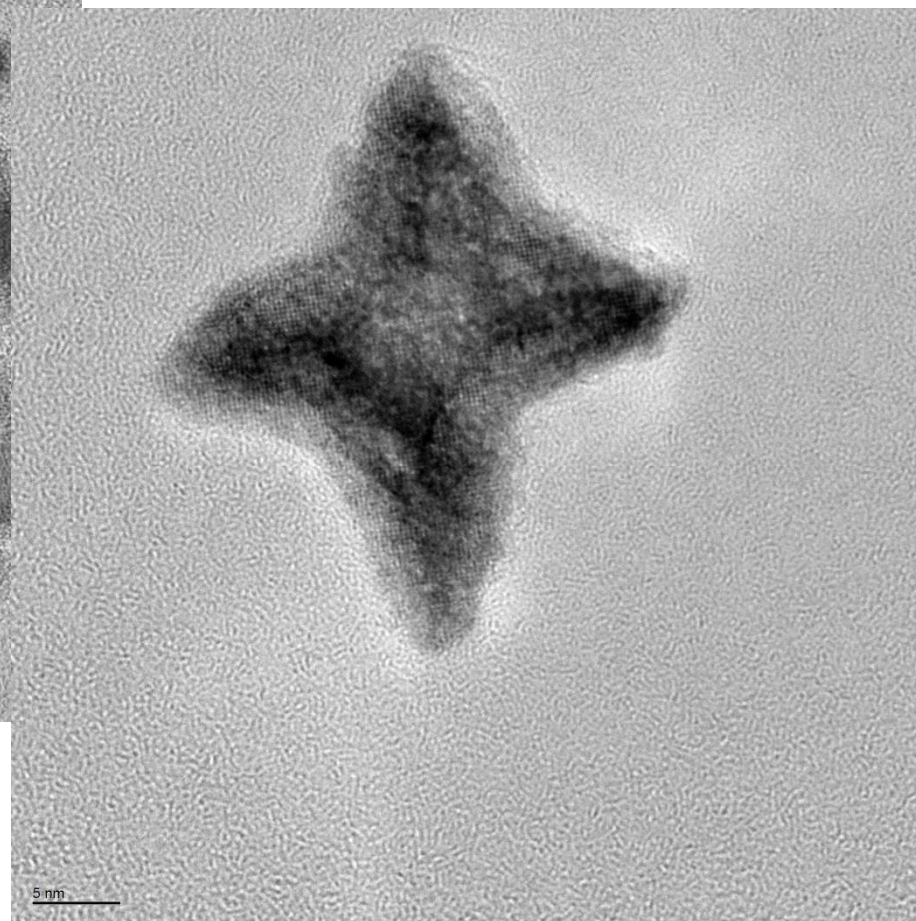
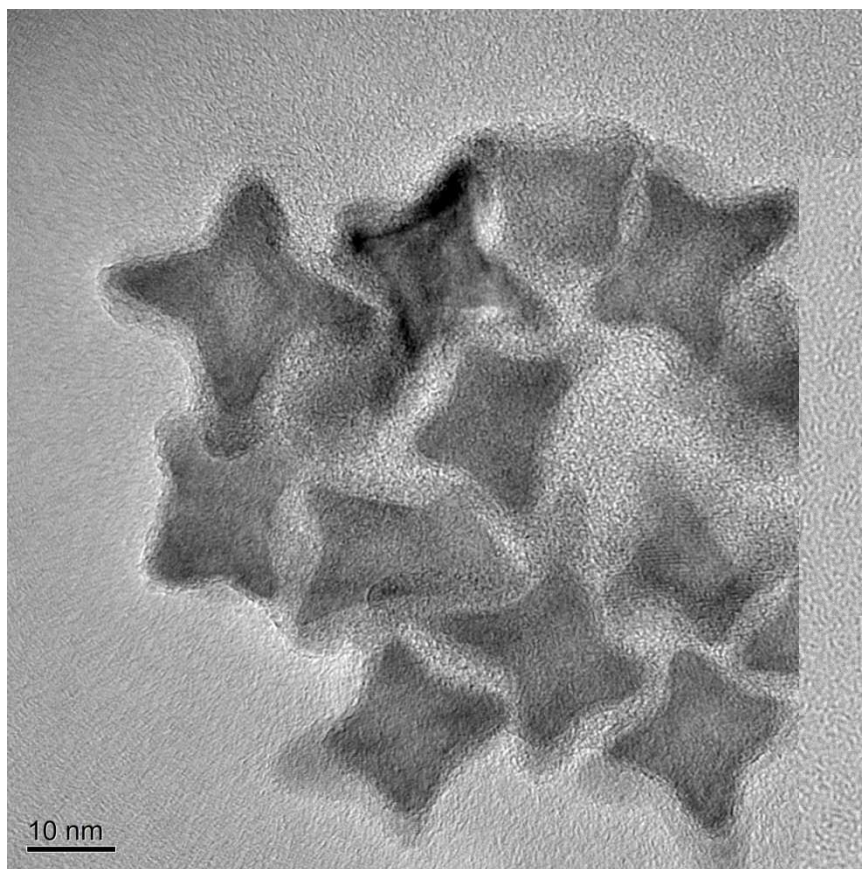
S-5500 30.0kV -0.2mm x110k SE 4/1/2

*A. Mrakovic, E. Illes, N. Knezevic, G. Singh,
D. Peddis et al, in preparation*



S-5500 30.0kV -0.2mm x450k SE 4/1/2016 17:00 100nm



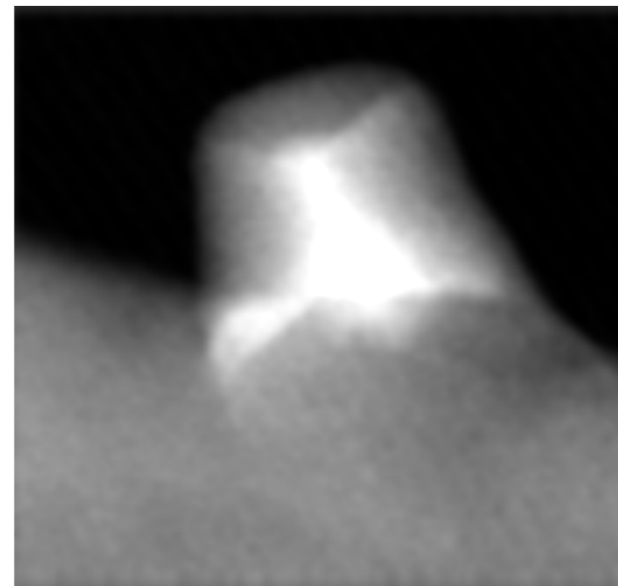
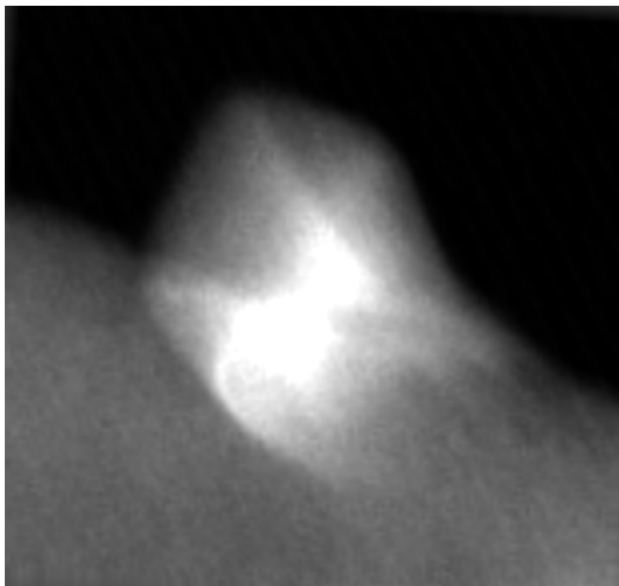


G. Muscas, R. Mathieu G. Singh, D. Peddis, in preparation

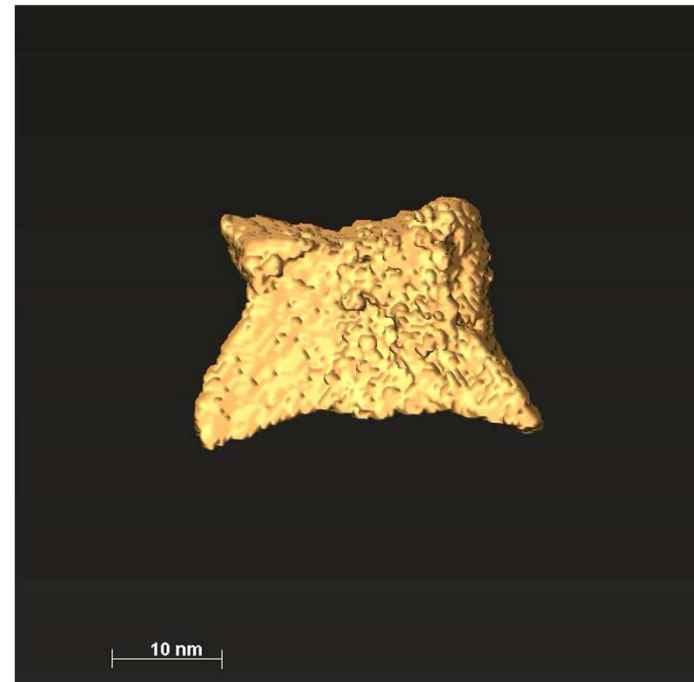
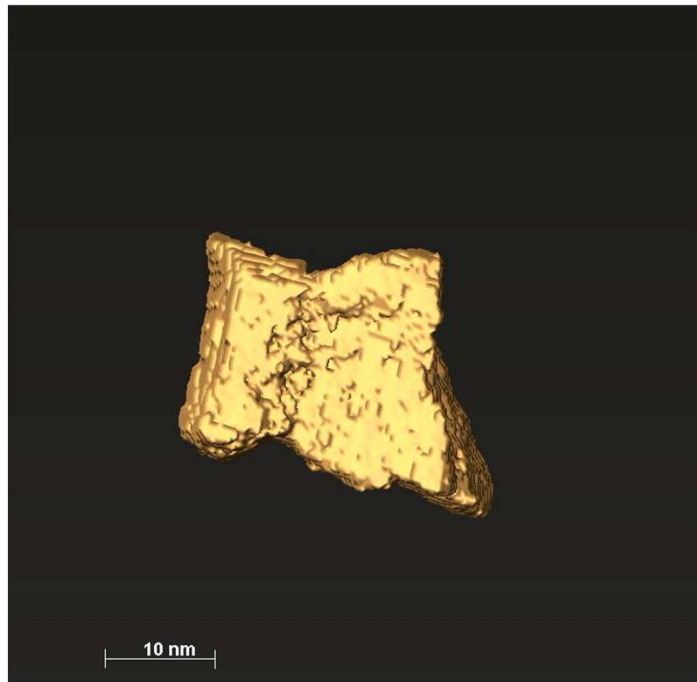




- 2 tomographical tilt series from -60° to $+60^{\circ}$.
- Acquired in a probe corrected Jeol



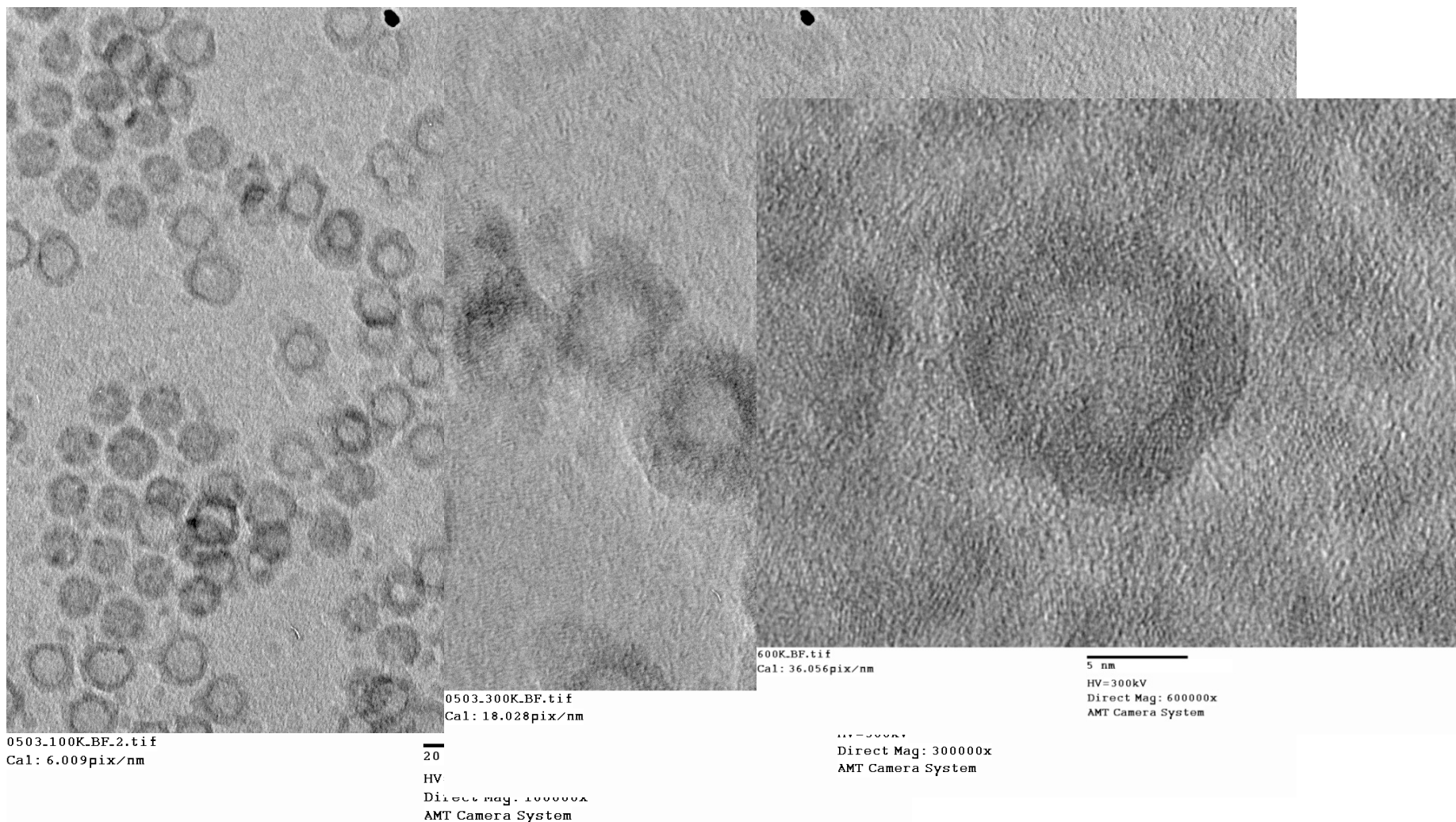
S. Estrade, University of Barcelona, Spain



S. Estrade, University of Barcelona



SUPERFICIE, SUPERFICIE, SUPERFICIE

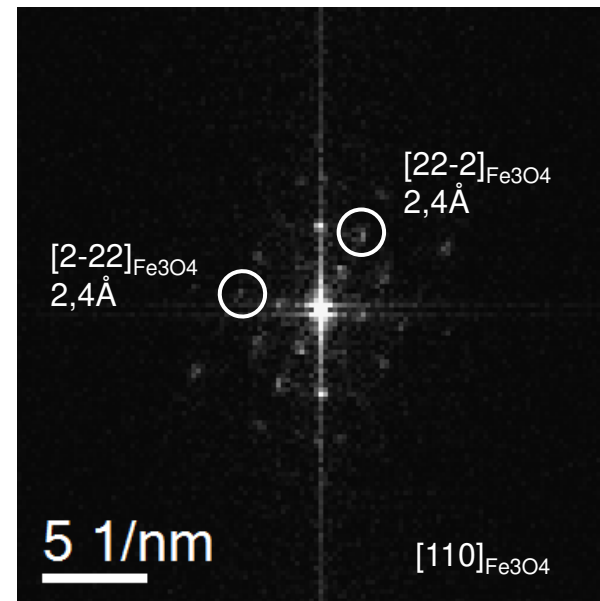
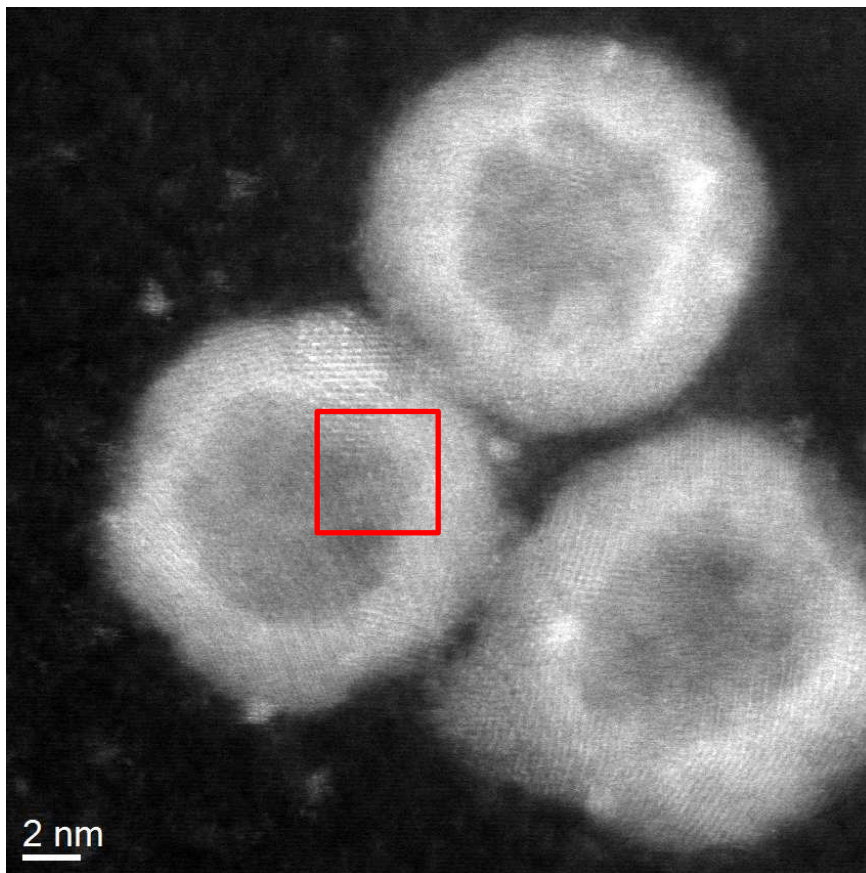


PhD Project [N. Yaacoub (Le Mans – France) – D. Peddis (ISM – CNR) – G. Singh (Thronheim, Norway)

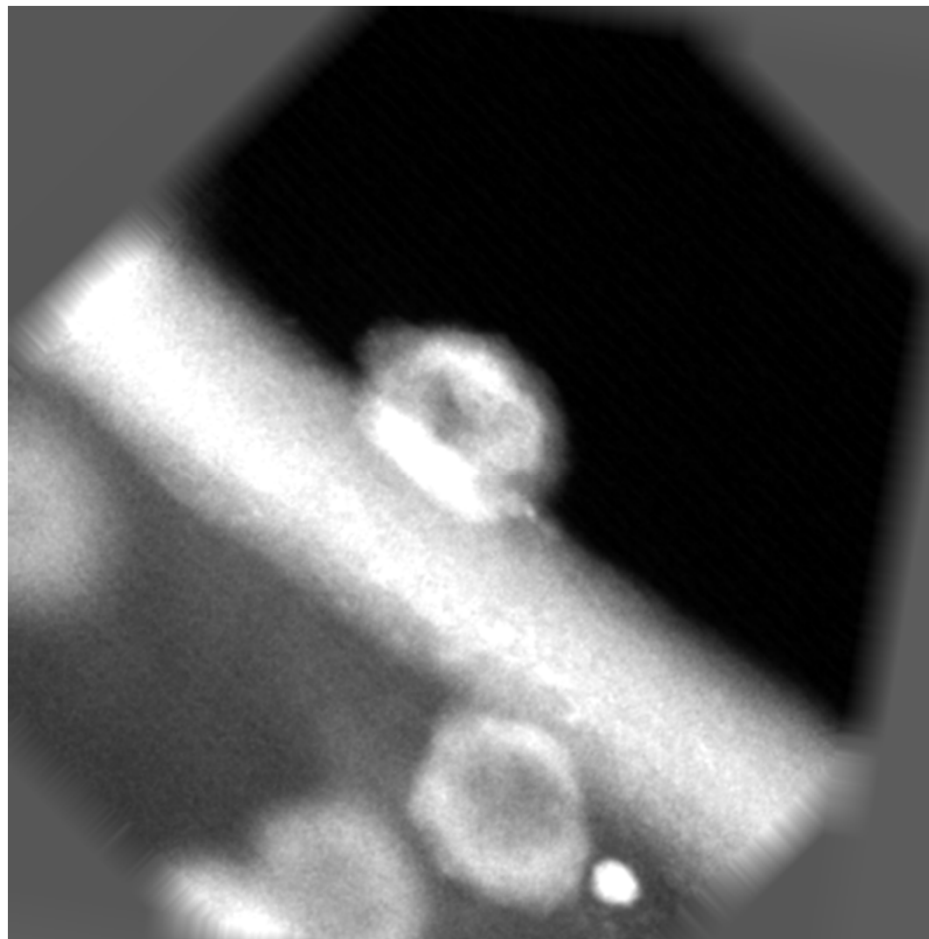


NANOPARTICELLE CAVE

- ⑩ The nanoparticles are found to be polycrystalline magnetite from the analysis of the HAADF images.
- ⑩ No high resolution images could be obtained from the smaller particles.



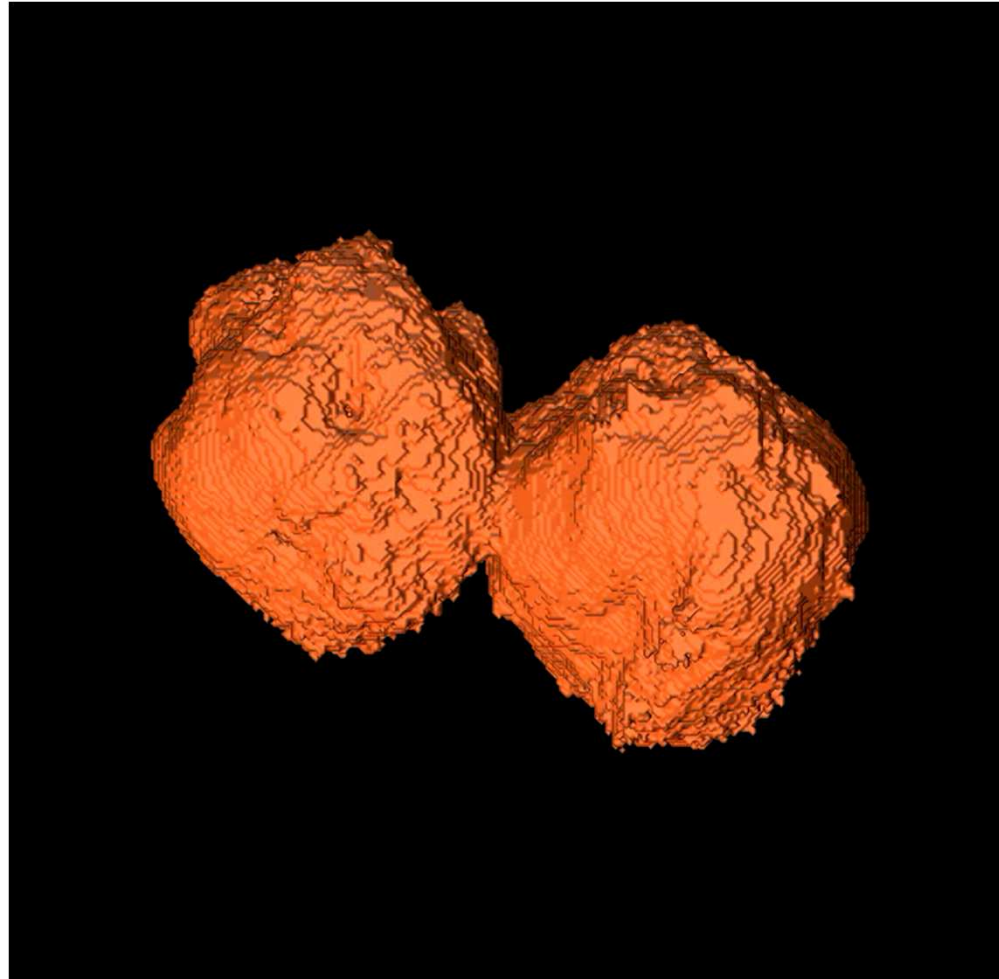
NANOPARTICELLE CAVE



S. Estrade, University of Barcelona

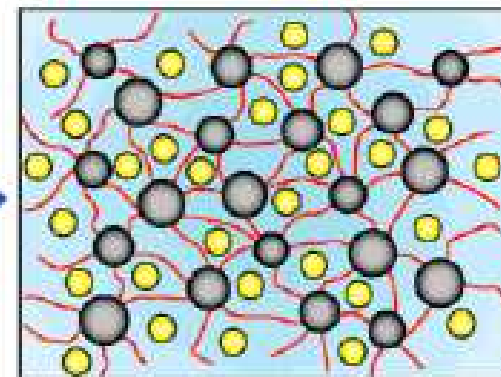
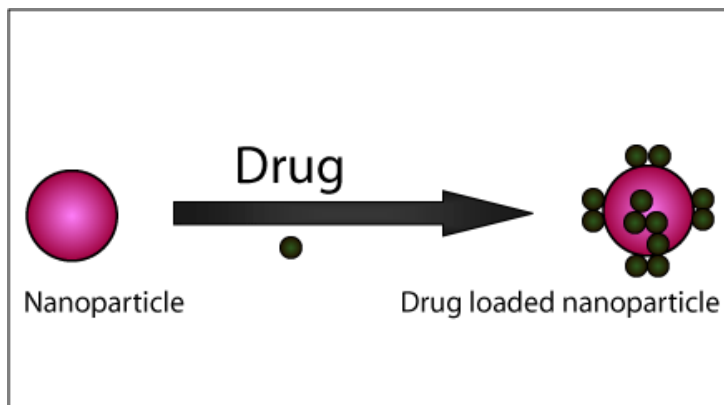


NANOPARTICELLE CAVE

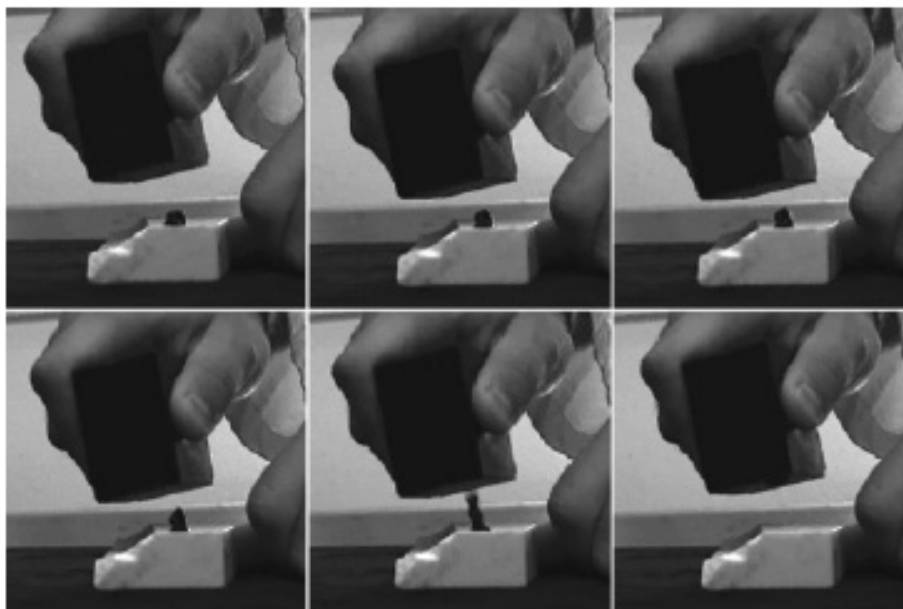


S. Estrade, University of Barcelona

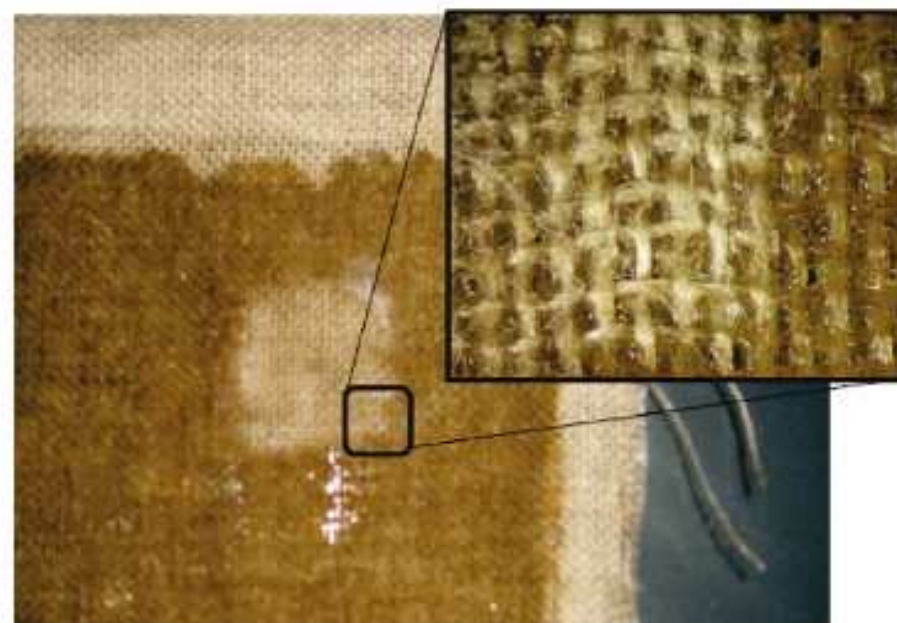
RESTAURO



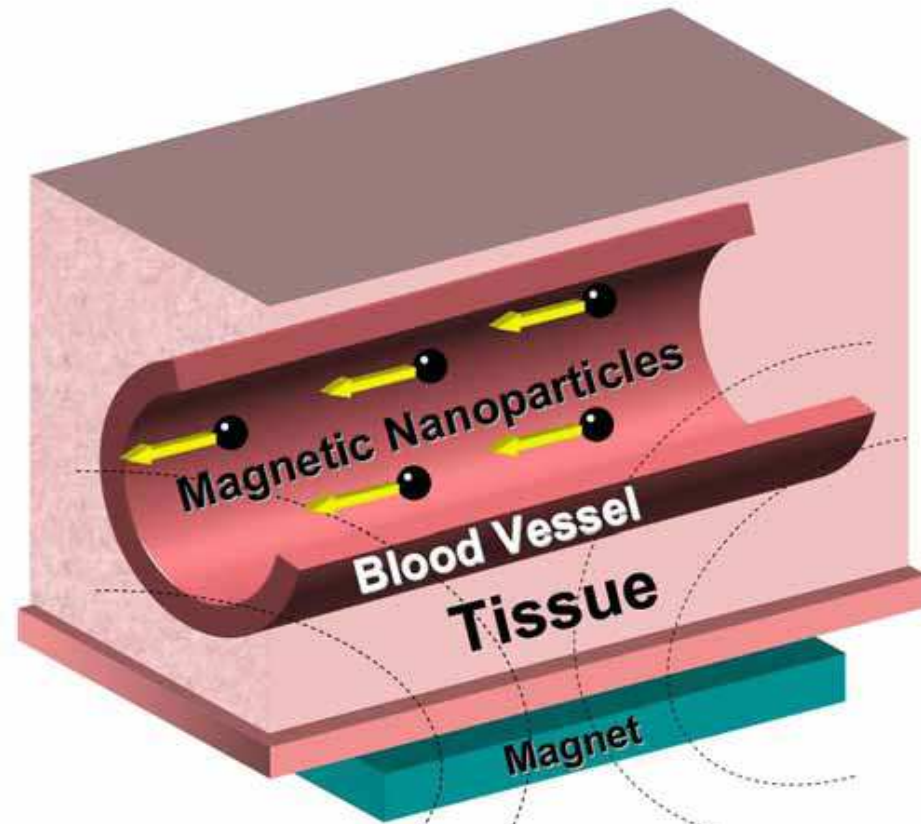
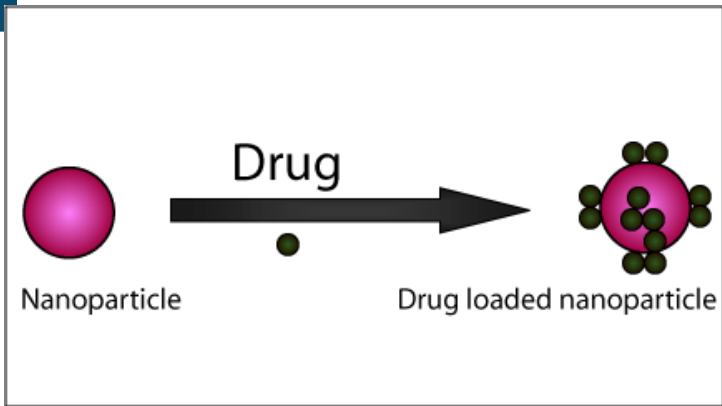
Nano-Magnetic Gel

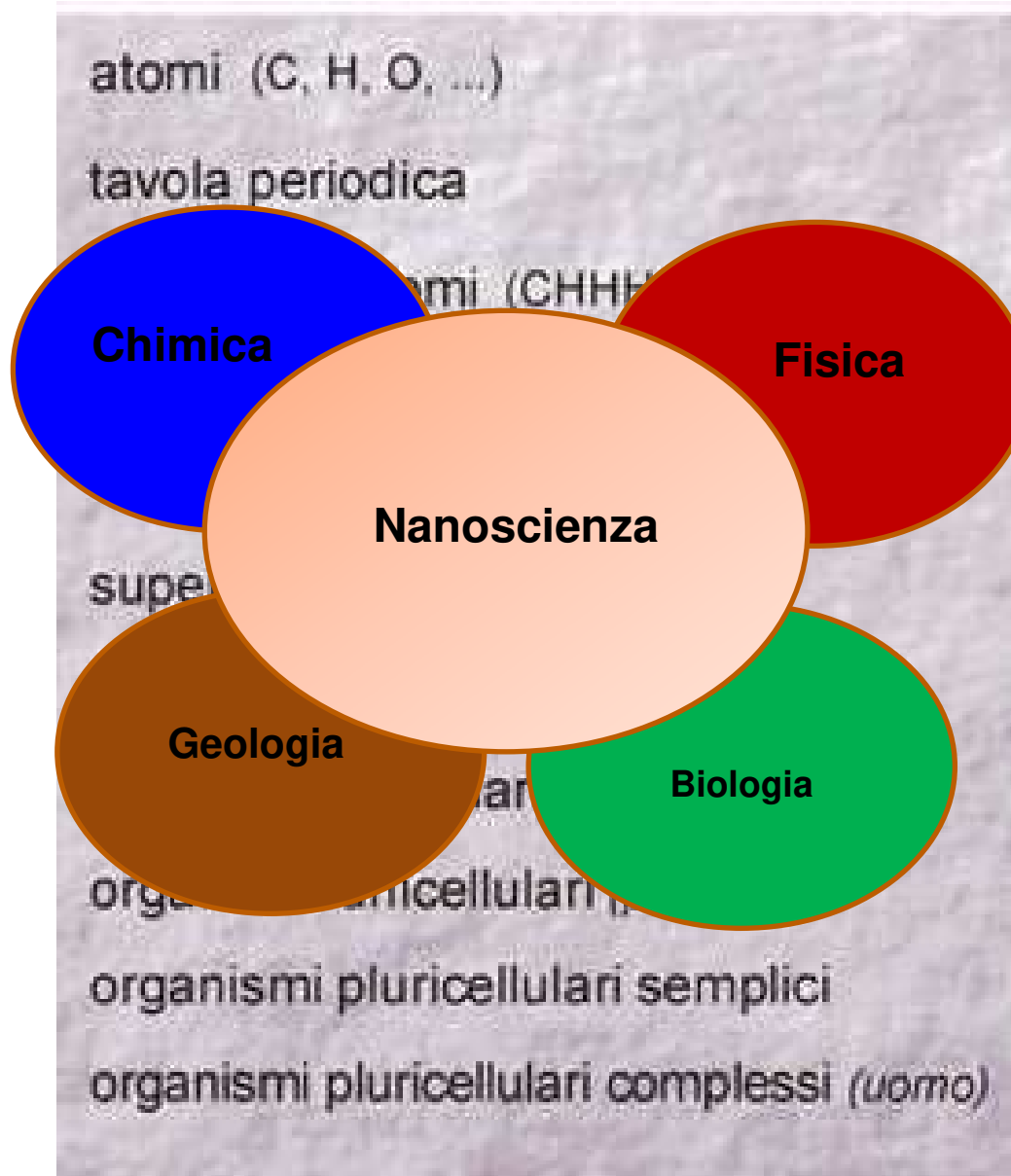


P. Baglioni et al. Langmuir, 25, 15, 8373, 2009



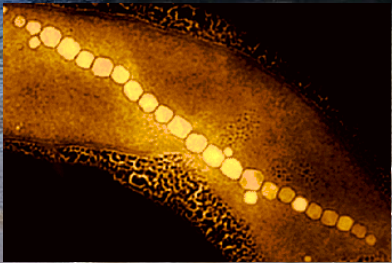
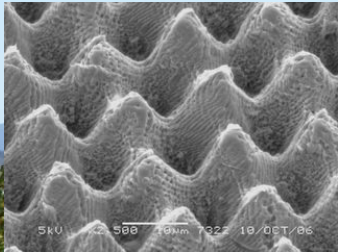
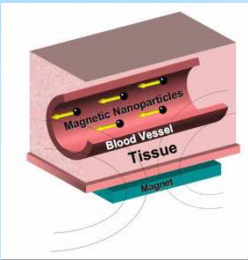
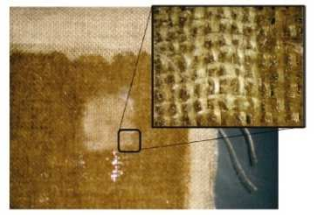
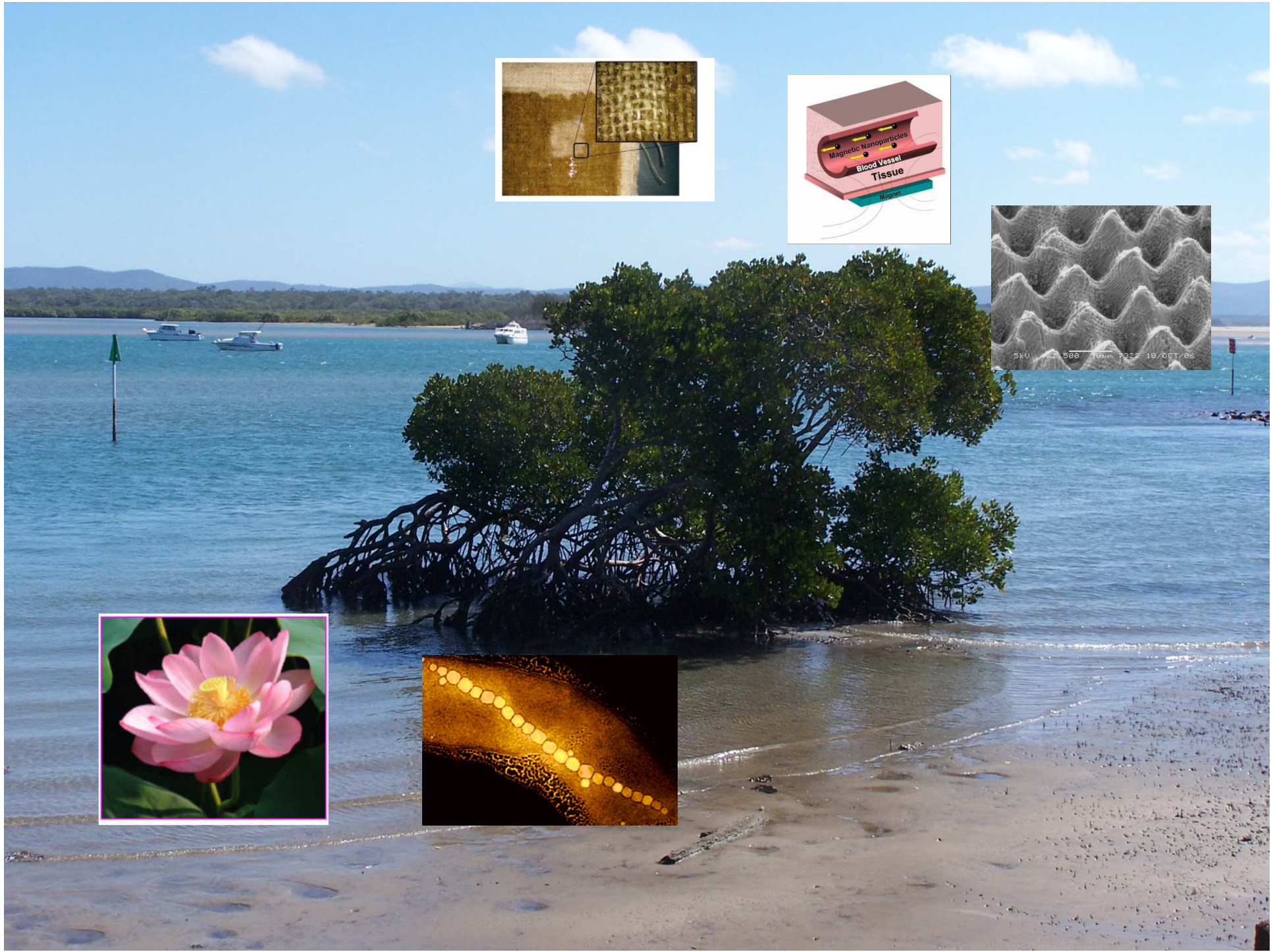
BIOMEDICINA











L'abitudine a penetrare la materia, a volerne sapere la composizione e la struttura, a prevederne le proprietà e il comportamento, conduce ad un insight, ad un abito mentale di concretezza e di concisione, al desiderio di non fermarsi alla superficie delle cose.

P. Levi, Ex Chimico, in L'altrui mestiere

