UNIONE EUROPEA
Fondo europeo di sviluppo regionale

PON Ricerca e Competitività 2007-2013

Ministero dell'Istruzione, dell'Università e della Ricerca

Ministero dello Sviluppo Economico

Centro Ricerca Energia e Ambiente
Dipartimento di Ingegneria dell'Innovazione
Università del Salento

CNRNANO

ordine ingegneri provincia di lecce

Collegio Provinciale Geometri e Geometri Laureati di Lecce

NAnoMAteriali per l'edilizia SosTEnibile (NAMASTE)

[PON04a3_00107 (2007-2013)-Smart Cities and Communities and Social Innovation]

Proponenti:

Dott.ssa Vergaro Viviana

Ing. Lorusso Caterina

PON Ricerca e Competitività 2007-2013

Budget: 599.896,80

Scopo dell'idea progettuale

Realizzazione di **materiali isolanti ad alte prestazioni** per il miglioramento, attraverso semplici interventi, dell'efficienza energetica del patrimonio immobiliare

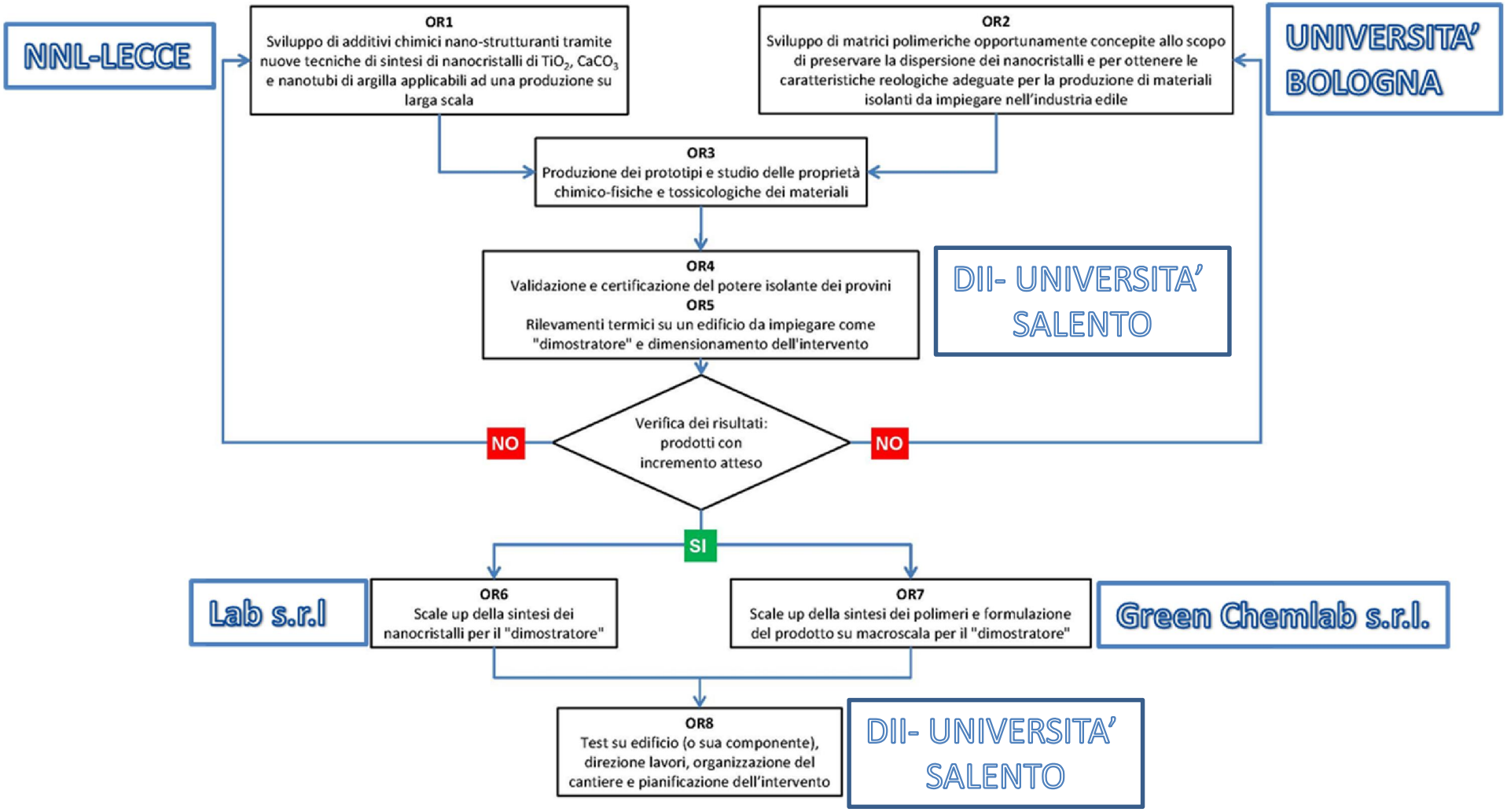
NUOVE SCHIUME POLIURETANICHE RIGIDE

Soluzione delle problematiche energetiche:

- insufficiente attenzione alle proprietà coibentanti
- efficienza energetica limitata

"BUONE PRATICHE" RICONDUCIBILI ALLA EDILIZIA ECOLOGICA E SOSTENIBILE

Obiettivi Realizzativi



Sintesi, Caratterizzazione e Aspetti Tossicologici dei nanomateriali

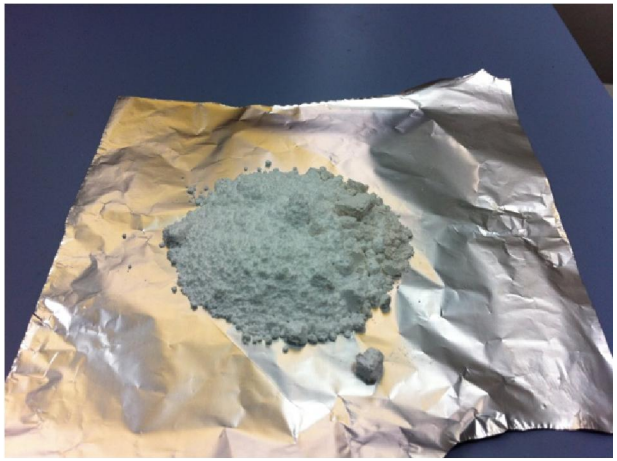
Caratterizzazione delle proprietà meccaniche e termiche delle schiume poliuretaniche

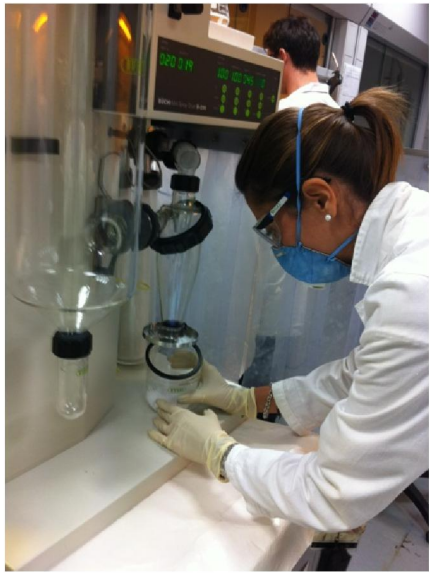
Nano-$CaCO_3$

Synthesis Reaction

$$2NaHCO_3\ (aq) + CaCl_2\ (aq) \longrightarrow 2NaCl\ (aq) + Ca(HCO_3)_2\ (aq)$$

$$Ca(HCO_3)_2\ (aq) \longrightarrow CaCO_3\ (s) + CO_2\ (g) + H_2O\ (l)$$

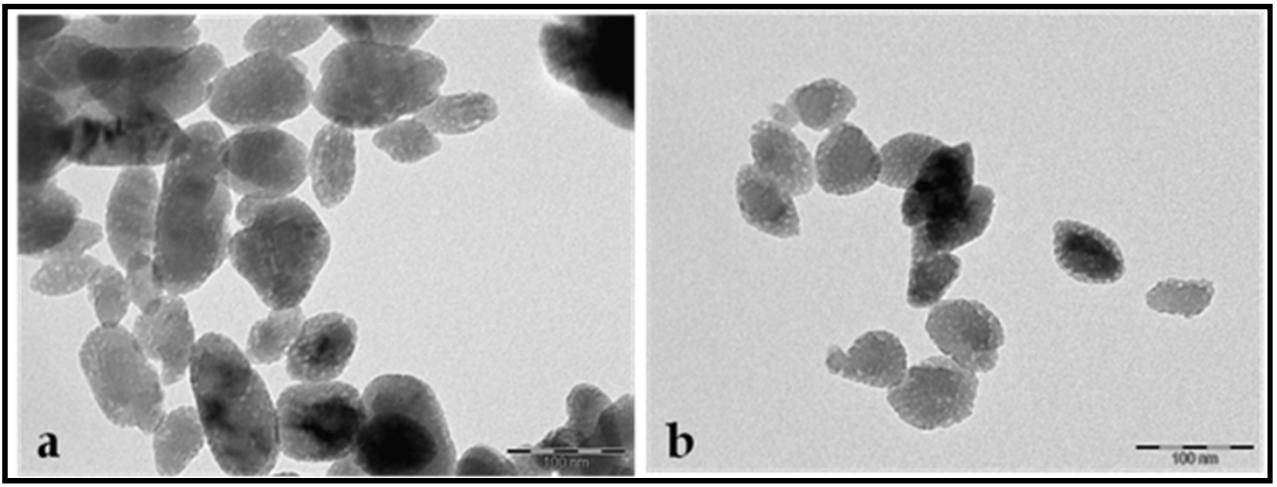


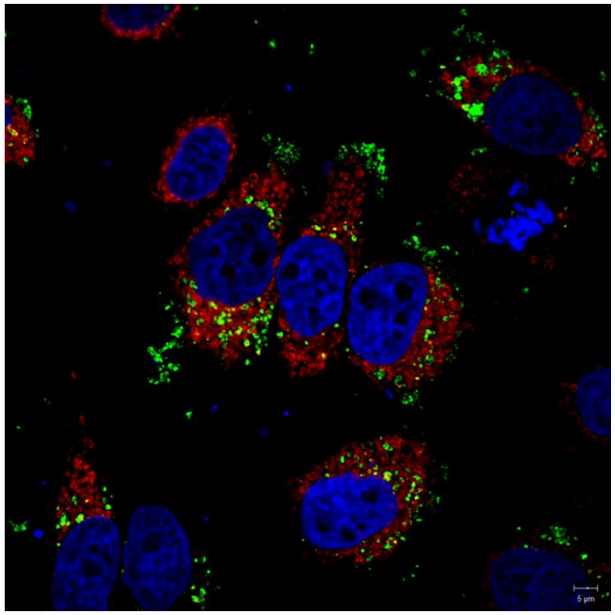


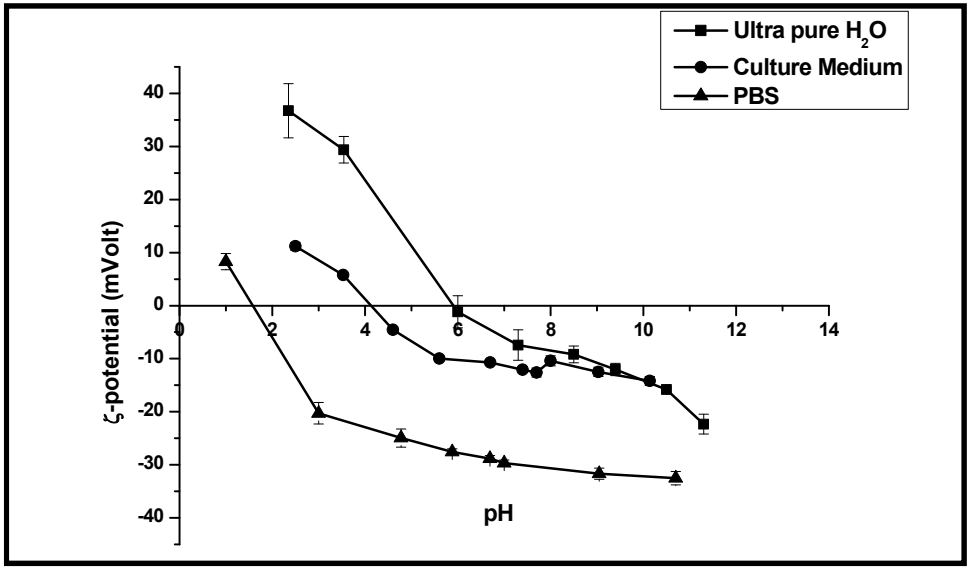
Advantages

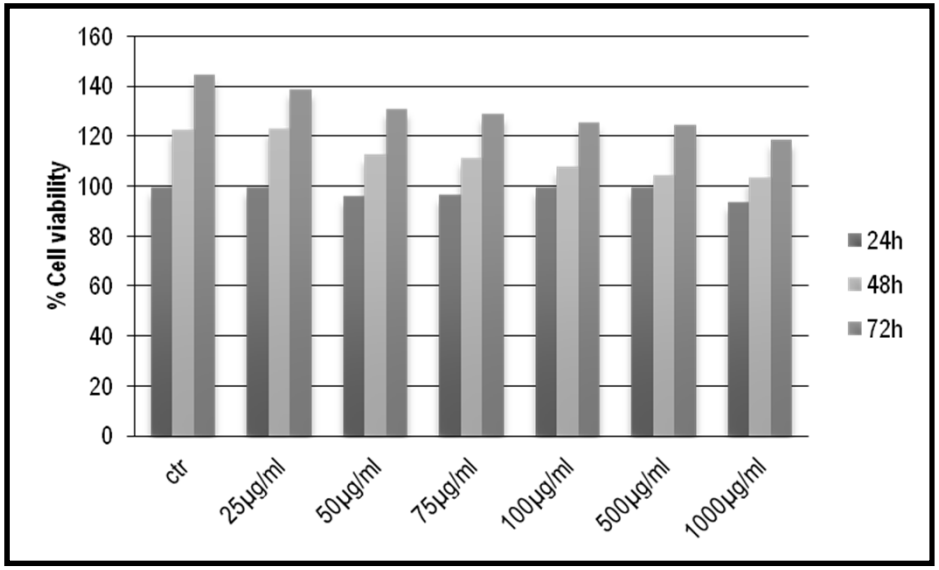
- Nano-synthesis
- Safety
- High quantitative yield
- Potential Scale-up

Nano-$CaCO_3$


a
100 nm
b
100 nm

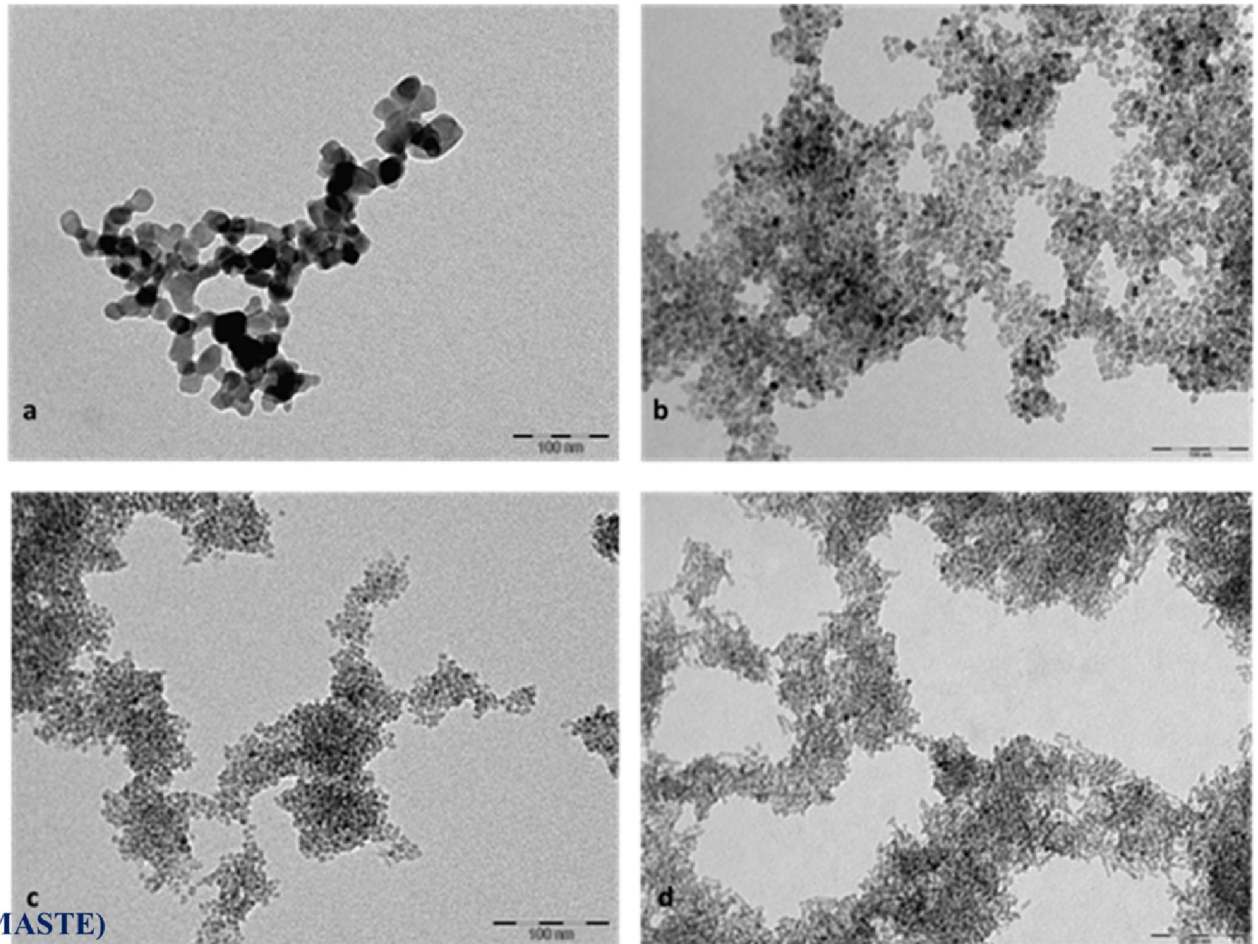



Ultra pure H_2O
Culture Medium
PBS
ζ-potential (mVolt)
40
30
20
10
0
-10
-20
-30
-40
0
2
4
6
8
10
12
14
pH

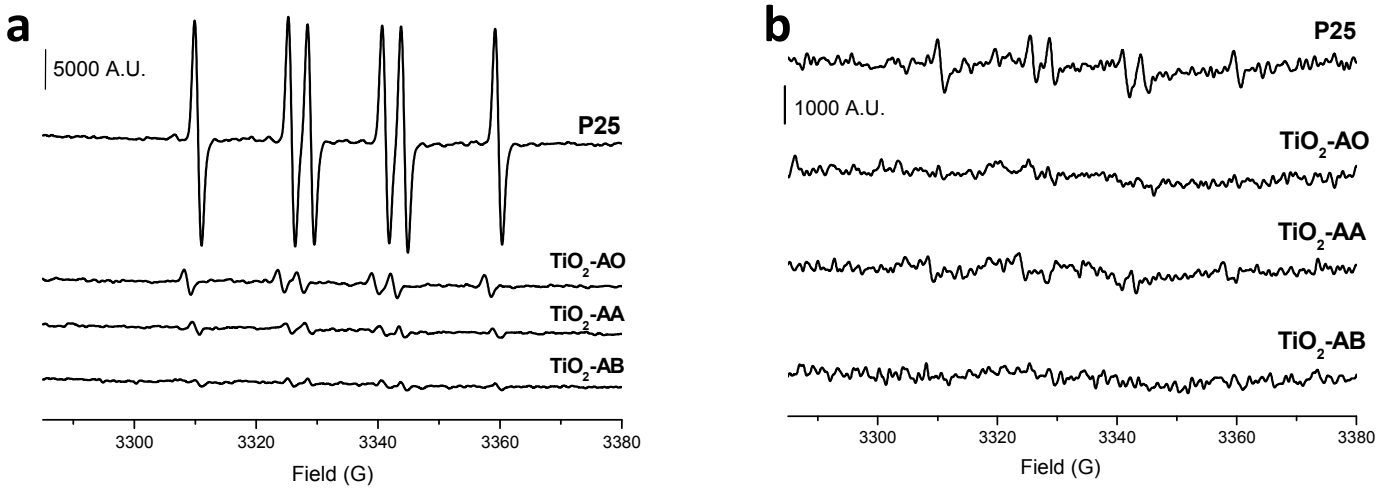

% Cell viability
160
140
120
100
80
60
40
20
0
ctr
25µg/ml
50µg/ml
75µg/ml
100µg/ml
500µg/ml
1000µg/ml
24h
48h
72h

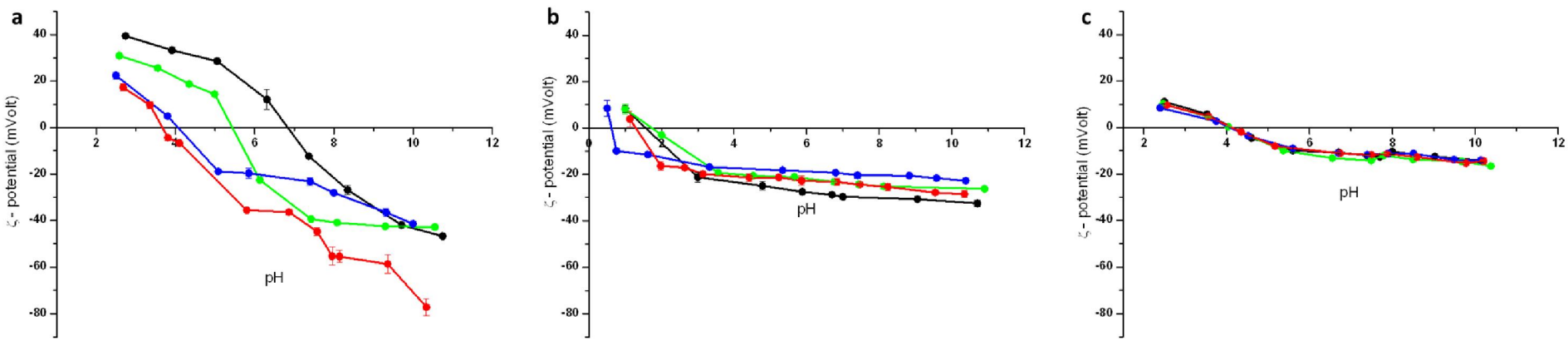
Nano-TiO_2

Sample	Acetic Acid [mmol]	TTIP : AA Ratio	Oleic Acid [mmol]	TTIP : OA Ratio	Boric Acid [mmol]	TTIP : BA Ratio	Reaction Time
AA	6.72	1:2					45’
AO			26.9	1:8			45’
AB					6.72	1:2	1’30”

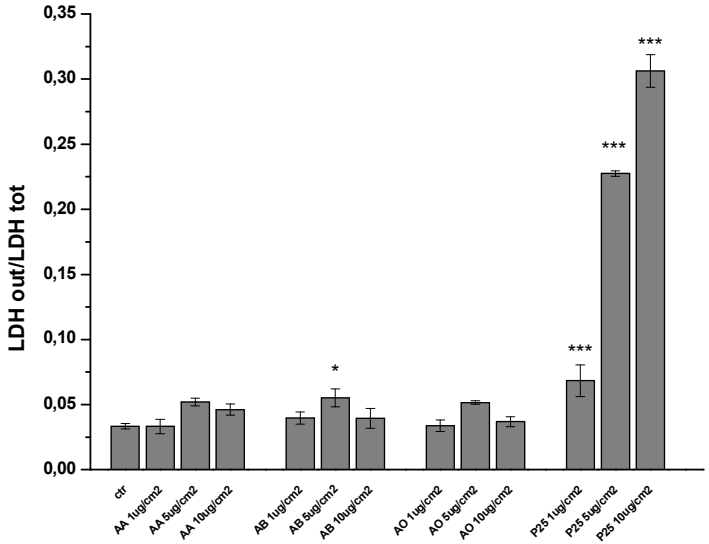


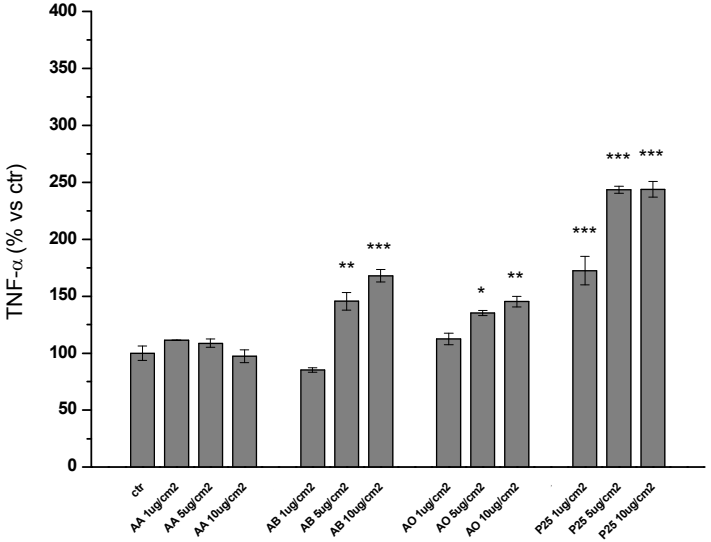
Nano-TiO_2

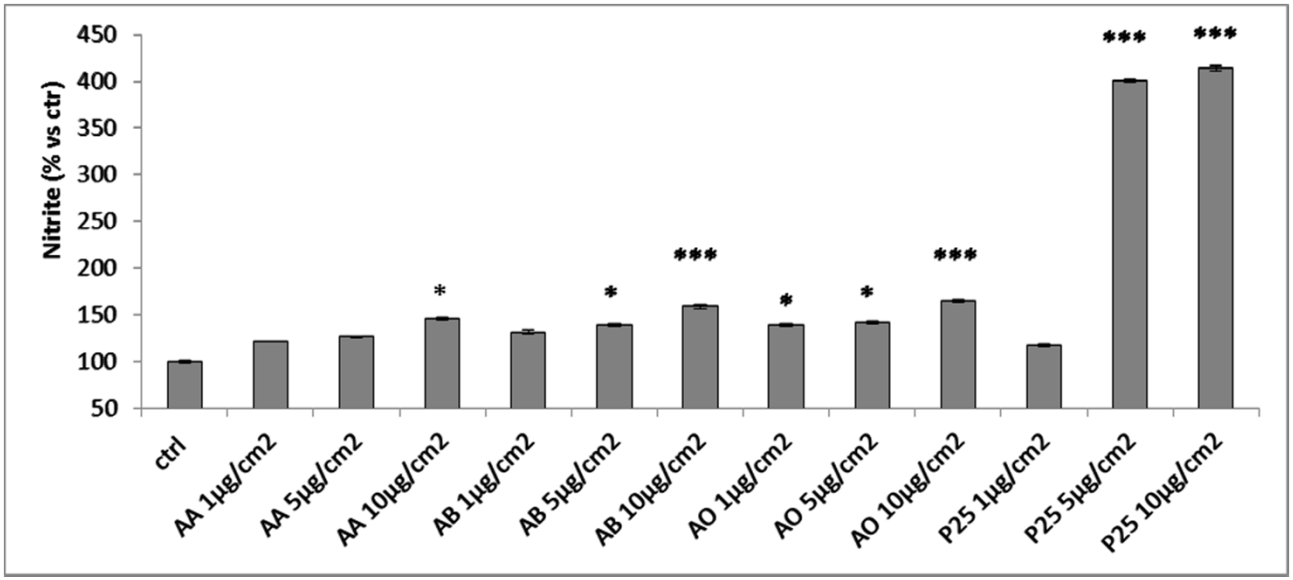

a
5000 A.U.
P25
TiO2-AO
TiO2-AA
TiO2-AB
3300
3320
3340
3360
3380
Field (G)
b
P25
1000 A.U.
TiO2-AO
TiO2-AA
TiO2-AB
3300
3320
3340
3360
3380
Field (G)


a
ζ- potential (mVolt)
pH
b
ζ- potential (mVolt)
pH
c
ζ- potential (mVolt)
pH

Nano-TiO_2

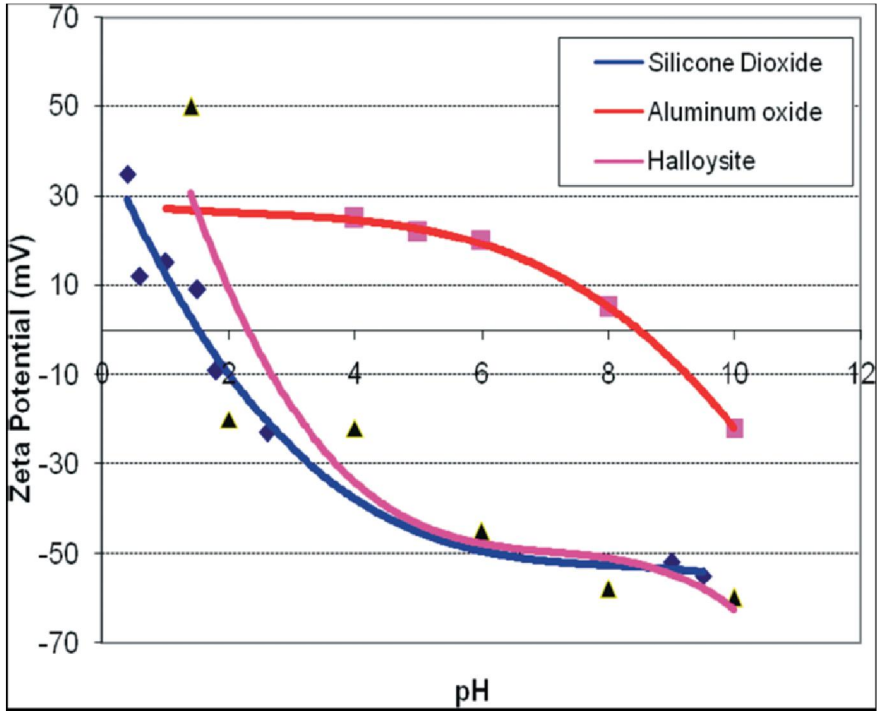

LDH out/LDH tot
0,35
0,30
0,25
0,20
0,15
0,10
0,05
0,00
*
***
***
***
ctr
AA 1ug/cm2
AA 5ug/cm2
AA 10ug/cm2
AB 1ug/cm2
AB 5ug/cm2
AB 10ug/cm2
AO 1ug/cm2
AO 5ug/cm2
AO 10ug/cm2
P25 1ug/cm2
P25 5ug/cm2
P25 10ug/cm2

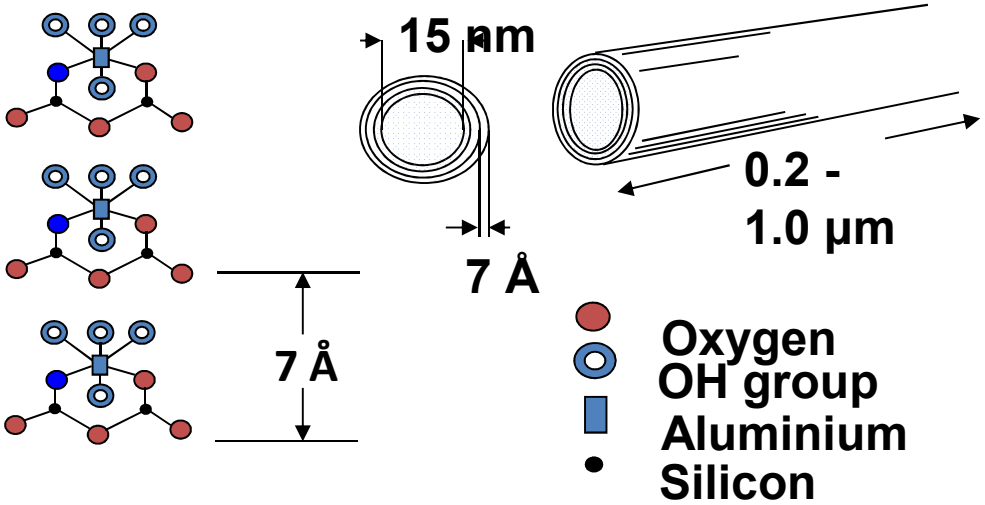

TNF-α (% vs ctr)
400
350
300
250
200
150
100
50
0
**
***
*
**
***
***
***
ctr
AA 1ug/cm2
AA 5ug/cm2
AA 10ug/cm2
AB 1ug/cm2
AB 5ug/cm2
AB 10ug/cm2
AO 1ug/cm2
AO 5ug/cm2
AO 10ug/cm2
P25 1ug/cm2
P25 5ug/cm2
P25 10ug/cm2


Nitrite (% vs ctr)
450
400
350
300
250
200
150
100
50
*
*
***
*
*
***
***
***
ctrl
AA 1µg/cm2
AA 5µg/cm2
AA 10µg/cm2
AB 1µg/cm2
AB 5µg/cm2
AB 10µg/cm2
AO 1µg/cm2
AO 5µg/cm2
AO 10µg/cm2
P25 1µg/cm2
P25 5µg/cm2
P25 10µg/cm2

Halloysite

- Two-layered aluminosilicate
- Hollow tubular structure
- Natural material
- 50 - 70 nm diameter
- 15 nm lumen
- 700 - 800 nm length

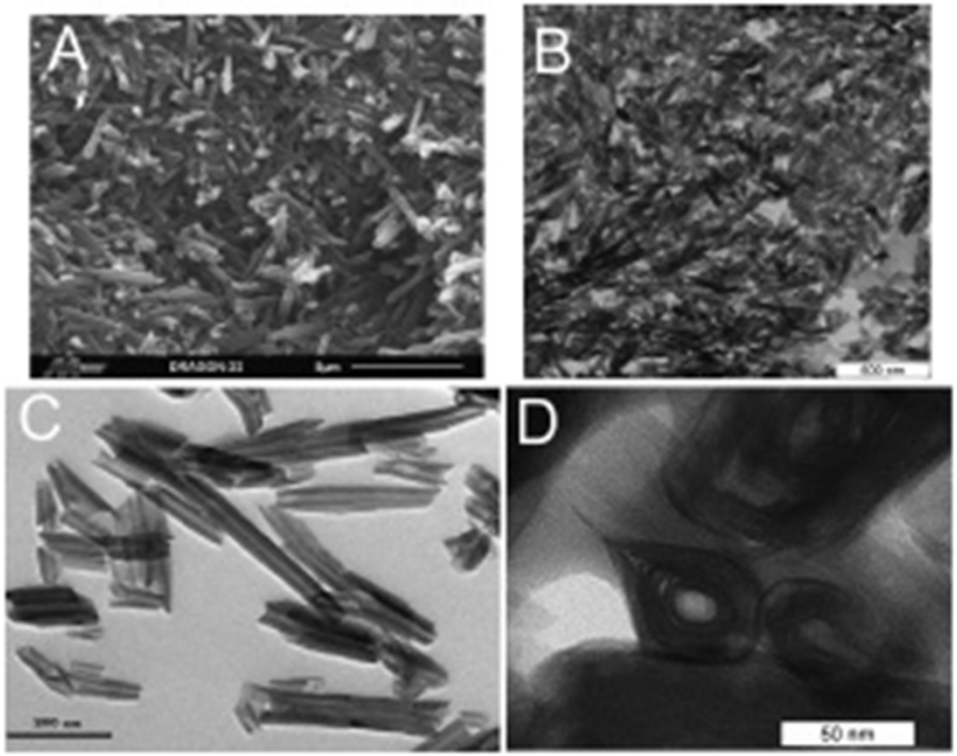




$Al_2Si_2O_5(OH)_4\ 2H_2O$

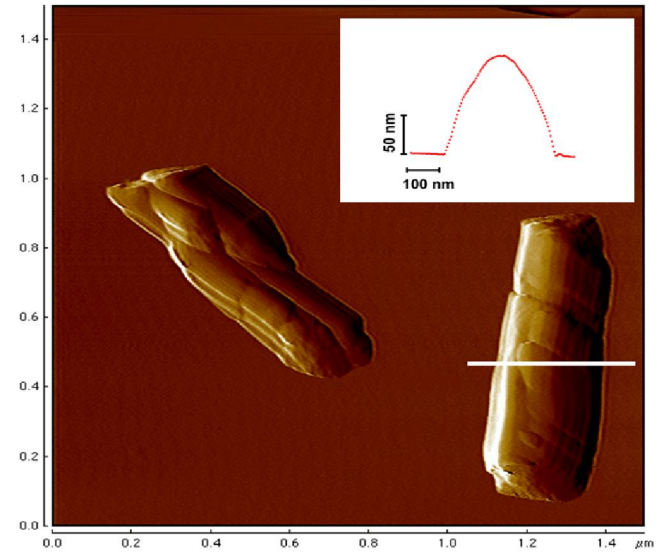
- Charge
- Stable colloids
- Different outside and inside chemistry
- Possibility to load negative molecules selectively into the lumen

Halloysite

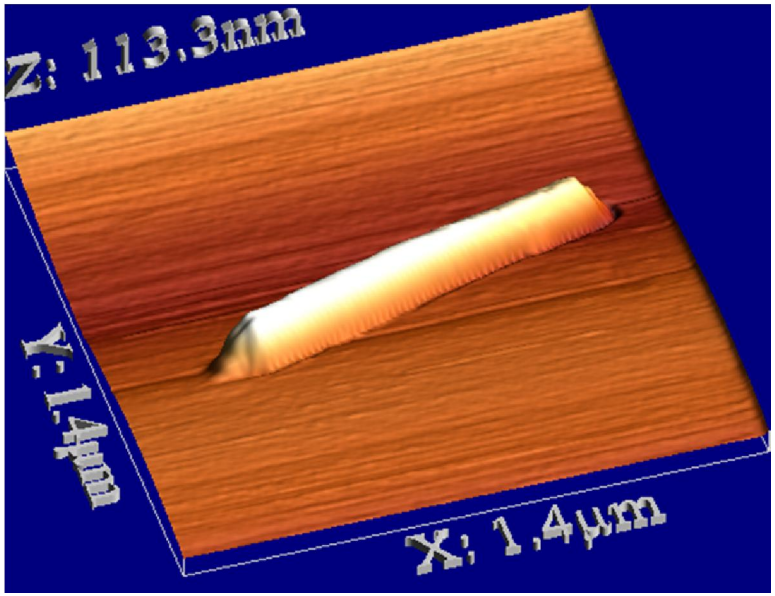


(A,B) **SEM** image of halloysite nanotubes powder
(C,D) **TEM** images of halloysite clay nanotubes:

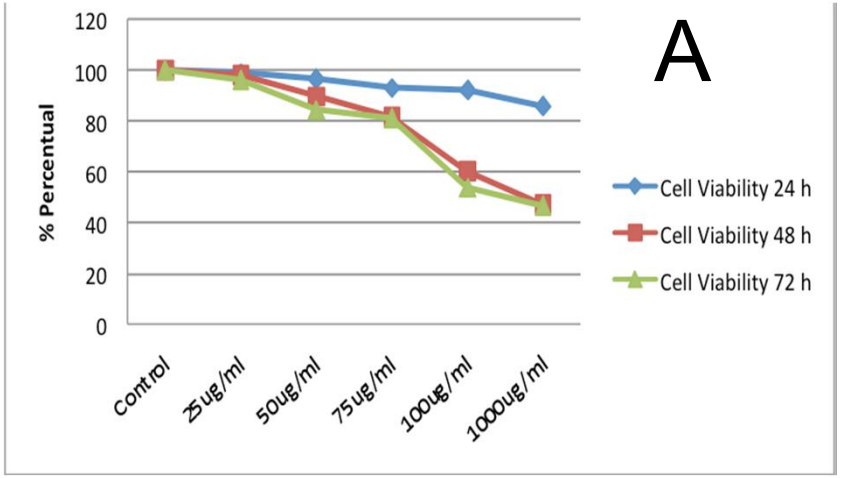
- **Cylindrical shape**
- **Polydisperse in lenght**
- **Empty lumen**
- **Rolled nature**

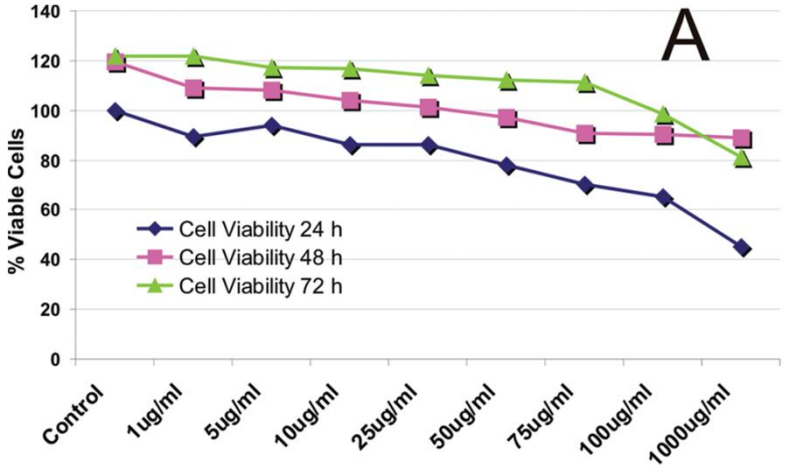


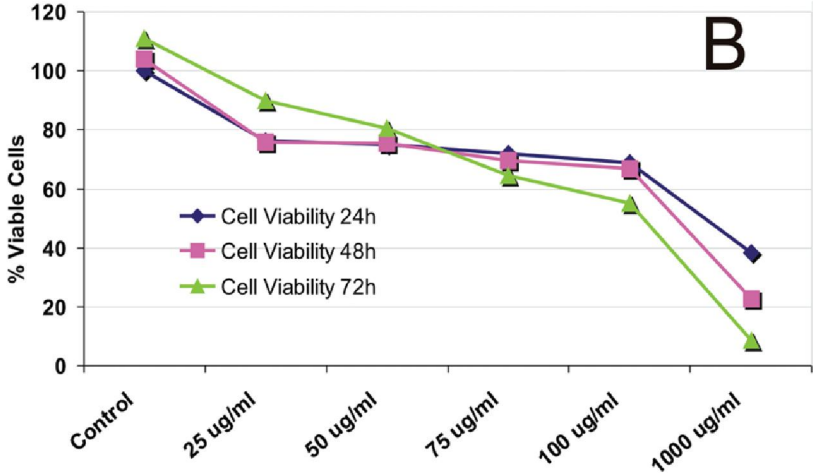
AFM: *Contact mode (deflection) image of two isolated* nanotubes. A typical height profile of a single nanotube is shown in the inset
AFM: 3D view of a single long nanotube

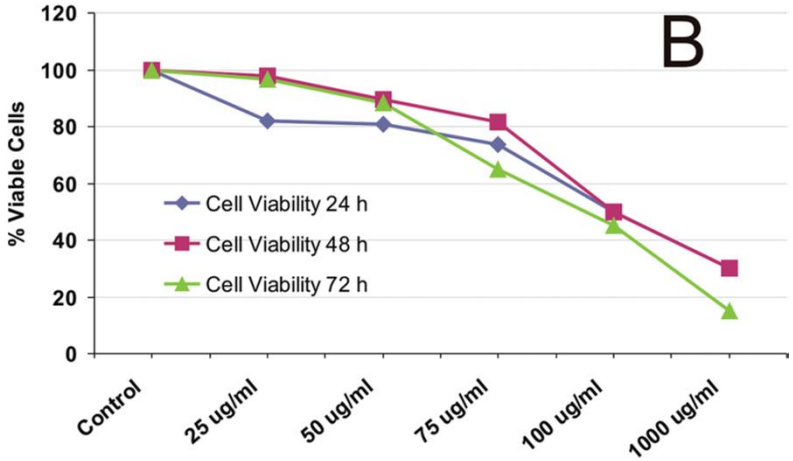


Halloysite









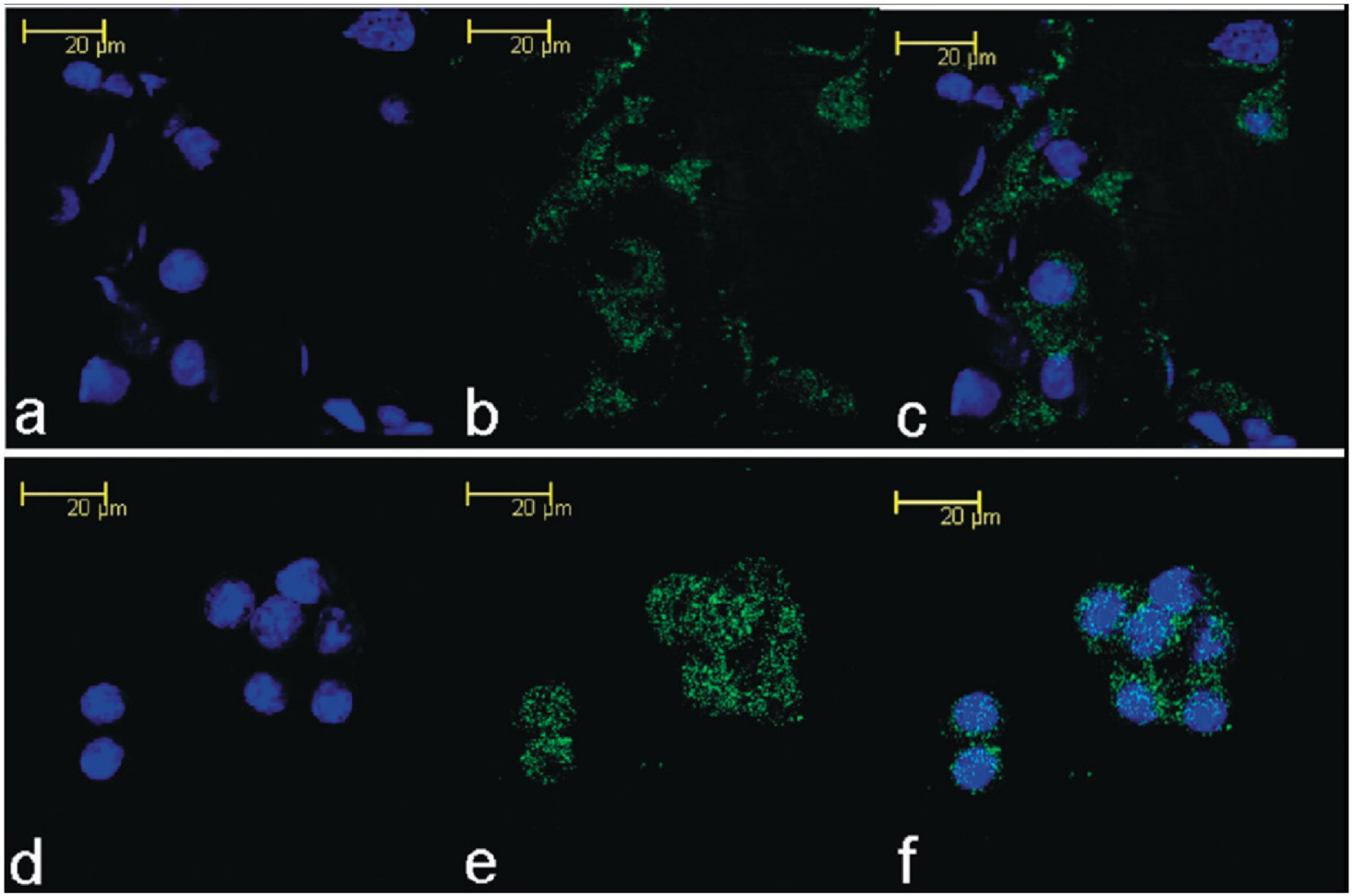
MTT assay of halloysite taken up by (a) HeLa and (b) MCF-7 cell percent cell viability versus halloysite concentration for 24 to 48 to 72 h (Error bar is STD (standard deviation), not visible

Trypan blue test of halloysite taken up by (a) HeLa and (b) MCF-7 cell percent cell viability versus halloysite concentration for 24 to 48 to 72 h (Error bar is STD (standard deviation), not visible

Halloysite

MCF-7

HeLa



CLSM images of halloysite nanotubes (HNTs) intracellular uptake by cancer cells. (a-c) CLSM images of HNT (coated by polyelectrolyte multilayers with a FITC-labeled layer embedded herein) spontaneous intracellular uptake by MCF-7 cells. (a) Hoechst fluorescence of nuclei (blue). (b) FITC fluorescence (green) of HNTs coated with an FITC layer. (c) overlaid images of FITC fluorescence of HNTs with a FITC layer and MCF-7 nuclei (blue).
(d,e) CLSM images of HNT (functionalized by APTES) spontaneous intracellular uptake by HeLa cells. (d) Hoechst fluorescence of nuclei (blue). (e) FITC fluorescence (green) of HNTs+APTES. (f) FITC fluorescence of HNTs+APTES and HeLa nuclei (blue) overlaid images.

Conclusioni

- Biocompatibilità
- Interazione con le cellule
- Buona dispersione in diversi solventi