Stefano Leporatti, PhD

Nanocarriers for Nanomedicine

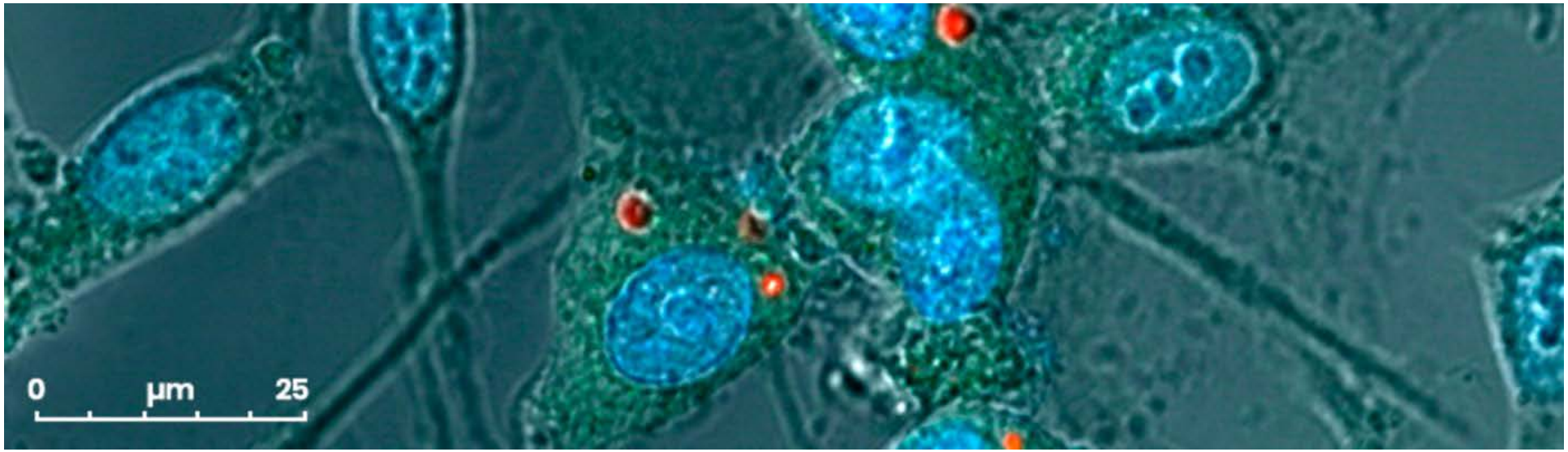
Team & collaborators: **Francesca Persano** (Uni-Salento & CNR Nanotec), Dr. **Nemany Hanafy** (now Lecturer @Kafrelsheikh University, Egypt), Dr. **Mariafrancesca Cascione** and **Valeria De Matteis** (Uni-Salento, Lecce), Prof. **Alessandro Parodi** (Sechenov University, Moscow, Russia), Prof. **Luciana Dini** (Uni-Sapienza, Roma). Dr. **Elisa Panzerini** (DiSteBA, Uni-Salento, Lecce) **Prof. Gianluigi Giannelli** (IRCSS De Bellis, Castellana Grotte, Bari), Prof. **A-M. Safer** (Kuwait University, Kuwait), Prof. **Rawil Fakhrullin** (Kazan University, Kazan, Russia), Prof. **Yuri M. Lvov** (Ruston University, Ruston, USA), Prof. **Michele Maffia** (DiSteBA, Uni-Salento, Lecce).

Ministero degli Affari Esteri
e della Cooperazione Internazionale

TecnoMedPuglia

TGF-β
IT-LIVER
MARIE CURIE - ITN

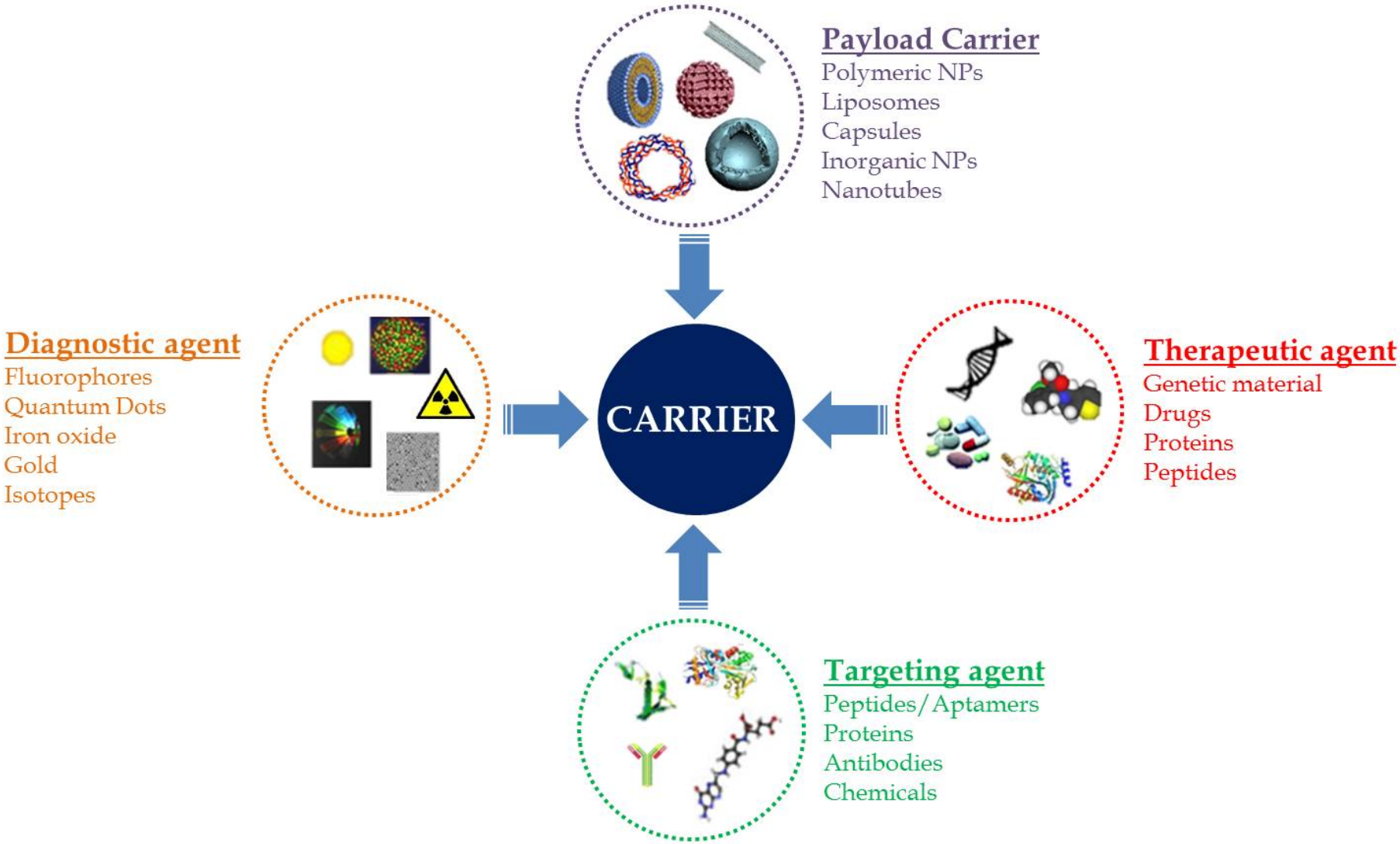
Biomolecular Delivery



http://www.nanotec.cnr.it/en/nano-biotechnology

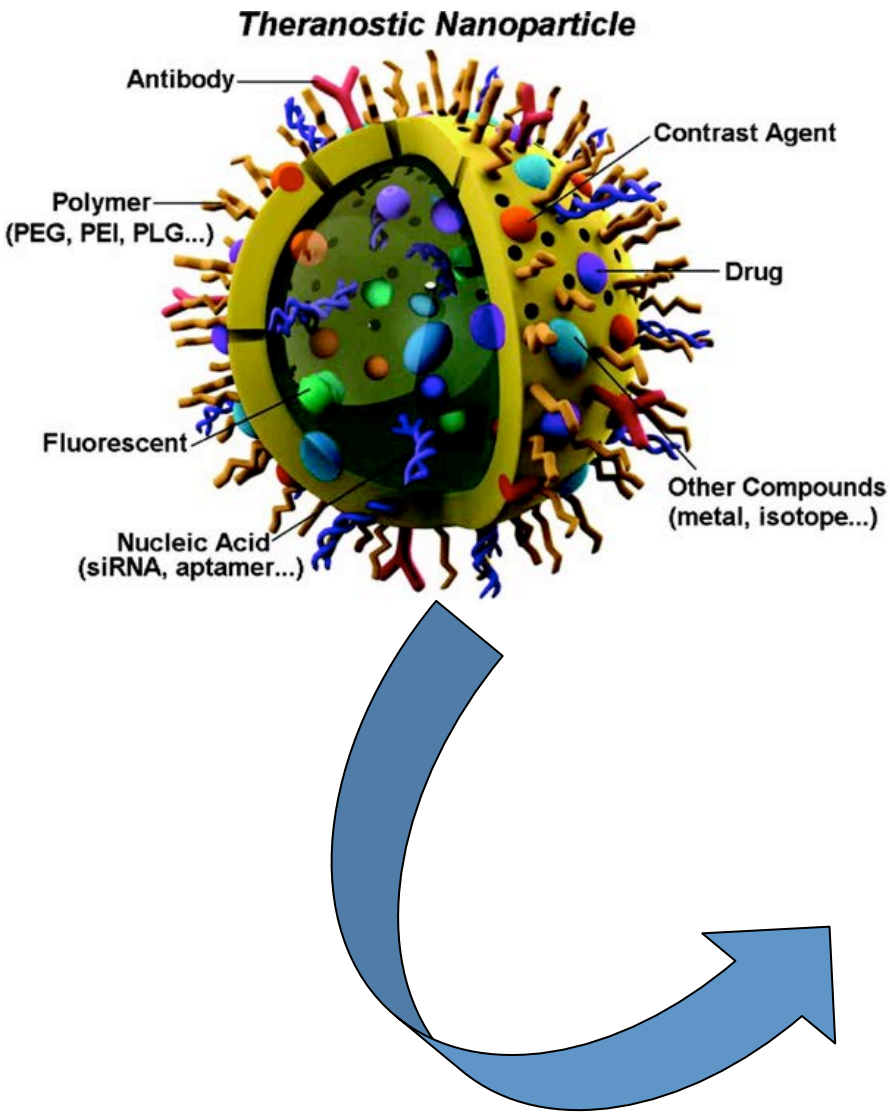
Incorporation of bioactive molecules into nanocarrier often offers several advantages for therapeutic purposes: it facilitates the delivery of insoluble drugs, ensures protection from enzymatic degradation, prolongs the halftime in the bloodstream and controls the release kinetics. The characteristics of a nanocarrier (size, composition, surface chemistry, response to intra- and extracellular stimuli) could be tuned for each specific application.

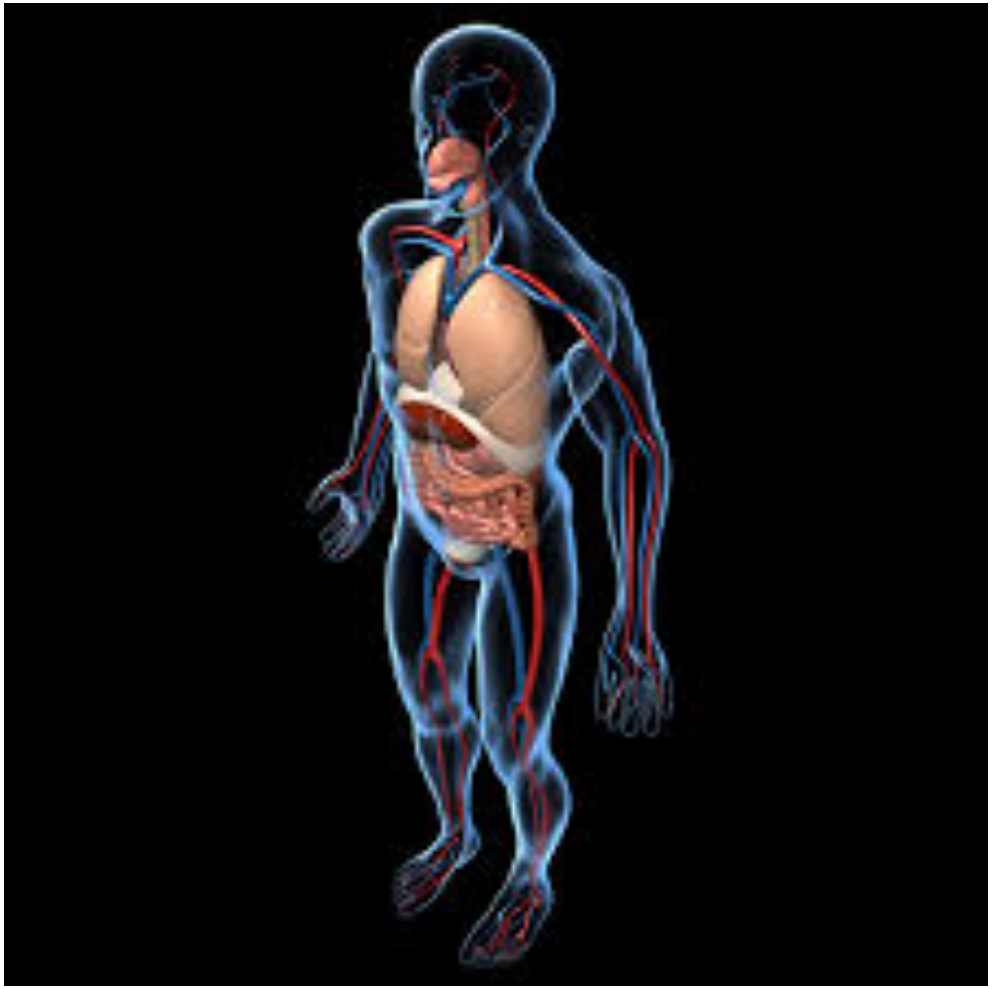
Nanocarrier Design



Credits: Bionanotechnology @ CNR Nanotec

Nanomedicine





Outline

Layer-by-Layer Polyelectrolyte NanoCarriers (Nano and Micro-capsules, Nanocolloids, LbL-coated Iron Oxide Nanoparticles)

Inorganic Nanoparticles (Halloysite NanoTubes (HNTs), Calcium Carbonate Nanorods, Silica Nanoparticles)

Hybrid Nanoparticles (Nanomicelles,Chitosan Nanoparticles, Lipid Protein Nanoparticles)

ACSNANO
Cite This: ACS Nano 2019, 13, 6151−6169
www.acsnano.org
PERSPECTIVE

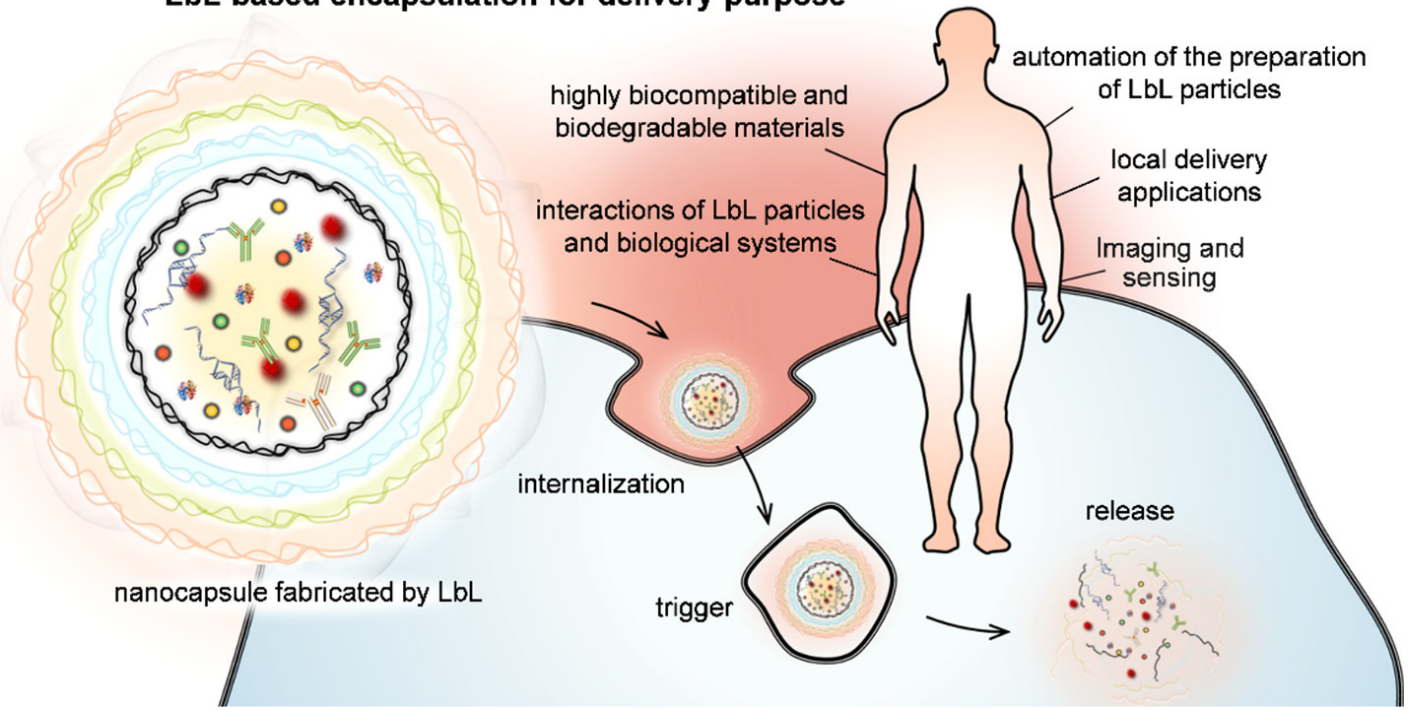
The Future of Layer-by-Layer Assembly: A Tribute to *ACS Nano* Associate Editor Helmuth Möhwald

Shuang Zhao,[†] Frank Caruso,[‡,⊗] Lars Dähne,[§] Gero Decher,[∥,⊥] Bruno G. De Geest,[#] Jinchen Fan,[¶] Neus Feliu,[†] Yury Gogotsi,[$] Paula T. Hammond,[□] Mark C. Hersam,[■] Ali Khademhosseini,[○] Nicholas Kotov,[¶,●] Stefano Leporatti,[△] Yan Li,[▲] Fred Lisdat,[▽] Luis M. Liz-Marzán,[▼,○] Sergio Moya,[▼] Paul Mulvaney,[●] Andrey L. Rogach,[††] Sathi Roy,[†] Dmitry G. Shchukin,[‡‡] Andre G. Skirtach,[§§] Molly M. Stevens,[%] Gleb B. Sukhorukov,[⊥⊥] Paul S. Weiss,[○,¶¶] Zhao Yue,[β] Dingcheng Zhu,[†] and Wolfgang J. Parak[*,†,▼]

[†]Fachbereich Physik, CHyN, Universität Hamburg, 22607 Hamburg, Germany

Professor Dr. Dr. h.c. Helmuth Möhwald (19.01.1946 - 27.3.2018)

LbL-based encapsulation for delivery purpose



Layer-by-layer (LbL) assembly can be used to fabricate encapsulation platforms for nanodelivery

Advances in Colloid and Interface Science 207 (2014) 139–154

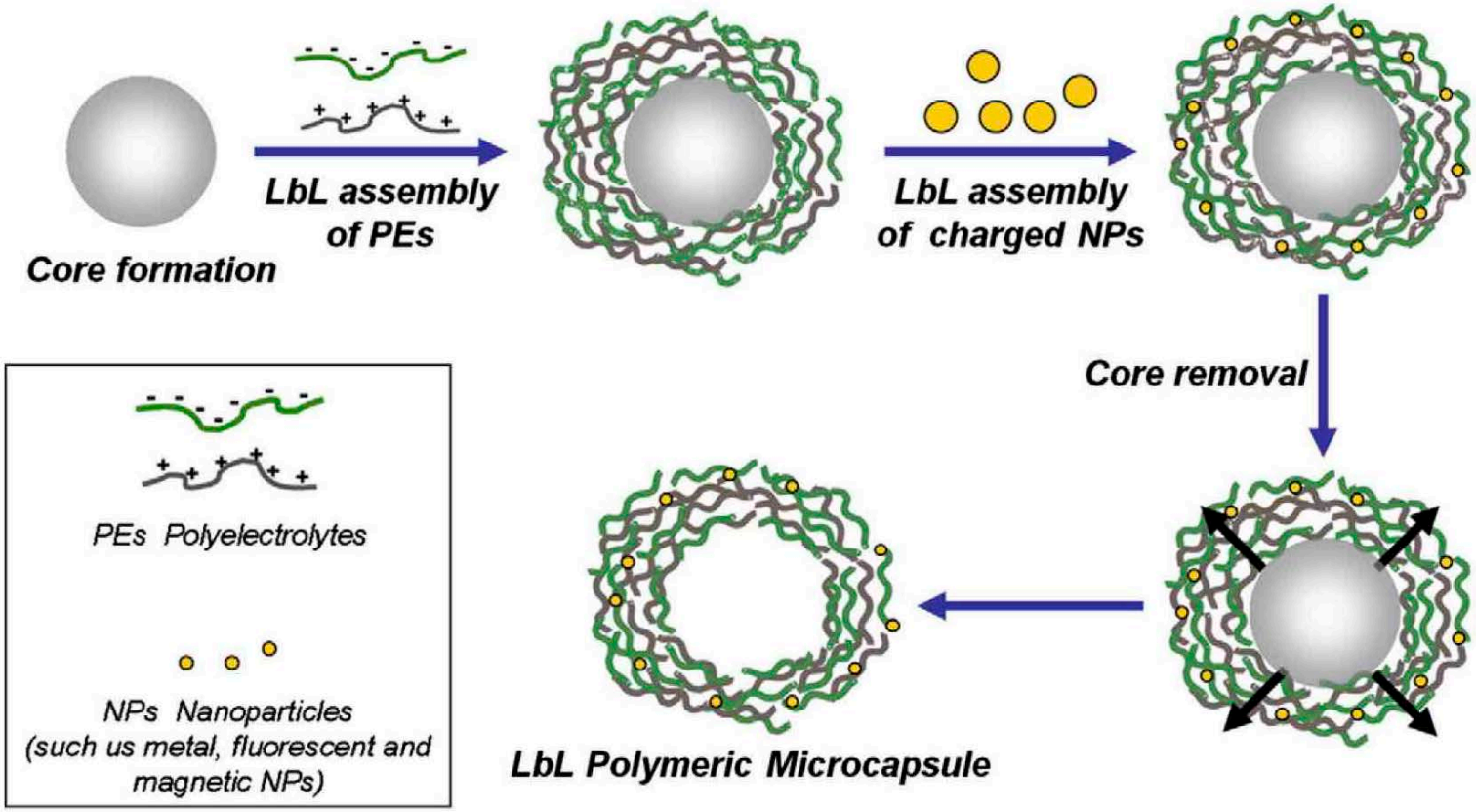
Contents lists available at ScienceDirect

Advances in Colloid and Interface Science

journal homepage: www.elsevier.com/locate/cis

Biological applications of LbL multilayer capsules: From drug delivery to sensing

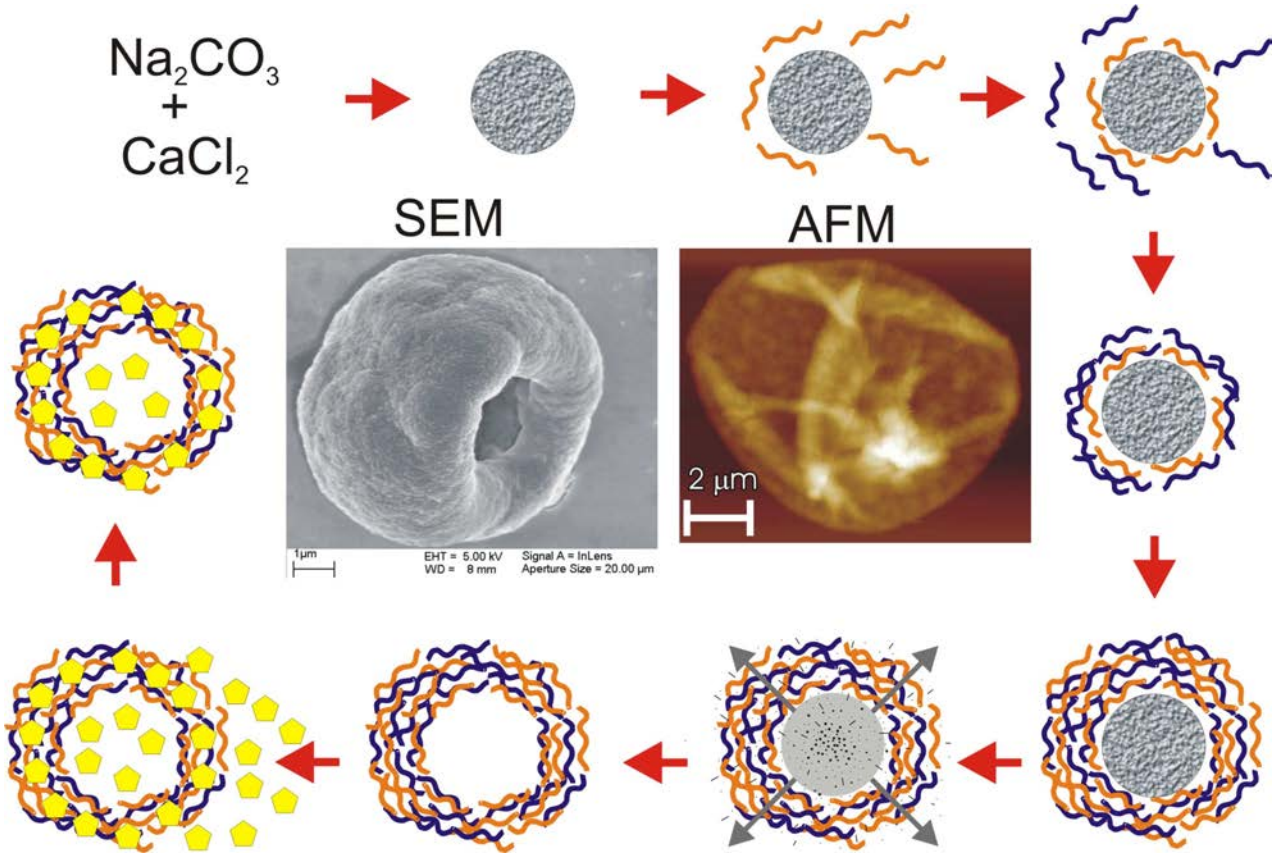
Loretta Laureana del Mercato [a], Marzia Maria Ferraro [a], Francesca Baldassarre [a], Serena Mancarella [a], Valentina Greco [a], Ross Rinaldi [a,b], Stefano Leporatti [a,*]



Imatinib-loaded polyelectrolyte microcapsules for sustained targeting of BCR-ABL+ leukemia stem cells

Ilaria E Palamà[1*], Stefano Leporatti[1*], Emanuela de Luca[2], Nicola Di Renzo[2], Michele Maffia[2], Carlo Gambacorti-Passerini[3], Ross Rinaldi[1], Giuseppe Gigli[1], Roberto Cingolani[1] & Addolorata ML Coluccia[1,2†]

[†]Author for correspondence
[1]National Nanotechnology Laboratory of CNR-INFM, IIT Research Unit, Scuola Superiore ISUFI, University of Salento, Via Arnesano 73100 Lecce, Italy
Tel.: +39 832 298 221
Fax: +39 832 298 230
malu.coluccia@unile.it
[2]'Vito Fazzi' Hospital, Italy
[3]University of Milano-Bicocca, Italy
*Authors contributed equally



10.2217/NNM.10.8 © 2010 Future Medicine Ltd

BASIC SCIENCE

Nanomedicine: Nanotechnology, Biology, and Medicine
8 (2012) 891–899

ELSEVIER

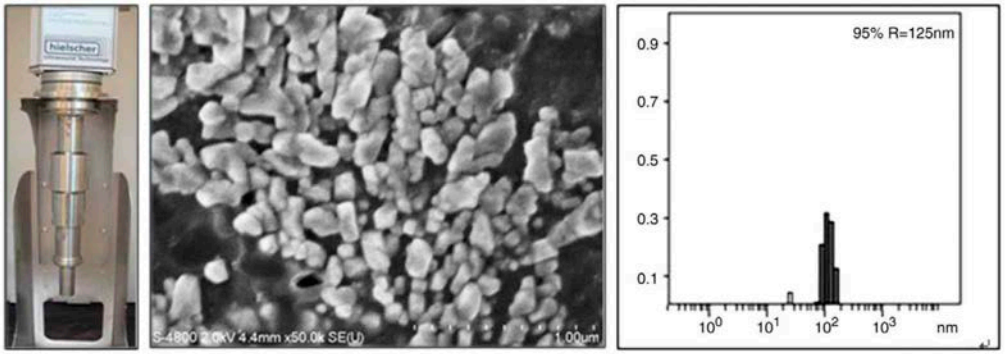
Research Article

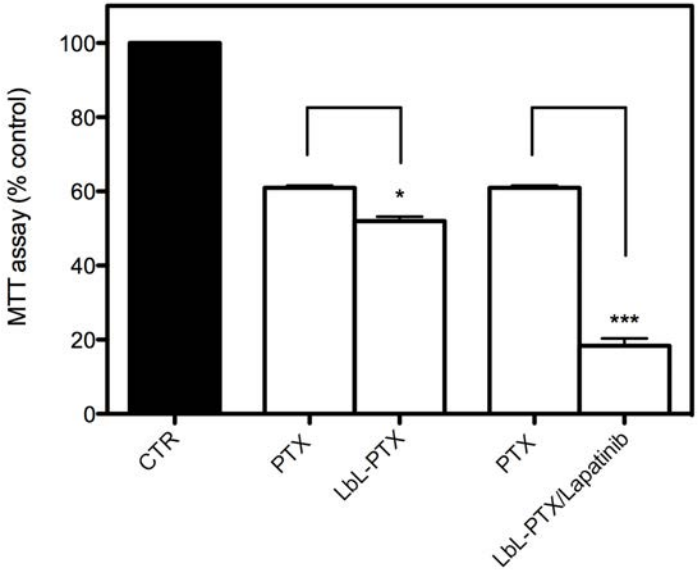
nanomedicine
Nanotechnology, Biology, and Medicine

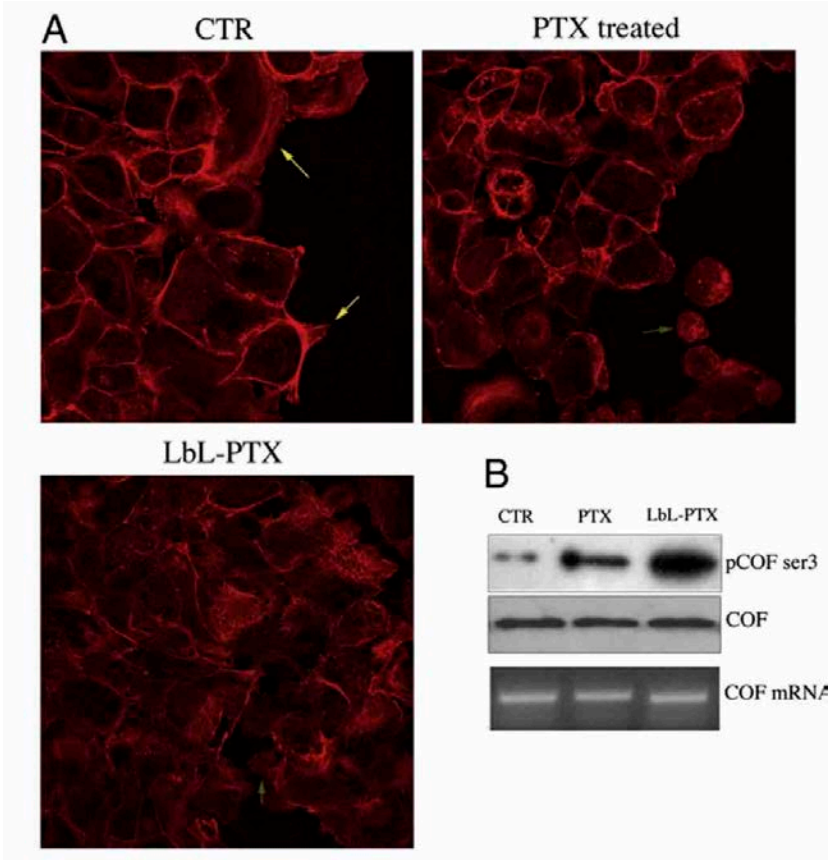
nanomedjournal.com

Lapatinib/Paclitaxel polyelectrolyte nanocapsules for overcoming multidrug resistance in ovarian cancer

Daniele Vergara, PhD[a,b], Claudia Bellomo, MS[c], Xingcai Zhang, MS[d], Viviana Vergaro, MS[c], Andrea Tinelli, MD[e], Vito Lorusso, MD[f], Ross Rinaldi, PhD[g], Yuri M. Lvov, PhD[d], Stefano Leporatti, PhD[c,*], Michele Maffia, PhD[a,b]



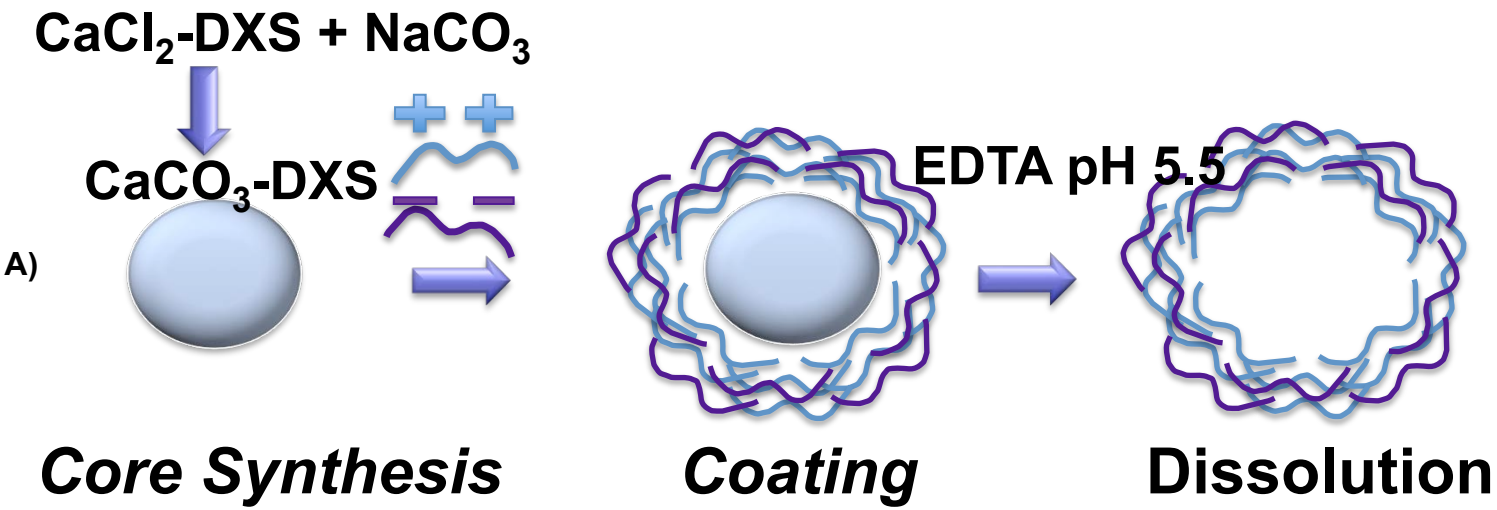


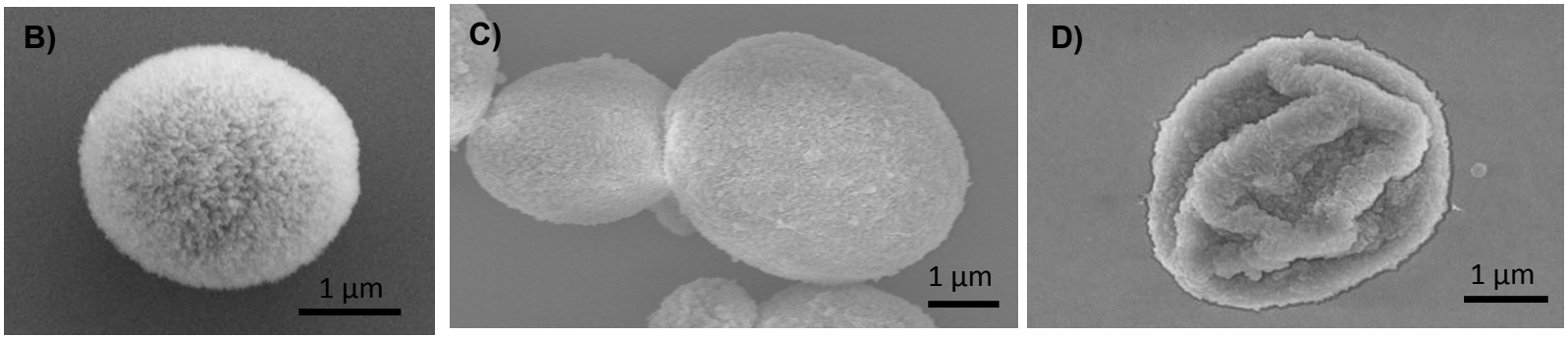


Macromolecular Bioscience
Macromolecular Journals
Full Paper

Polyelectrolyte Capsules as Carriers for Growth Factor Inhibitor Delivery to Hepatocellular Carcinoma

Francesca Baldassarre, Viviana Vergaro, Flavia Scarlino, Flavia De Santis, Giovanna Lucarelli, Antonio della Torre, Giuseppe Ciccarella, Ross Rinaldi, Gianluigi Giannelli, Stefano Leporatti*





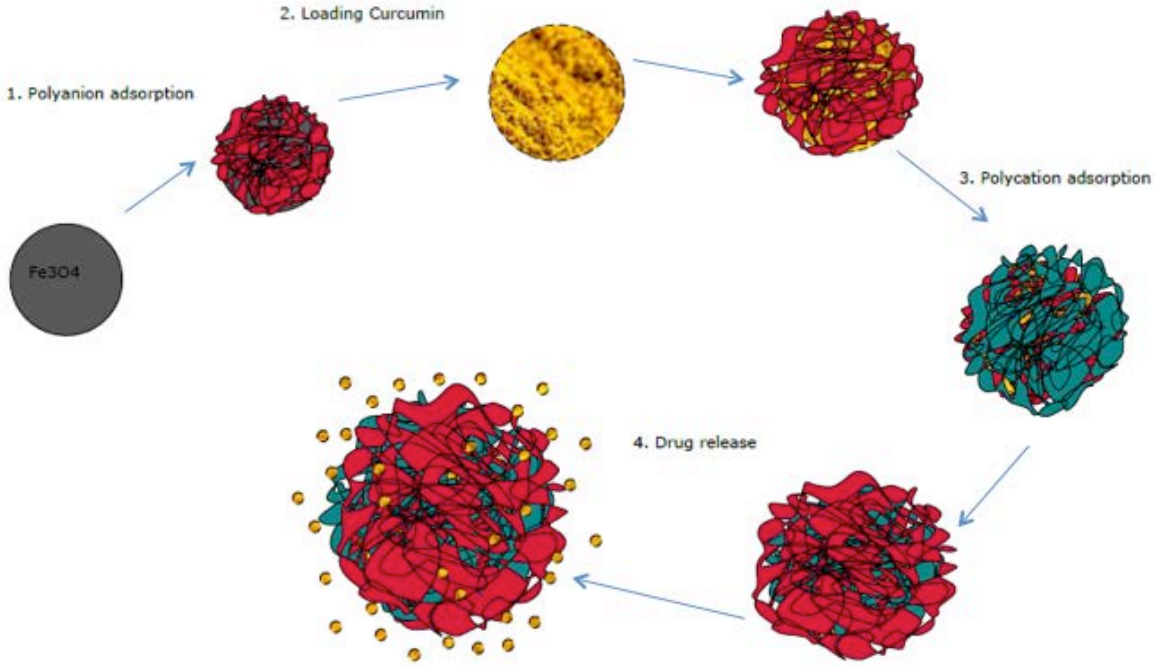
Full Paper

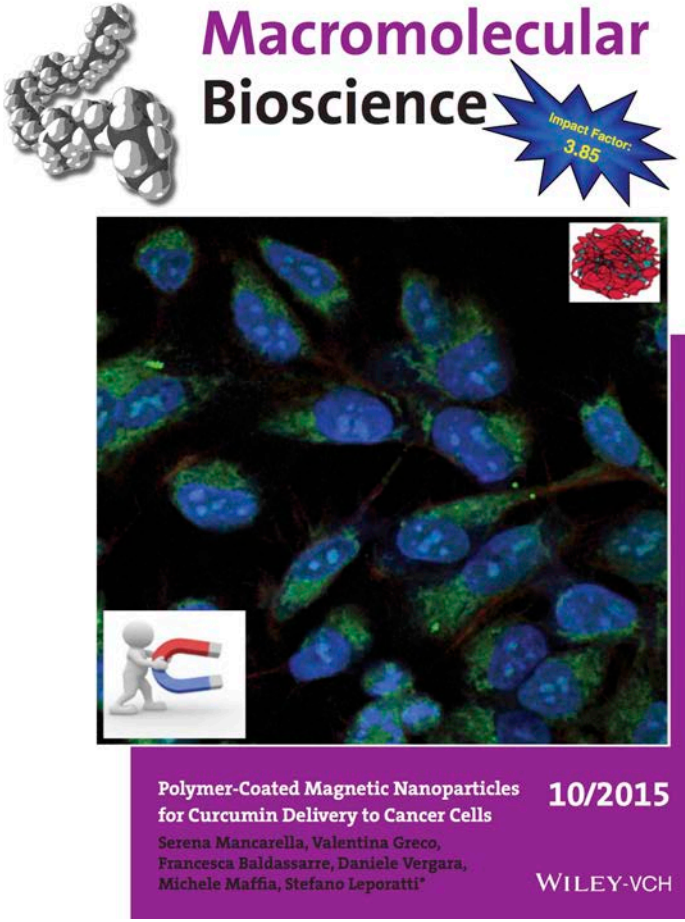
Macromolecular Journals

Macromolecular Bioscience

Polymer-Coated Magnetic Nanoparticles for Curcumin Delivery to Cancer Cells

Serena Mancarella, Valentina Greco, Francesca Baldassarre, Daniele Vergara, Michele Maffia, Stefano Leporatti*





Macromol. Biosci. **2015,** *15*, 1365–1374

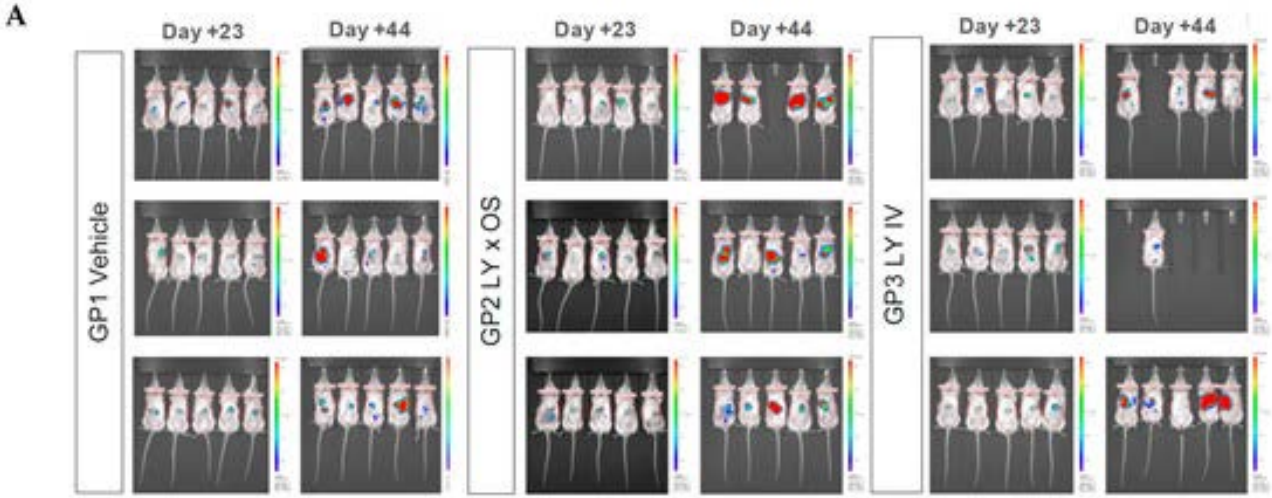
cancers

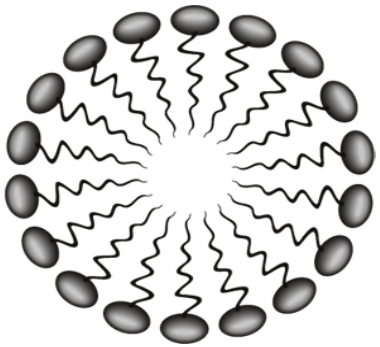
MDPI

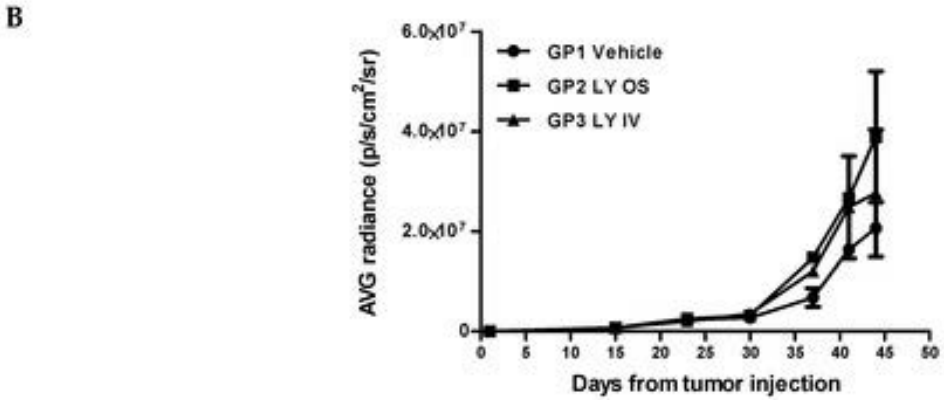
Review

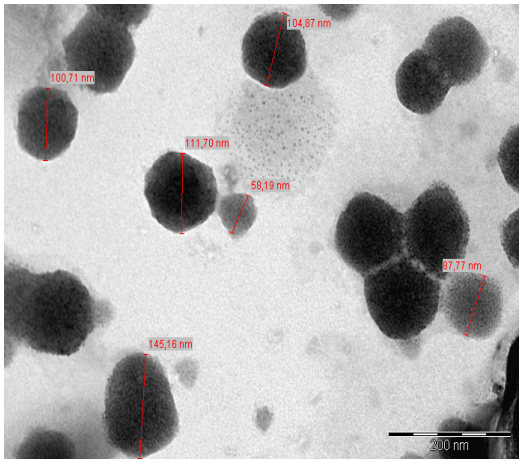
Validation of Hepatocellular Carcinoma Experimental Models for TGF-β Promoting Tumor Progression

Serena Mancarella [1], Silke Krol [1,*], Alberto Crovace [1], Stefano Leporatti [2], Francesco Dituri [1], Martina Frusciante [1] and Gianluigi Giannelli [1,*]









Biomacromolecules **2010,** *11,* 820–826

Cytocompatibility and Uptake of Halloysite Clay Nanotubes

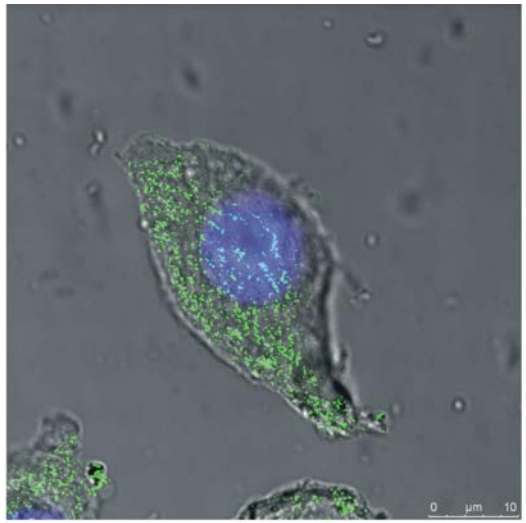
Viviana Vergaro,[†] Elshad Abdullayev,[‡] Yuri M. Lvov,[‡] Andre Zeitoun,[§] Roberto Cingolani,[†] Ross Rinaldi,[†] and Stefano Leporatti*,[†]

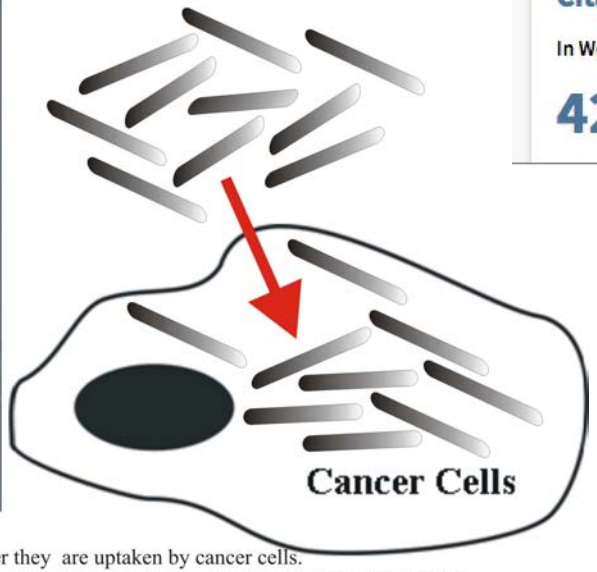
Citation Network

In Web of Science Core Collection

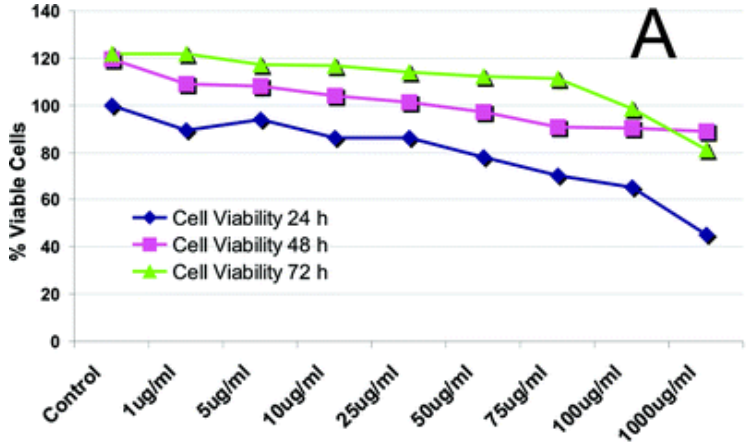
420

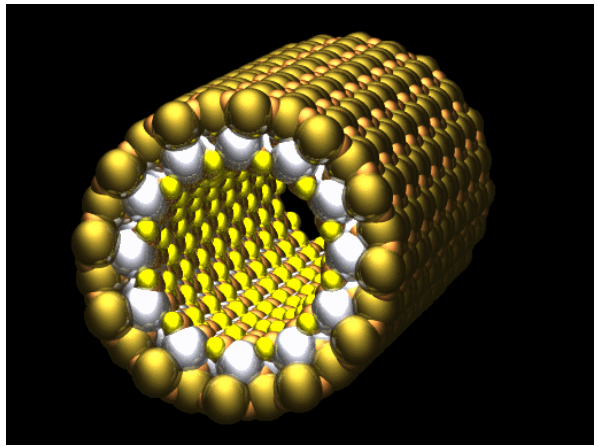
Highly Cited Paper

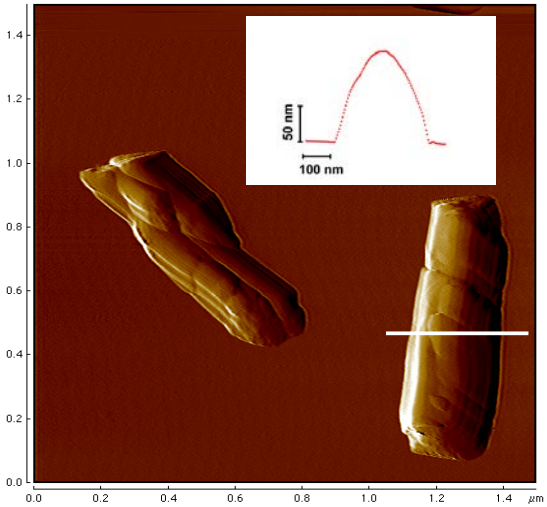


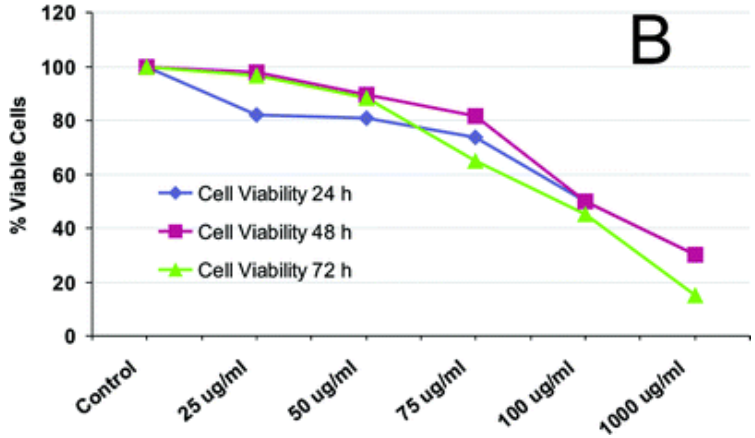


Halloysite clay nanotubes show high cytocompatibility after they are uptaken by cancer cells.
Fluorescence and optical overlayed confocal image shows halloysite nanotubes internalised inside a cancer cell
(nucleus appears blue for Hoechst staining whereas tubes appear green due to FITC labeling through LbL coating)









Mini-review

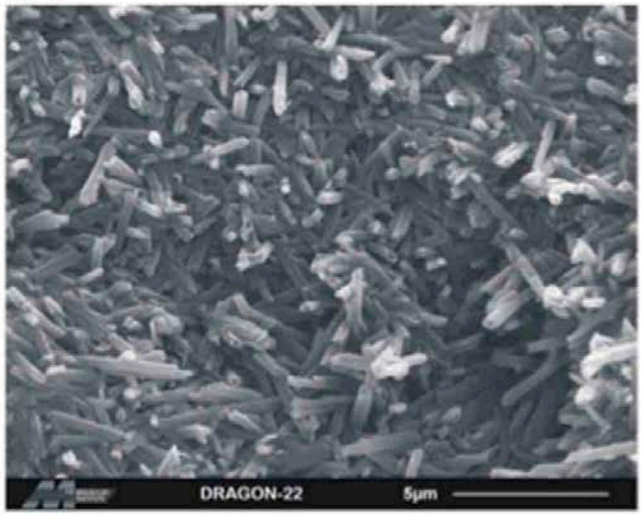
Received: 8 November 2016 Revised: 23 January 2017 Accepted article published: 11 February 2017 Published online in Wiley Online Library:

(wileyonlinelibrary.com) DOI 10.1002/pi.5347

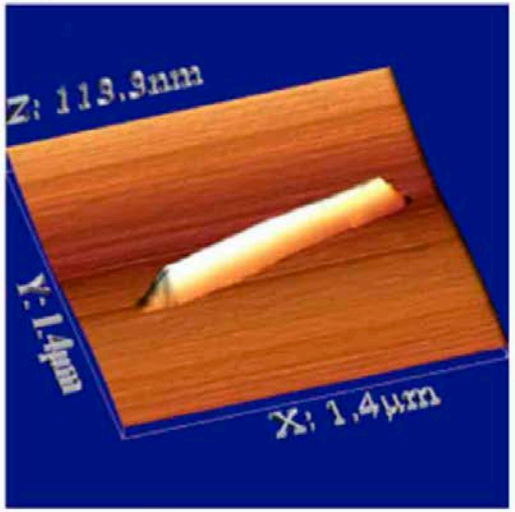
Halloysite clay nanotubes as nano-bazookas for drug delivery

Stefano Leporatti*

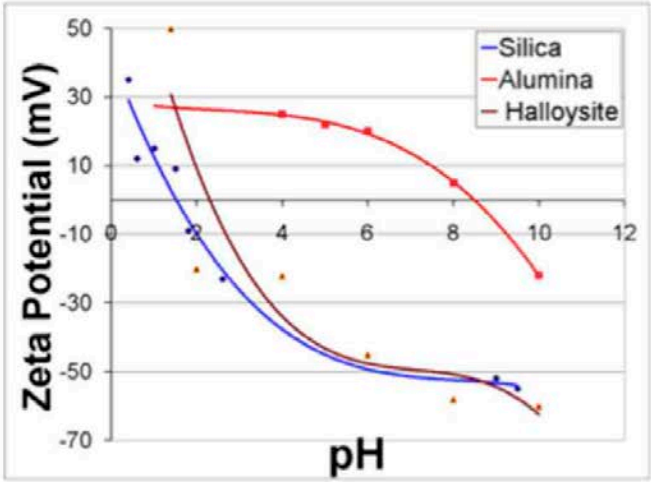
(A)



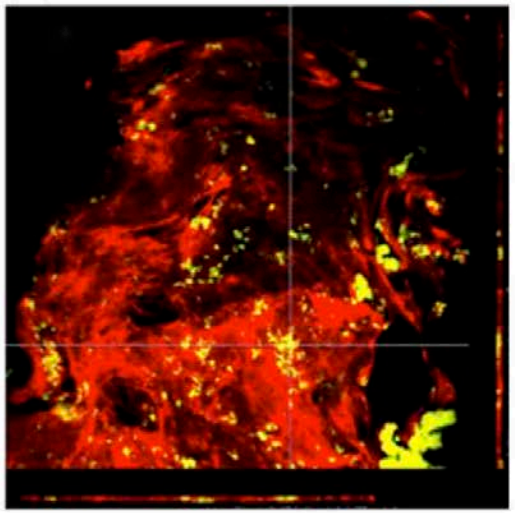
(B)



(C)



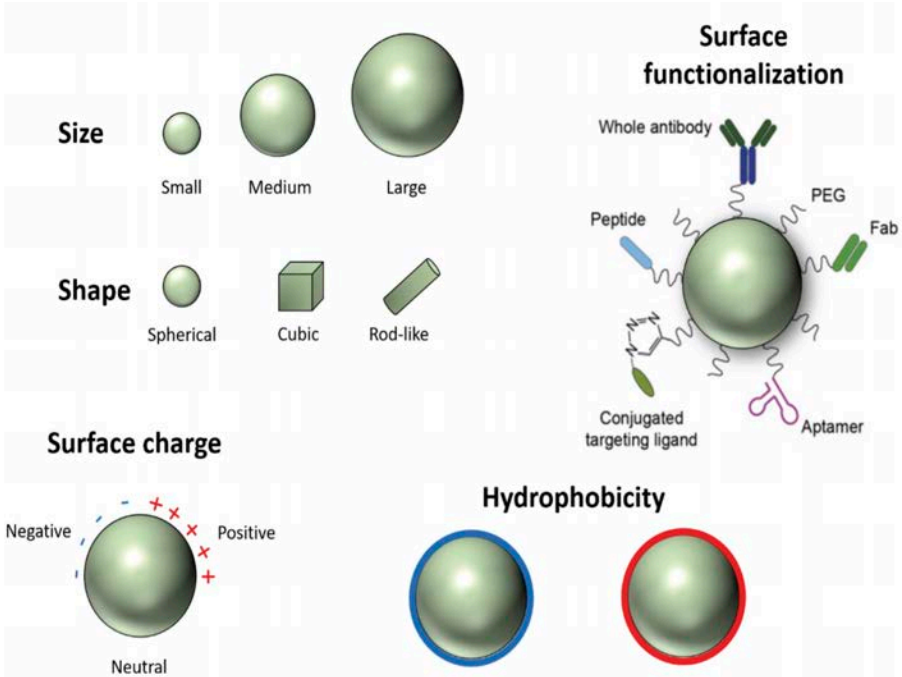
(D)

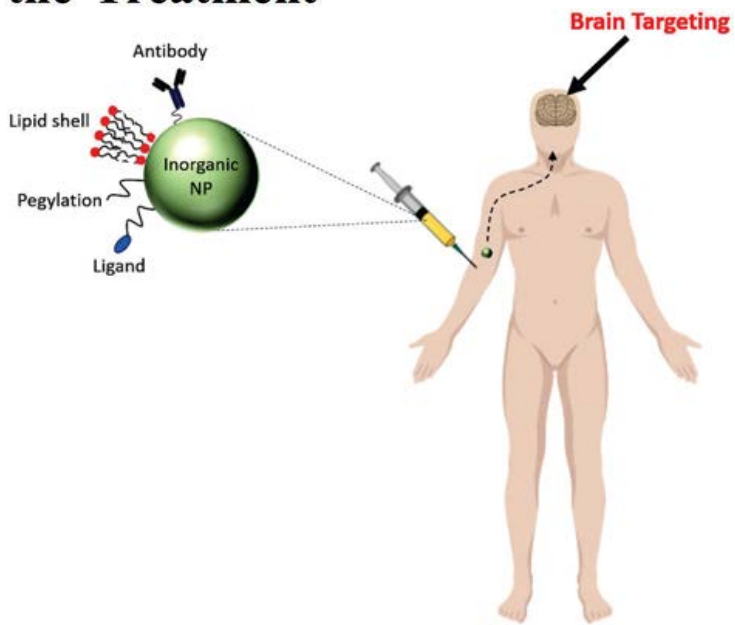


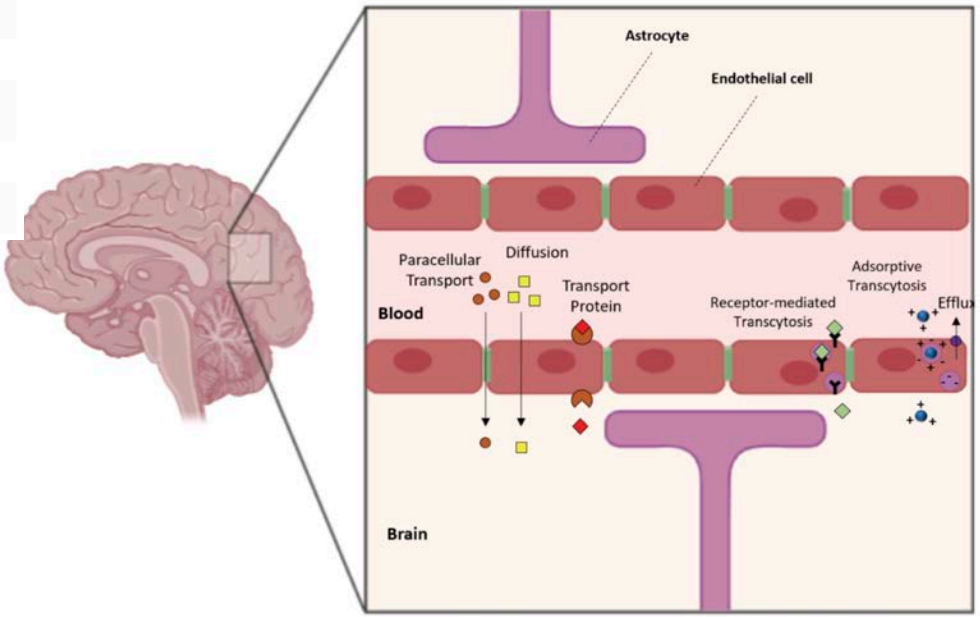
REVIEW ARTICLE

Current Overview of Inorganic Nanoparticles for the Treatment of Central Nervous System (CNS) Diseases

Francesca Persano[1,2] and Stefano Leporatti[2,*]








Volume 9
Number 12
28 March 2021
Pages 2749–2938
Journal of
Materials Chemistry B
Materials for biology and medicine
rsc.li/materials-b
ISSN 2050-750X
ROYAL SOCIETY OF CHEMISTRY
REVIEW ARTICLE
Stefano Leporatti, Rawil Fakhrullin et al.
Recent advances in the design of inorganic and nano-clay particles for the treatment of brain disorders
Indexed in Medline!

Journal of
Materials Chemistry B

ROYAL SOCIETY OF CHEMISTRY

REVIEW

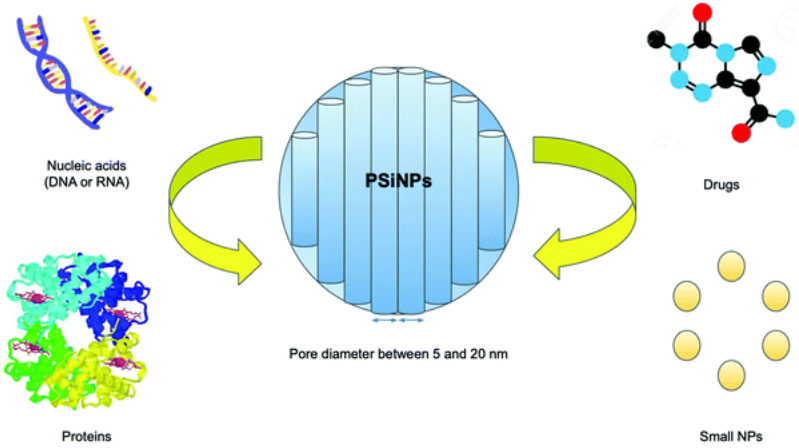
View Article Online
View Journal | View Issue

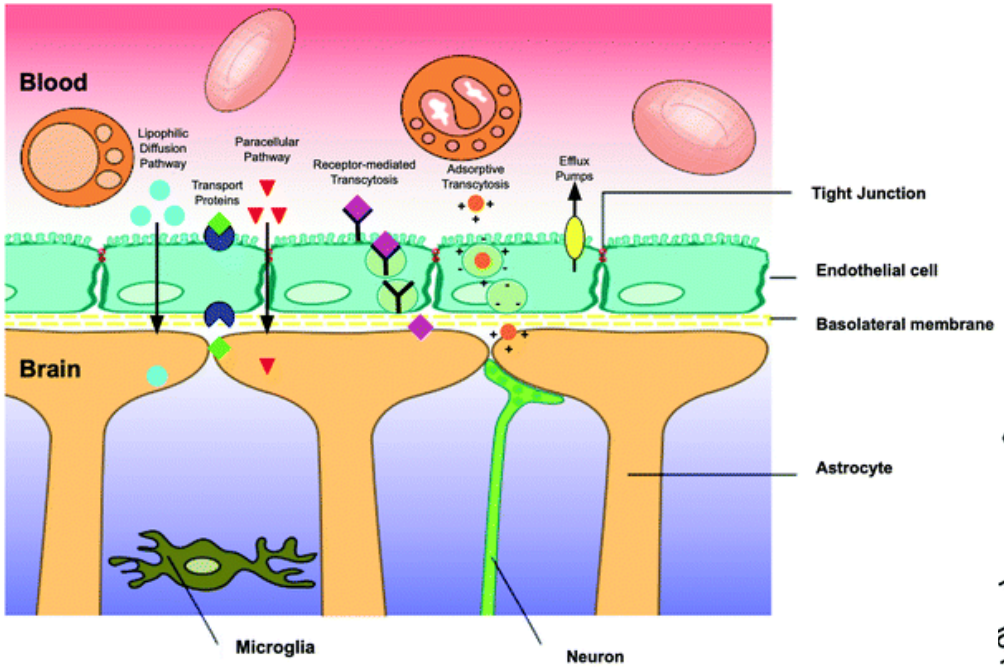
Check for updates

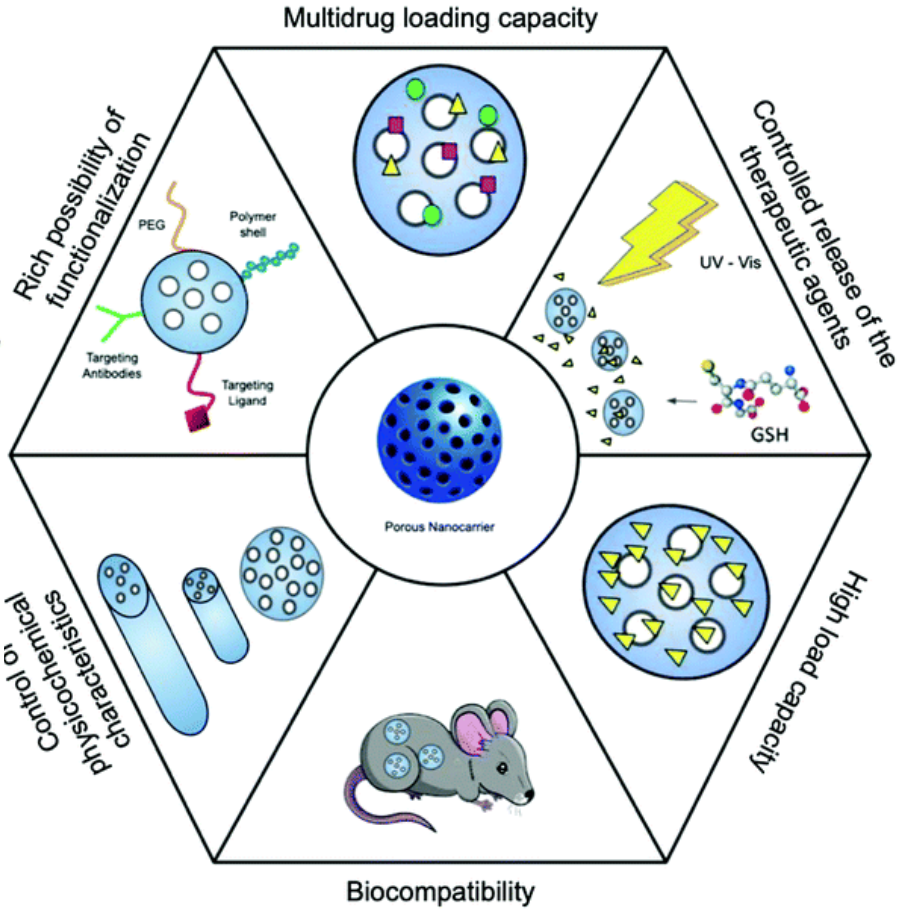
Cite this: *J. Mater. Chem. B*, 2021, 9, 2756

Recent advances in the design of inorganic and nano-clay particles for the treatment of brain disorders

Francesca Persano,†[ab] Svetlana Batasheva, †[c] Gölnur Fakhrullina,[c] Giuseppe Gigli,[ab] Stefano Leporatti *[b] and Rawil Fakhrullin *[c]







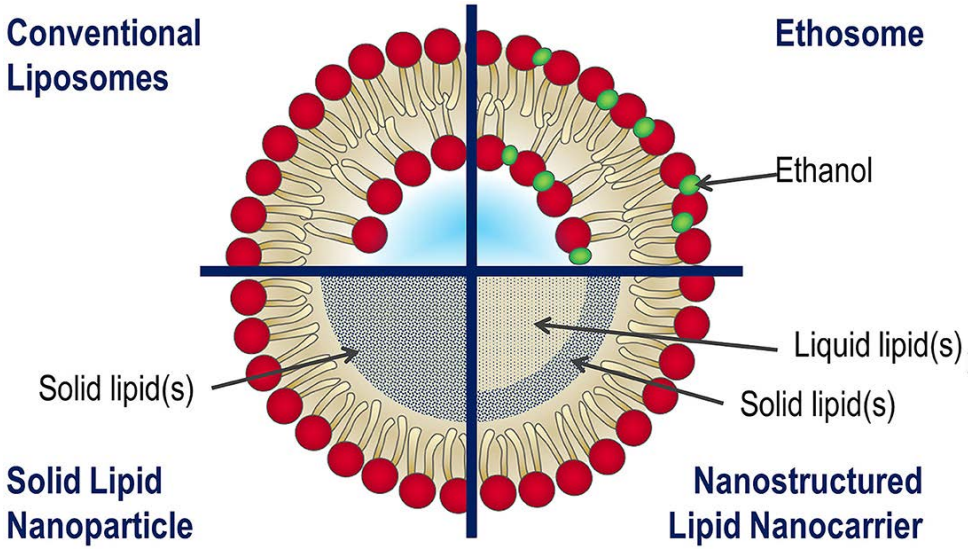
frontiers in Bioengineering and Biotechnology

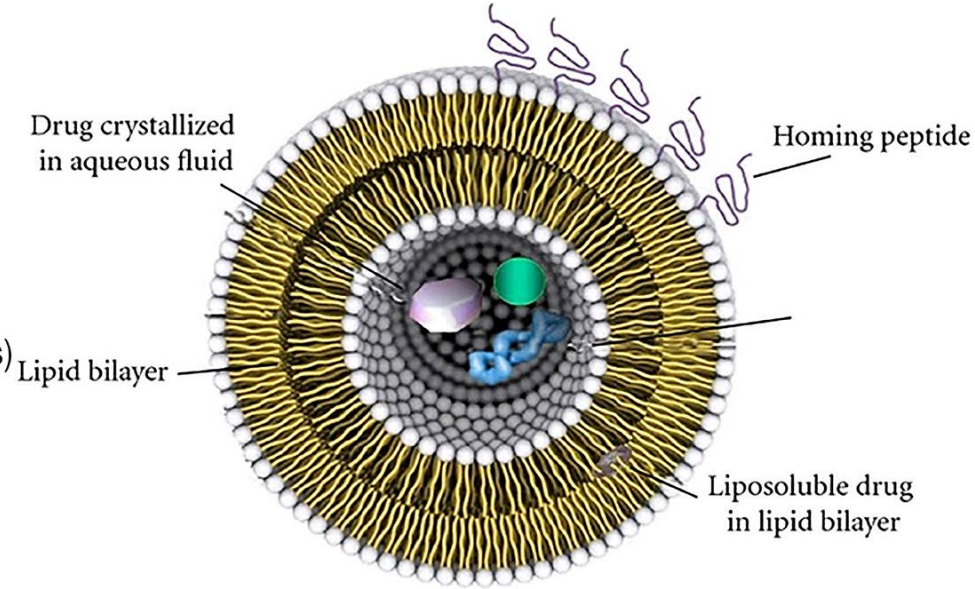
REVIEW
published: 26 October 2020
doi: 10.3389/fbioe.2020.566767

The New Frontiers in Neurodegenerative Diseases Treatment: Liposomal-Based Strategies

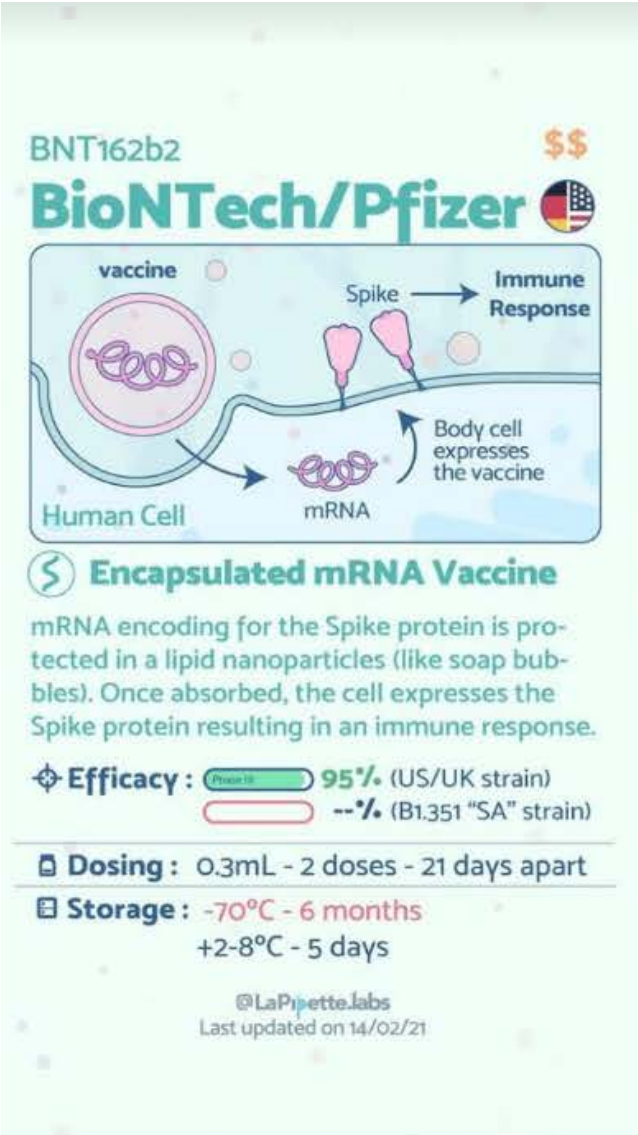
Mariafrancesca Cascione[1], Valeria De Matteis[1], Stefano Leporatti[2]* and Rosaria Rinaldi[1]*

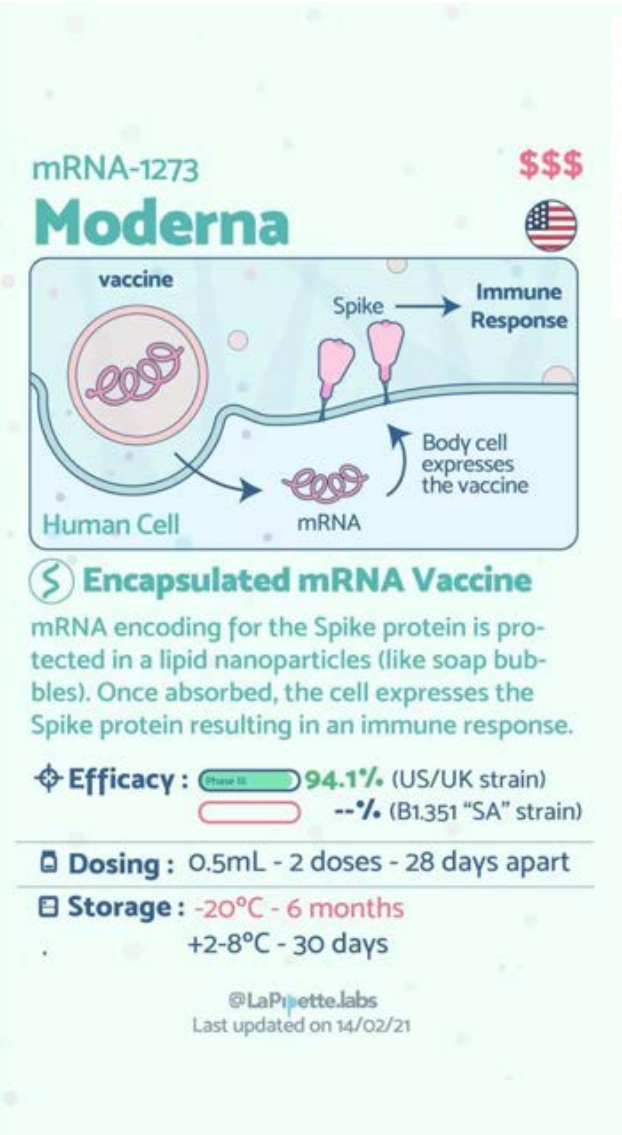
[1] Department of Mathematics and Physics "Ennio De Giorgi," University of Salento, Lecce, Italy, [2] National Research Council Nanotec Institute of Nanotechnology, Lecce, Italy

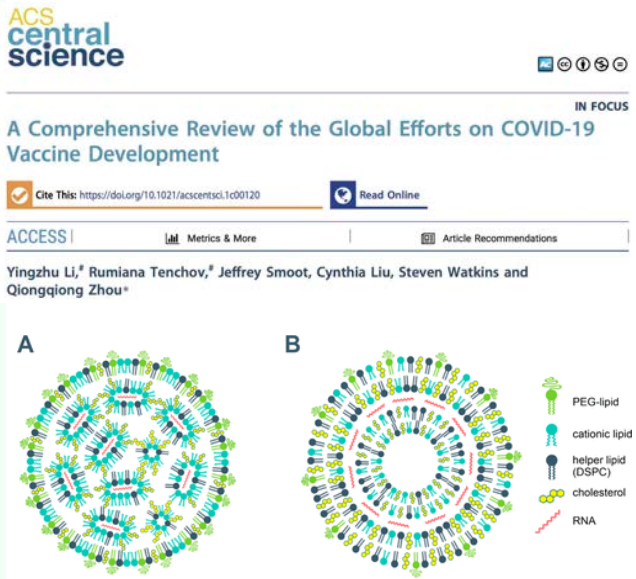




Solid Lipid Nanoparticles for mRNA Vaccines against COVID-19







Suggested structures of lipid nanoparticle vaccine carriers: mRNA organized in inverse lipid micelles inside the nanoparticle (A); mRNA intercalated between the lipid bilayers (B)

Credits: Lapipette.Labs

cancers

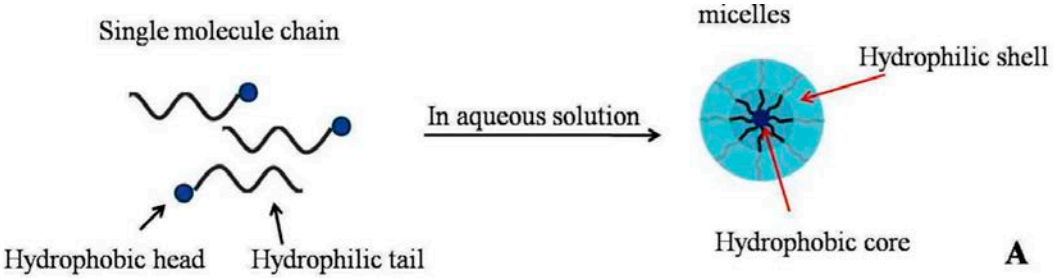
MDPI

Review

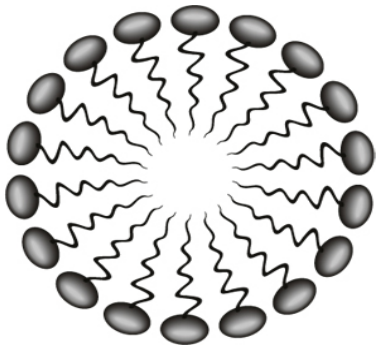
Micelles Structure Development as a Strategy to Improve Smart Cancer Therapy

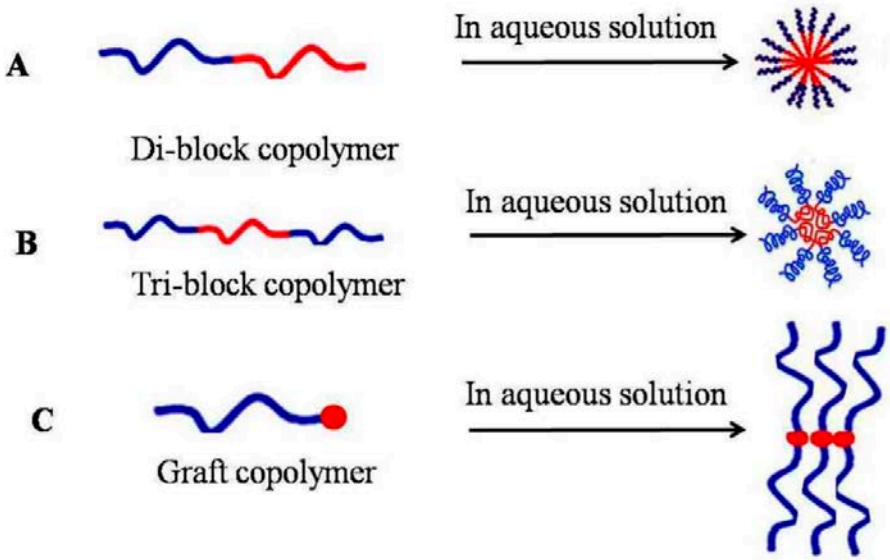
Nemany A. N. Hanafy [1,2], Maged El-Kemary [2] and Stefano Leporatti [3,*]

1 Sohag Cancer Center, Sohag 82511, Egypt; nemany.hanafy@nanotec.cnr.it
2 Institute of Nanoscience and Nanotechnology, Kafrelsheikh University, Kafrelsheikh 33516, Egypt; elkemary@sci.kfs.edu.eg
3 CNR NANOTEC-Istituto di Nanotecnologia, 73100 Lecce, Italy
* Correspondence: stefano.leporatti@nanotec.cnr.it; Tel.: +39-083-231-9829



Scheme 1. Assembled micelles structure.





Scheme 2. Polymer micelle structures.

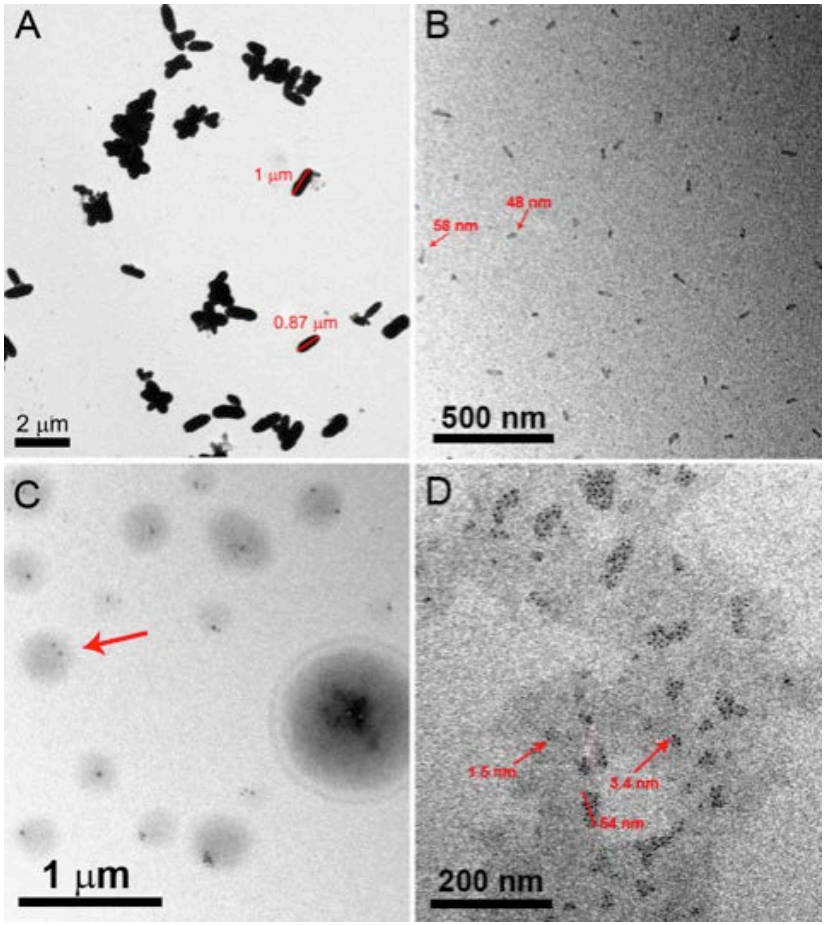
Cancers **2018**, *10*, 238; doi:10.3390/cancers10070238

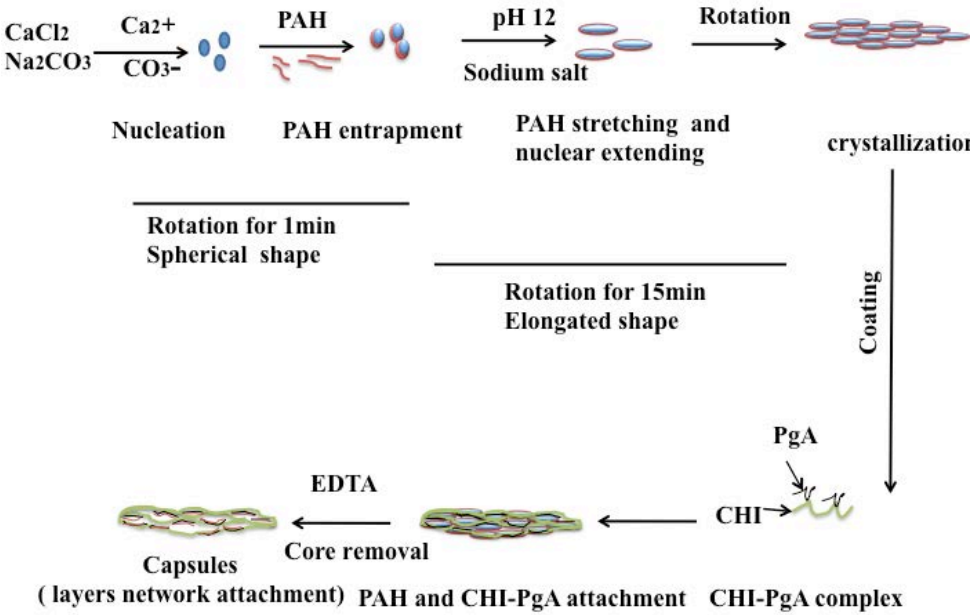
AMERICAN SCIENTIFIC PUBLISHERS

Science of Advanced Materials
Vol. 8, pp. 514–523, 2016
www.aspbs.com/sam

$CaCO_3$ Rods as Chitosan-Polygalacturonic Acid Carriers for Bromopyruvic Acid Delivery

Nemany A. N. Hanafy[1,2], Maria Luisa De Giorgi[2], Concetta Nobile[1], Mariafrancesca Cascione[2], Ross Rinaldi[2], and Stefano Leporatti[1,*]





BENI-SUEF UNIVERSITY JOURNAL OF BASIC AND APPLIED SCIENCES 4 (2015) 60–70

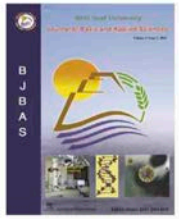
HOSTED BY

ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect

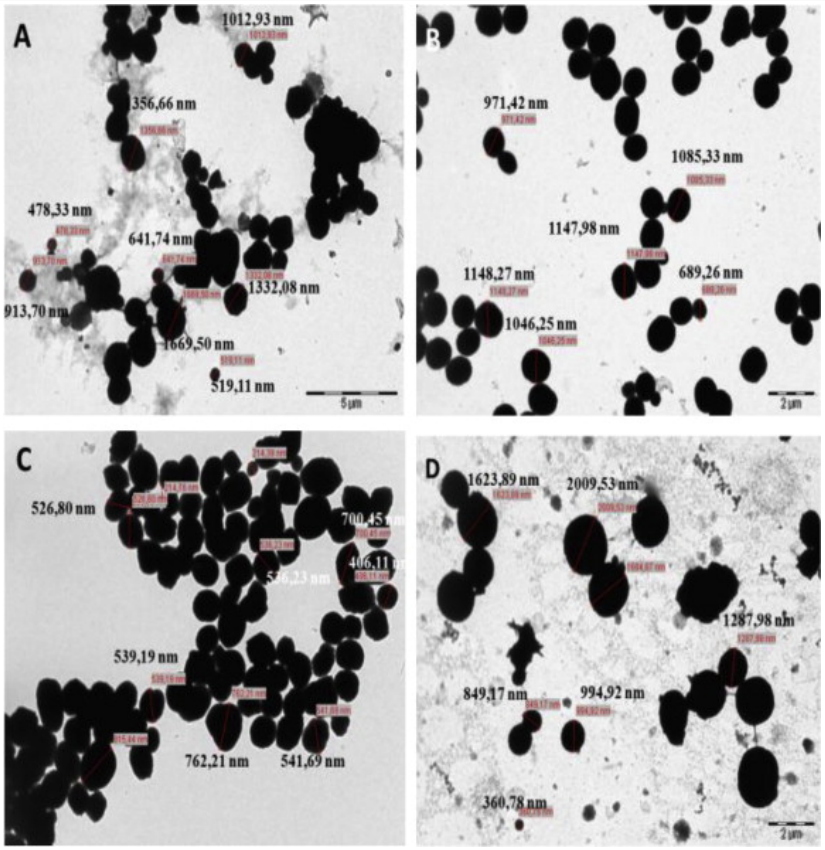
journal homepage: www.elsevier.com/locate/bjbas

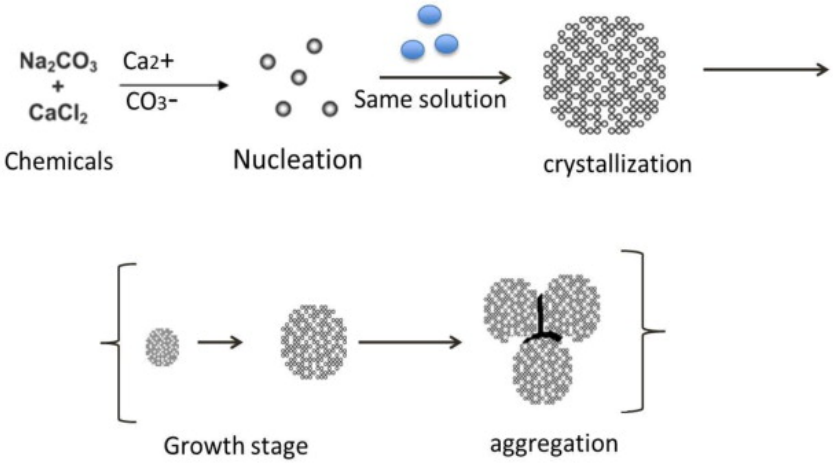


Full Length Article

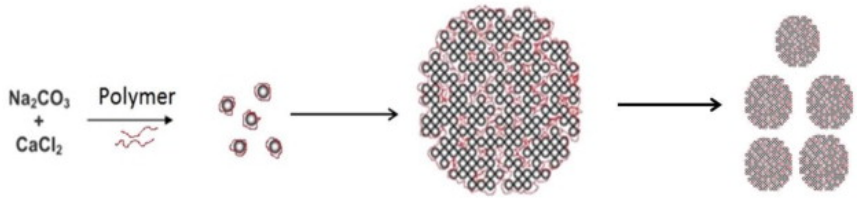
Control of colloidal $CaCO_3$ suspension by using biodegradable polymers during fabrication

Nemany Abdelhamid Nemany Hanafy [a,b], *Maria Luisa De Giorgi* [b], *Concetta Nobile* [a], *Ross Rinaldi* [a], *Stefano Leporatti* [a,*]





Scheme A



Scheme B

J Mater Sci: Mater Med (2017)28:120
DOI 10.1007/s10856-017-5930-7

CrossMark

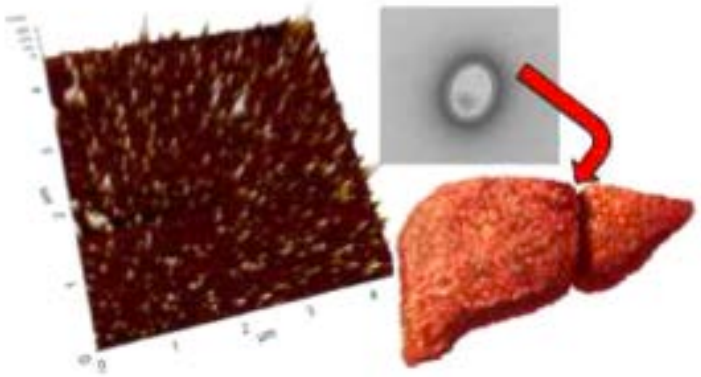
DELIVERY SYSTEMS

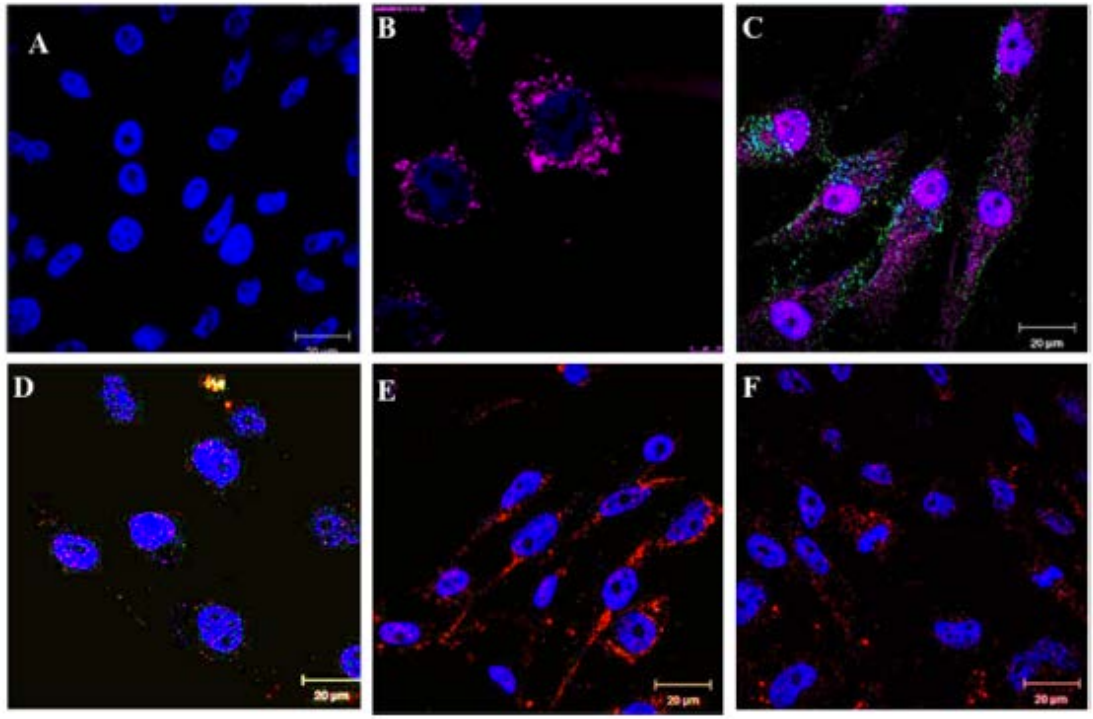
Original Research

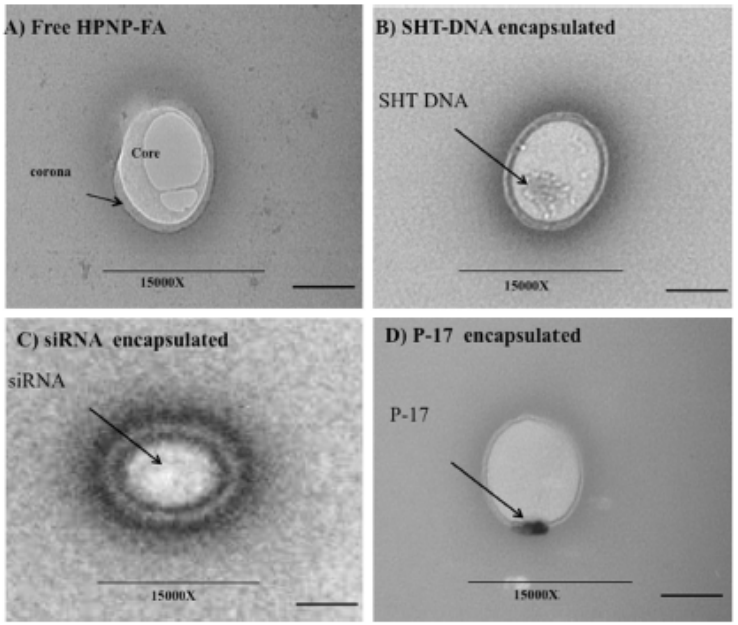
Hybrid polymeric-protein nano-carriers (HPPNC) for targeted delivery of TGFβ inhibitors to hepatocellular carcinoma cells

Nemany A. N. Hanafy[1,2] · Alessandra Quarta[1] · Riccardo Di Corato[3] · Luciana Dini[4] · Concetta Nobile[1] · Vittorianna Tasco[1] · Sonia Carallo[1] · Mariafrancesca Cascione[2] · Andrea Malfettone[5] · Jitka Soukupova[5] · Rosaria Rinaldi[2] · Isabel Fabregat[5] · Stefano Leporatti[1]

Graphical Abstract A novel fabrication of Hybrid Polymeric-Protein Nano-Carriers (HPPNC) for delivering TGF β1 inhibitors to HCC cells has been developed. SHT-DNA, siRNA and P-17 have been successfully encapsulated. TGF β1 inhibitors-loaded HPPNC were efficiently uptaken by HLF cells.







CNR NANOTEC ISTITUTO DI NANOTECNOLOGIA

TGF-β IT-LIVER MARIE CURIE - ITN

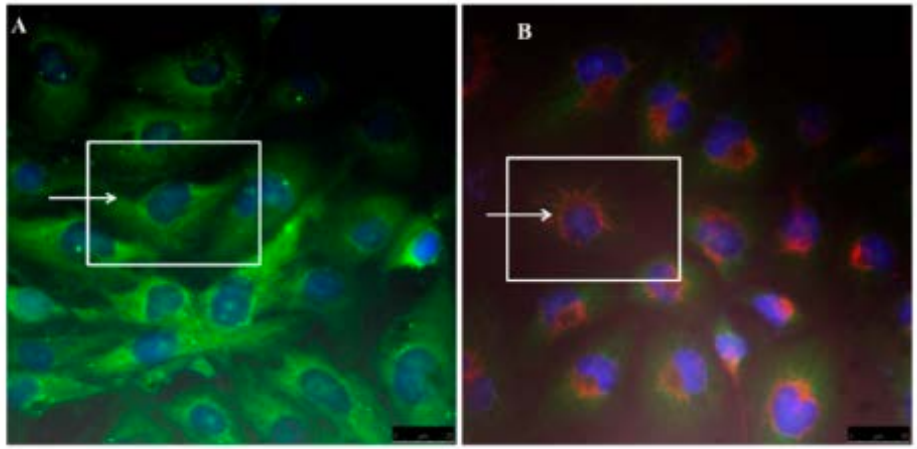
International Journal of
Molecular Sciences

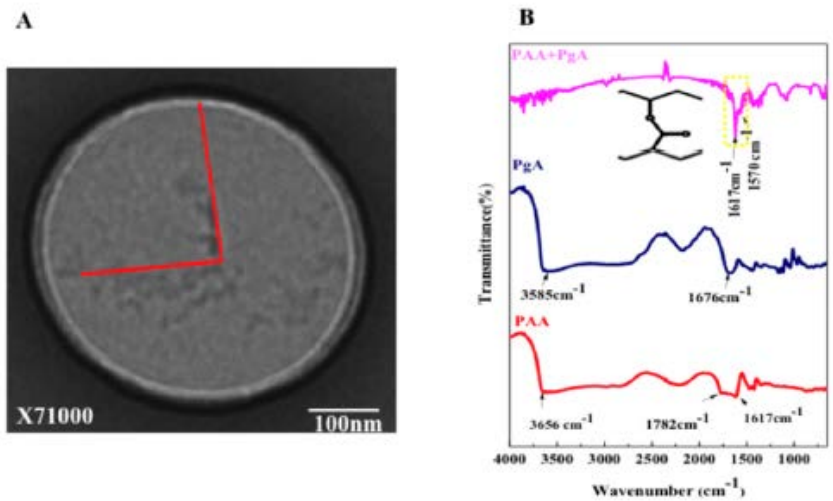
MDPI

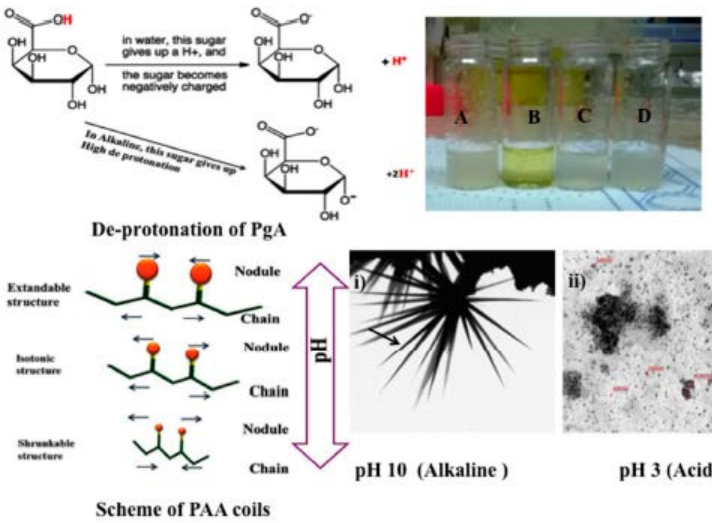
Article

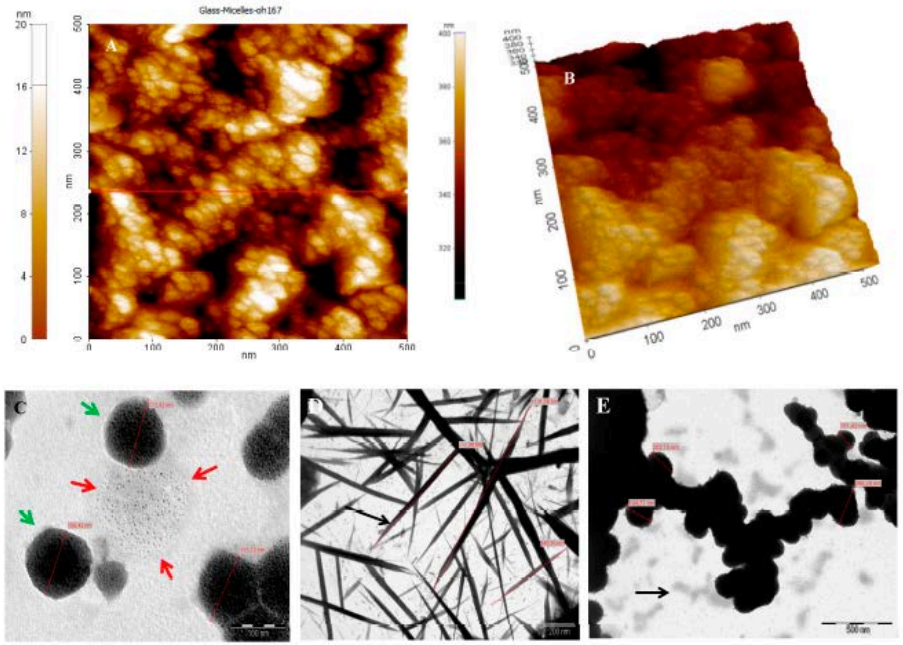
Polymeric Nano-Micelles as Novel Cargo-Carriers for LY2157299 Liver Cancer Cells Delivery

Nemany Abdelhamid Nemany Hanafy [1,2,†], Alessandra Quarta [1], Marzia Maria Ferraro [3], Luciana Dini [3], Concetta Nobile [1], Maria Luisa De Giorgi [2], Sonia Carallo [1], Cinzia Citti [1,3], Antonio Gaballo [1], Giuseppe Cannazza [4], Rosaria Rinaldi [2], Gianluigi Giannelli [5] and Stefano Leporatti [1,*]









Int. J. Mol. Sci. **2018**, *19*, 748; doi:10.3390/ijms19030748

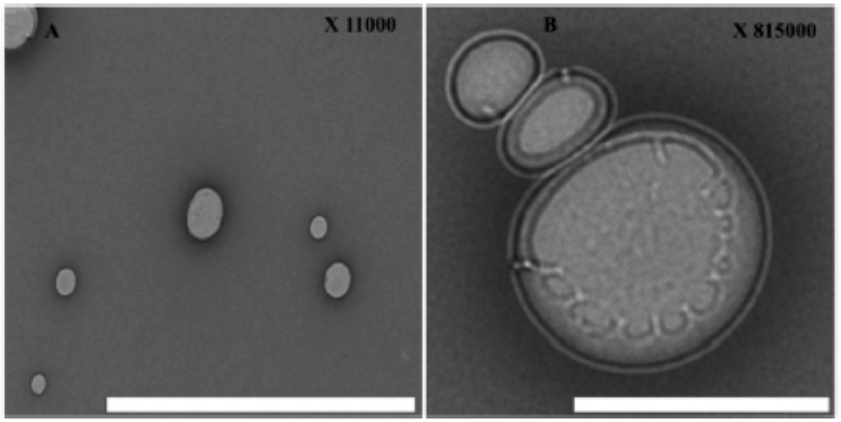
nanomaterials

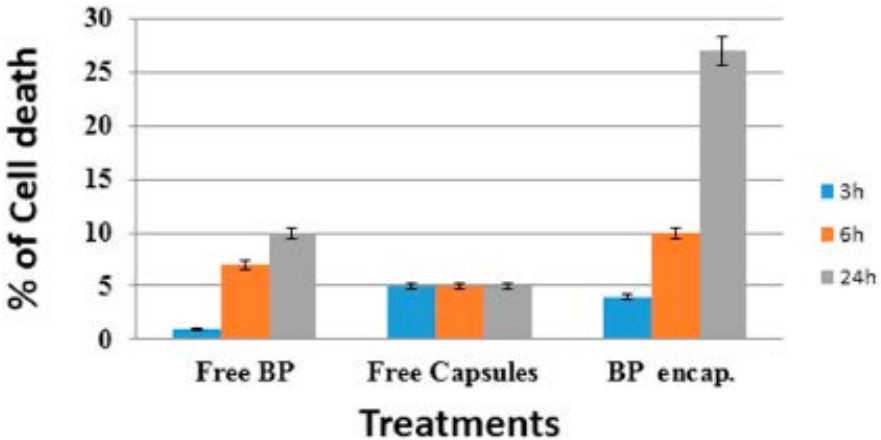
MDPI

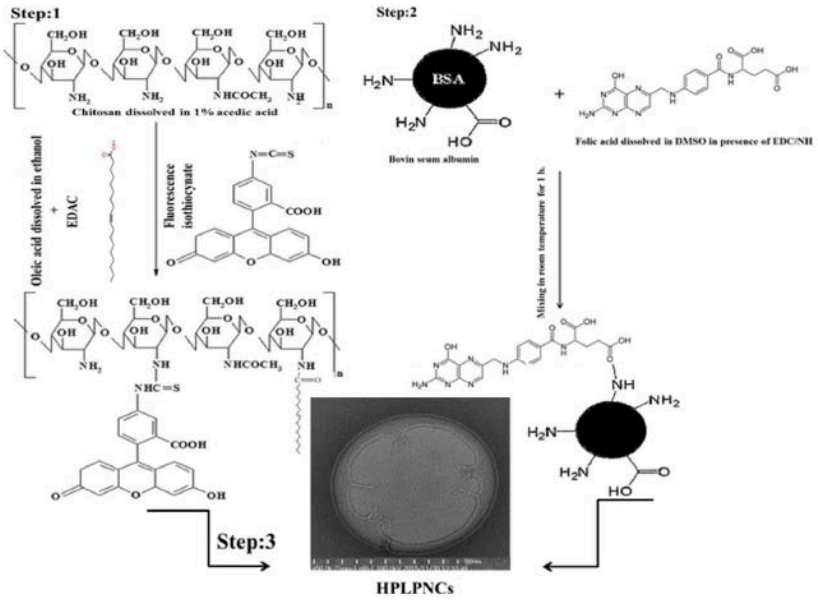
Communication

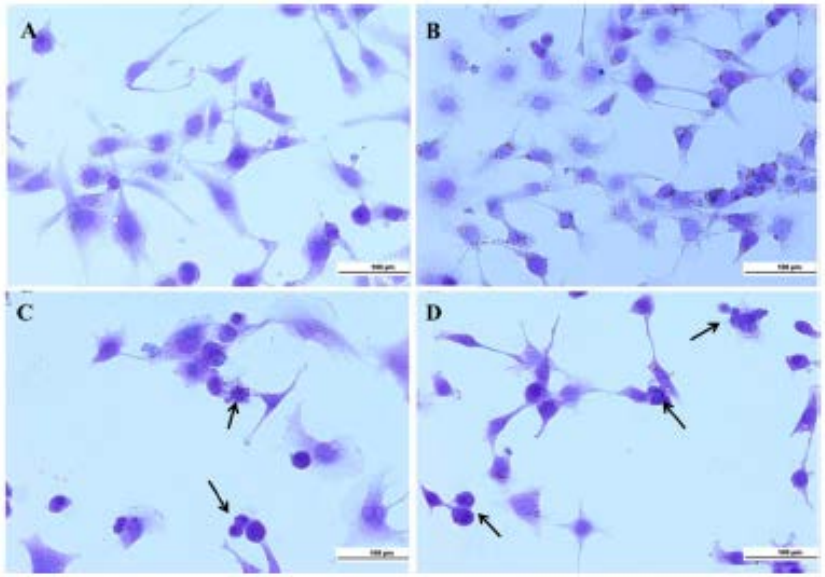
Inihibition of Glycolysis by Using a Micro/Nano-Lipid Bromopyruvic Chitosan Carrier as a Promising Tool to Improve Treatment of Hepatocellular Carcinoma

Nemany A. Hanafy [1,2,†,‡], Luciana Dini [3], Cinzia Citti [1,3], Giuseppe Cannazza [3,4] and Stefano Leporatti [1,*]









Nanomaterials 2018, *8*, 34; doi:10.3390/nano8010034

CNR NANOTEC
ISTITUTO DI NANOTECNOLOGIA

International Journal of Nanomedicine

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Conjugation Of EGCG And Chitosan NPs As A Novel Nano-Drug Delivery System

This article was published in the following Dove Press journal:
International Journal of Nanomedicine

Abdel-Majeed Safer [1]
Stefano Leporatti [2]
Jacquilion Jose [3]
Mahmoud S Soliman [4]

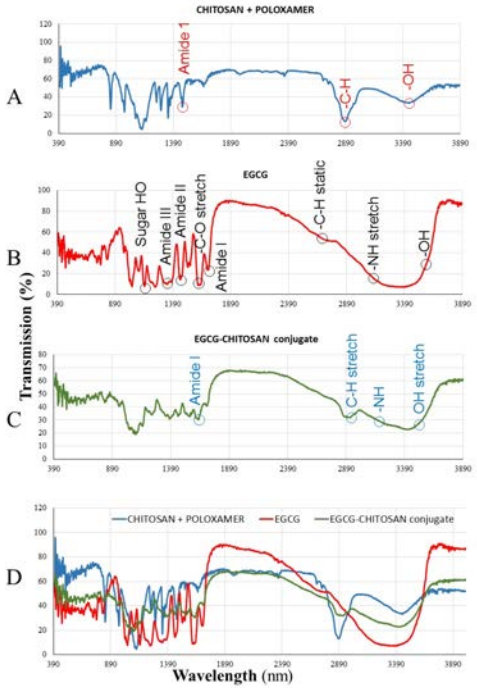
[1]Department of Biological Sciences, Faculty of Science, Kuwait University, Kuwait City, Kuwait; [2]CNR Nanotec, Istituto di Nanotecnologia, Lecce 73100, Italy; [3]Nanoscopy Science Center, Faculty of Science, Kuwait University, Kuwait City, Kuwait; [4]Nanotechnology Research Facility, Faculty of Engineering and Petroleum, College of Engineering and Petroleum, Kuwait University, Kuwait City, Kuwait

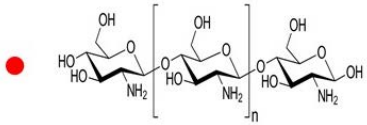
Purpose: Chitosan nanoparticles (CS NPs) have been used as a good vehicle for nano-drug delivery due to their good physicochemical properties. Epigallocatechin-3-gallate (EGCG), one of the major active ingredients of green tea, is a natural antioxidant that helps in reducing and preventing cell damage and fighting cancer, plus providing other benefits. The aim of this study is to optimise the preparation parameters in terms of the physical characteristics and stability in CS/EGCG NPs conjugation.

Results: The conjugation of CS/EGCGNPs was obtained by means of Poloxamer 188. The average CS/EGCG NPs complex was of size 117.8±38.71nm with a surface charge of +67.8 ±4.38mV and isoelectric point at pH 7.61.

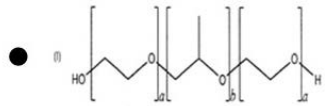
Conclusion: In conclusion, NPs produced were stable at 4°C with nanometric size, good polydispersity, good loading and efficiency, envisaging to be a possible candidate for nano-therapeutic delivery system against hepatic fibrosis.

Keywords: chitosan, EGCG, conjugation, nano-drug delivery

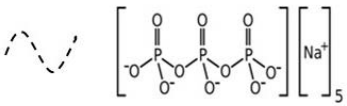




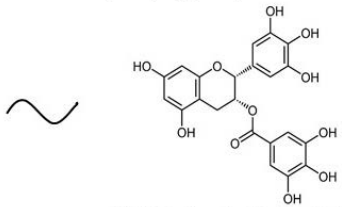
A) Chitosan



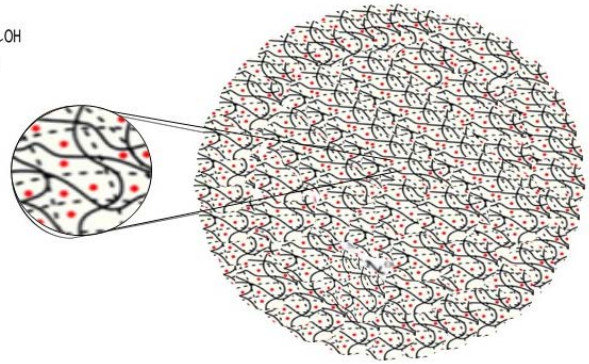
B) Poloxamer 188



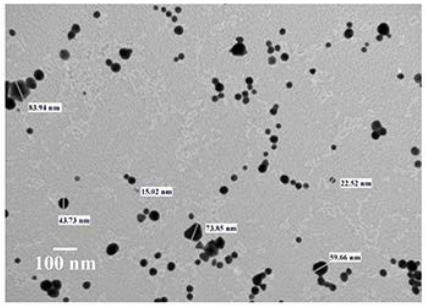
C) Tripolyphosphat TPP



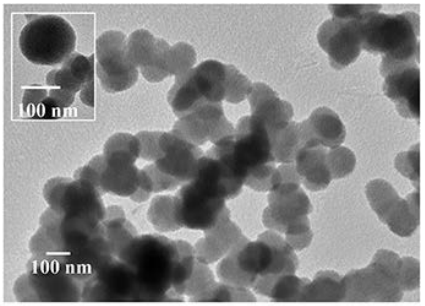
D) Epigallocatechin-3-gallate



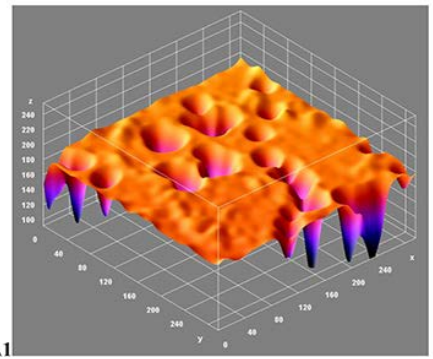
E) EGCG-Chitosan Conjugate



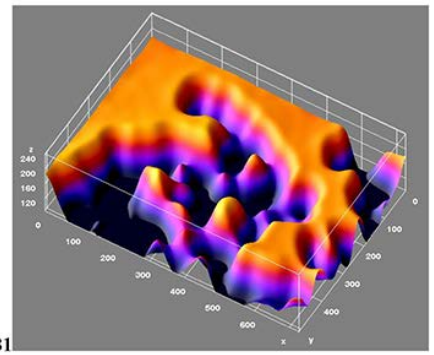
A



B



A1



B1

IOP Publishing Nano Express 2 (2021) 012006 https://doi.org/10.1088/2632-959X/abeb4b

NANO EXPRESS

CrossMark

OPEN ACCESS

RECEIVED
30 December 2020

REVISED
22 February 2021

ACCEPTED FOR PUBLICATION
2 March 2021

PUBLISHED
18 March 2021

TOPICAL REVIEW

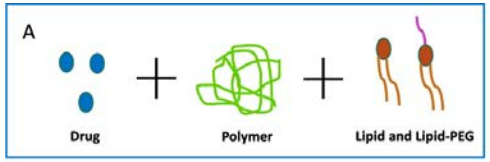
Lipid-polymer hybrid nanoparticles in cancer therapy: current overview and future directions

Francesca Persano[1,2], Giuseppe Gigli[1,2] and Stefano Leporatti[2]

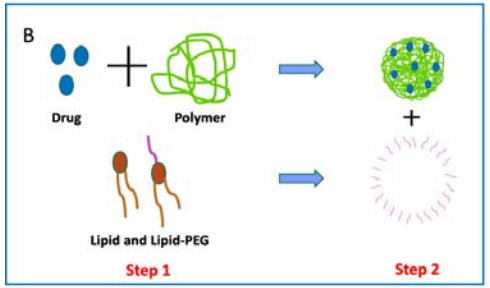
[1] University of Salento, Department of Mathematics and Physics, Via Per Arnesano 73100, Lecce, Italy
[2] CNR Nanotec-Istituto di Nanotecnologia, Via Monteroni 73100, Lecce, Italy

E-mail: stefano.leporatti@nanotec.cnr.it

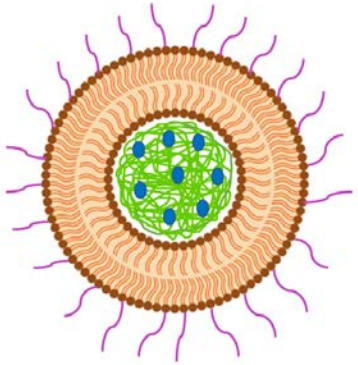
Keywords: hybrid nanosystem, lipid-polymer hybrid nanoparticle, lipid shell, polymeric core, nanomedicine, cancer, drug delivery



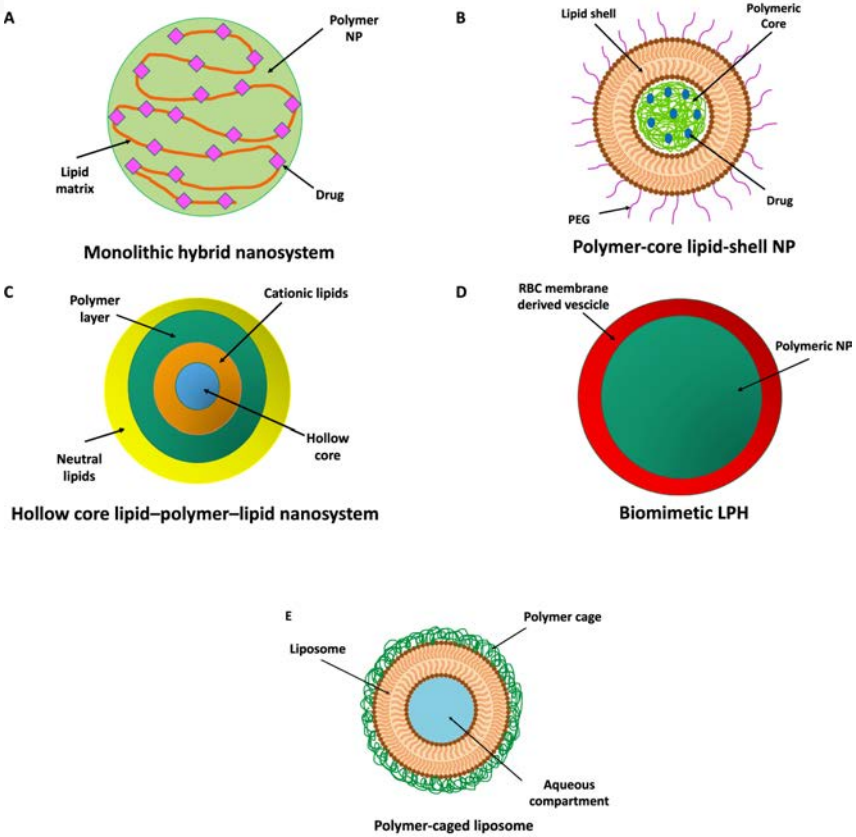
One-step method



Two-step method



LPHNPs



Conclusions and Prospectives

- Layer-by-Layer Polyelectrolyte Nano-Carriers are efficient nano-delivery tools to vehicle drugs to Cancer Cells
- Inorganic Nanoparticles are smart delivery systems that can be multi-fuctionalised to target tumoral and brain diseases
- Hybrid Nanocarriers are biocompatible weapons against neoplastic diseases
- Personalised Medicine through Nano-theranostic particles can be envisaged
- Nano-vaccines are already available against pandemic outbreaks

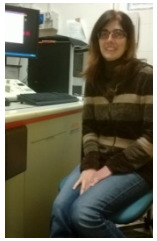
Team Work

Prof. Gianluigi Giannelli

Prof. Isabel Fabregat

Nemany Hanafy

Dr. Maria Luisa De Giorgi



Dr. Concetta Nobile

Dr. Alessandra Quarta

Prof. Luciana Dini

Serena Mancarella

Mariafrancesca Cascione

Dr. Antonio Gaballo

Prof. Rosaria RINALDI

Dr Luigi Carbone and Betty Perrone

First secondment @ Uni-Bari

Second secondment@IDIBELL Barcellona

Thank You for Your attention !!!