Nanotechnology at HIAST

Yomen Atassi, Professor
Director of research at HIAST

Introduction

1. Master in Materials Sciences & Engineering in 2008
    1. Polymer and composite materials,
    2. Ceramics and glasses,
    3. Metallurgy
2. Doctoral program in Materials Sciences & Engineering in 2013
3. Materials Science Engineering program in 2013

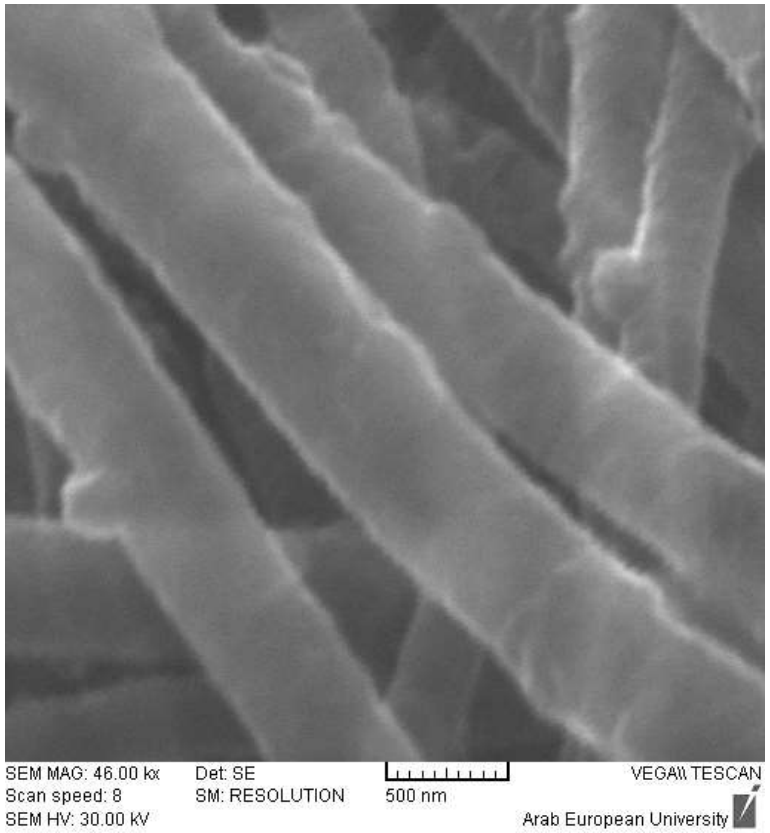
Nanoscience research according to their potential applications:

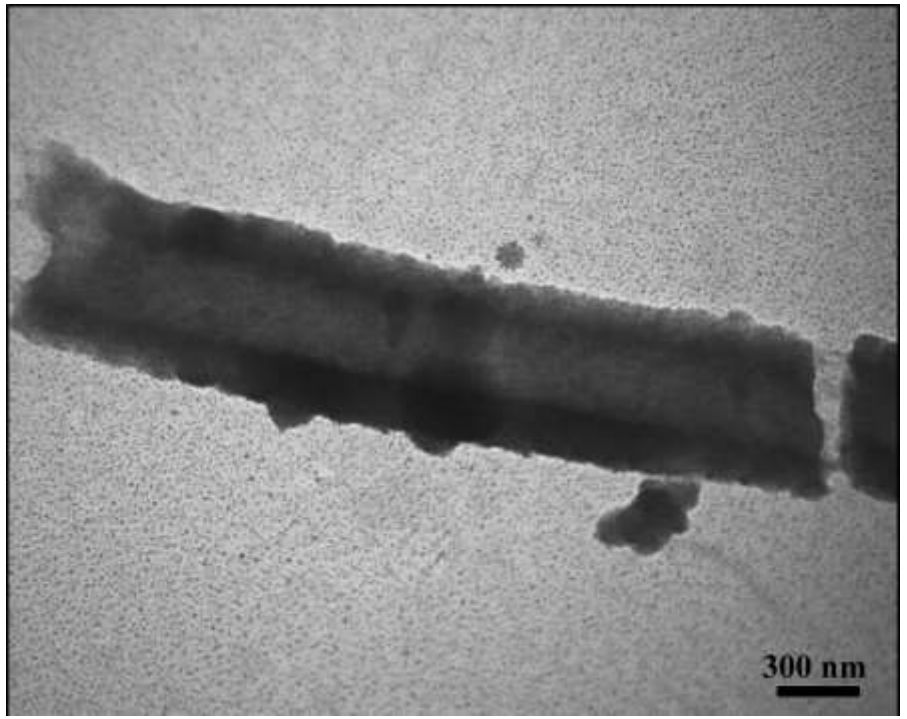
1. Environment
2. Agriculture
3. Pharmacy
4. Medicine
5. Technical Applications

Environmental Applications

1. Membrane for water filtration (Poster Session)
2. CQDs for detecting heavy metal ions in water (Poster Session)
3. Nanoferrites against EM pollution. (Poster Session, 2 posters)

1. Membranes for Water Filtration



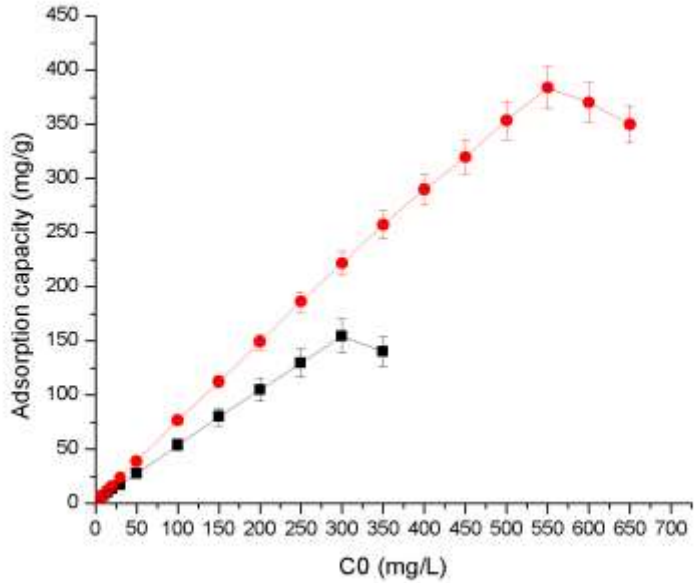


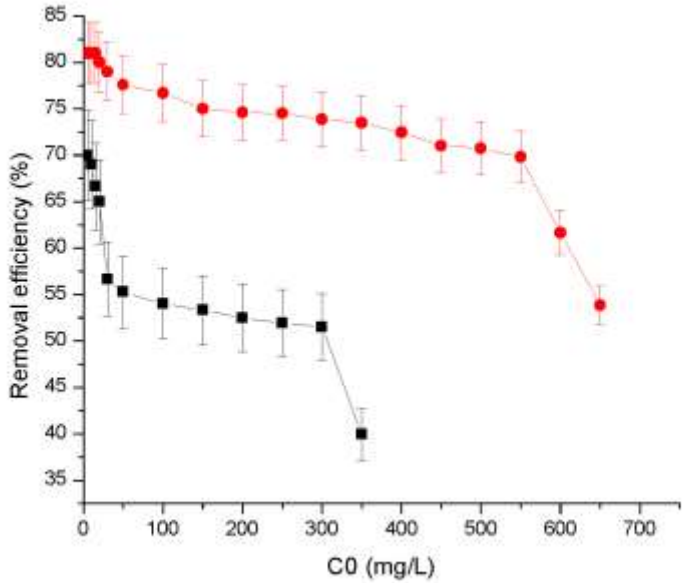
SEM and TEM micrographs of pTSA-PANI/PLLA nanofiber membranes

Environmental Science and Pollution Research, 2019, DOI 10.1007/s11356-019-06654-1

1. Membranes for Water Filtration

pTSA-PANI/PLLA nanofiber membranes for methyl orange adsorption

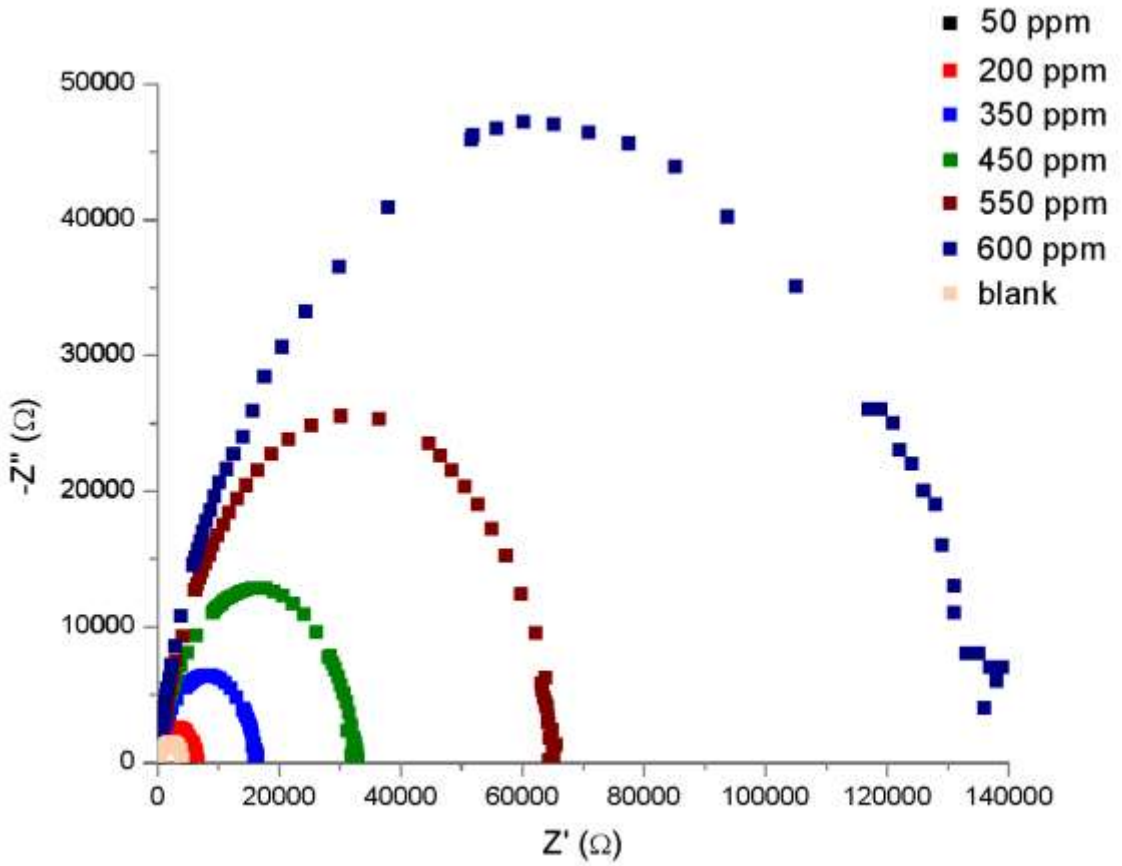




■PLLA and ●pTSA-PANI/PLLA mats

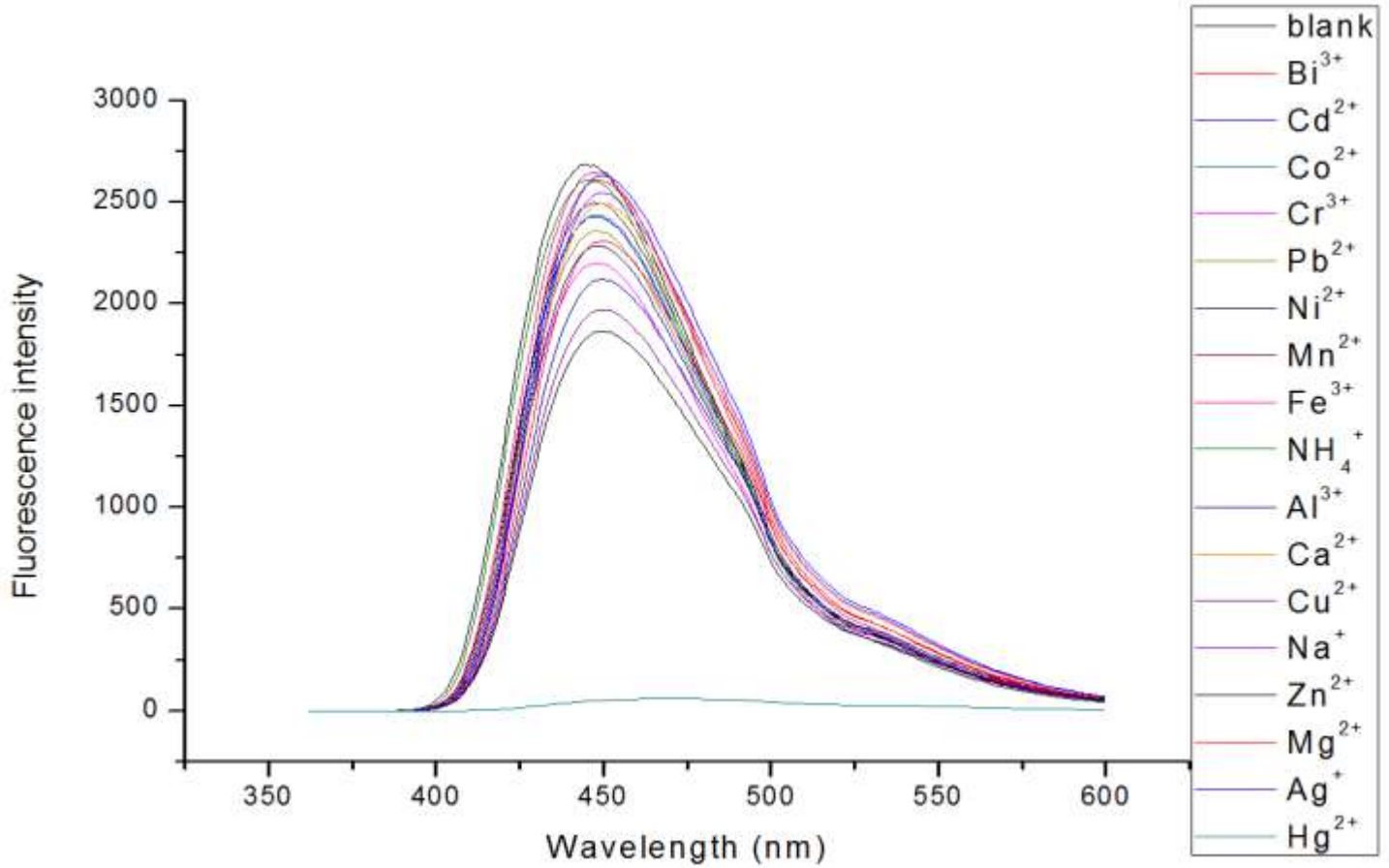
Environmental Science and Pollution Research, 2019, DOI 10.1007/s11356-019-06654-1

1. Membranes for Water Filtration



Environmental Science and Pollution Research, 2019, DOI 10.1007/s11356-019-06654-1

2. CQDs for detecting heavy metal ions in water



Environment

2. Detection of heavy metal ions in water using CQDs

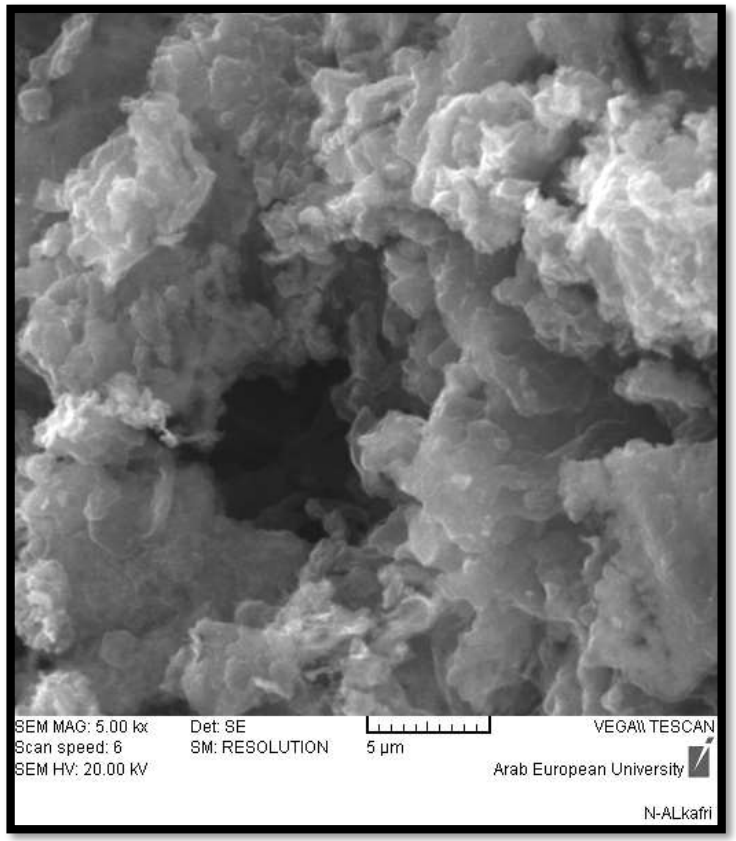
Detection of Hg(II) ions in water is based on the quenching of CQDs fluorescence:

Limit of detection 7.63 nM

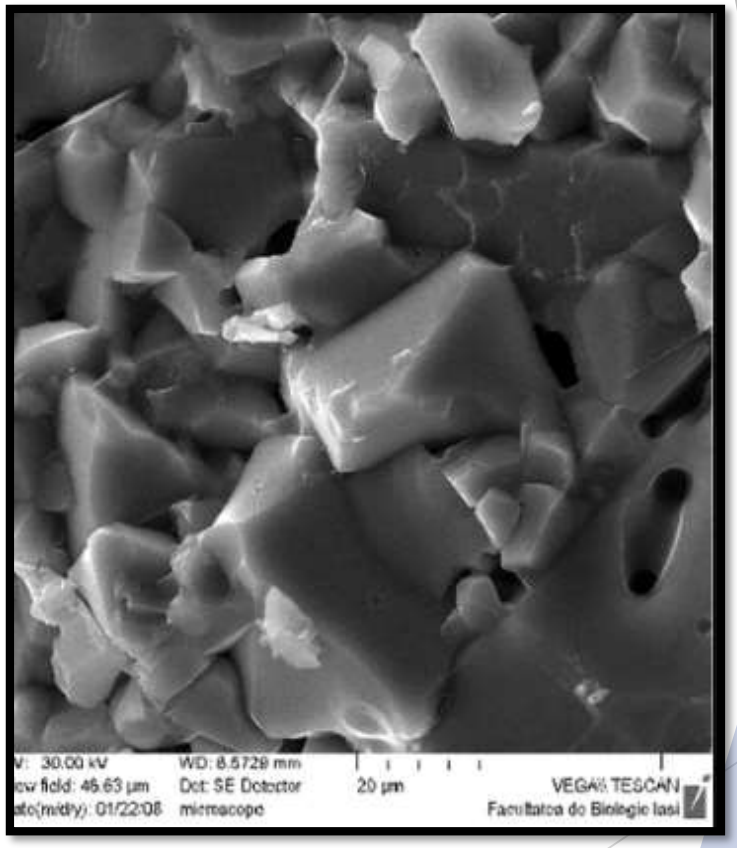
Linear range 0 – 4.2 µM

Accepted Heliyon, 2019

3. Nanoferrites against EM pollution



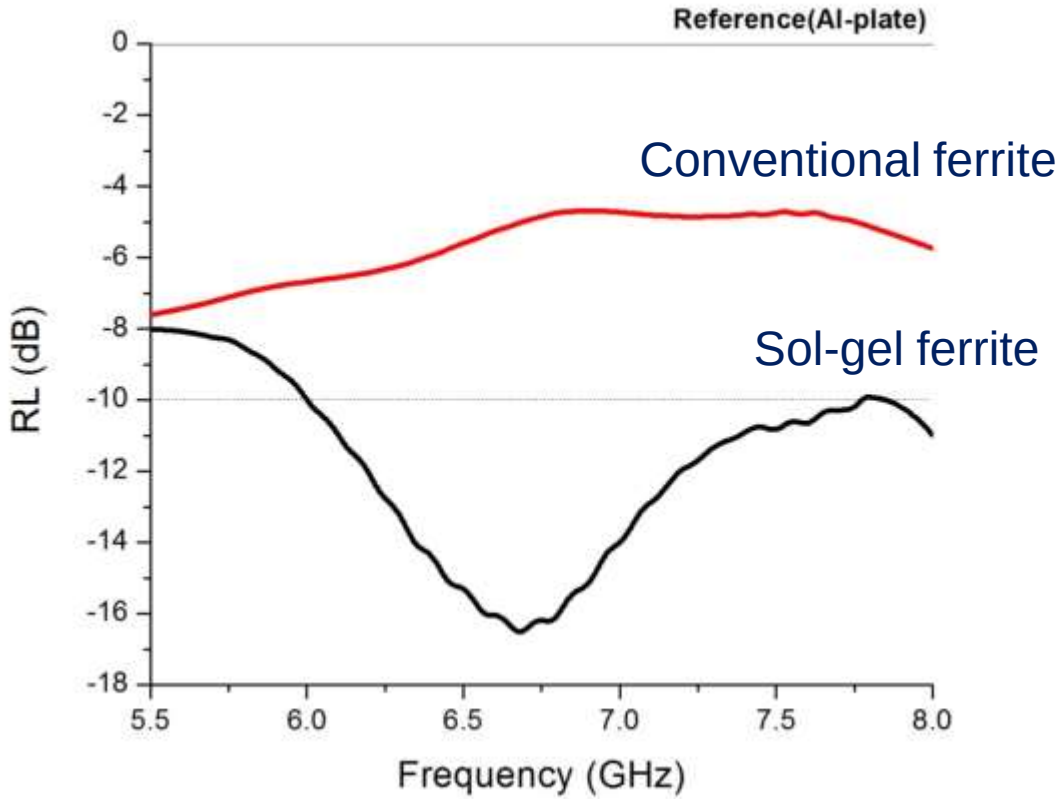
Sol-gel nanoferrite
118-135nm



Conventional ferrite
180-205 µm

Materials Chemistry and Physics 211 (2018) 79e87

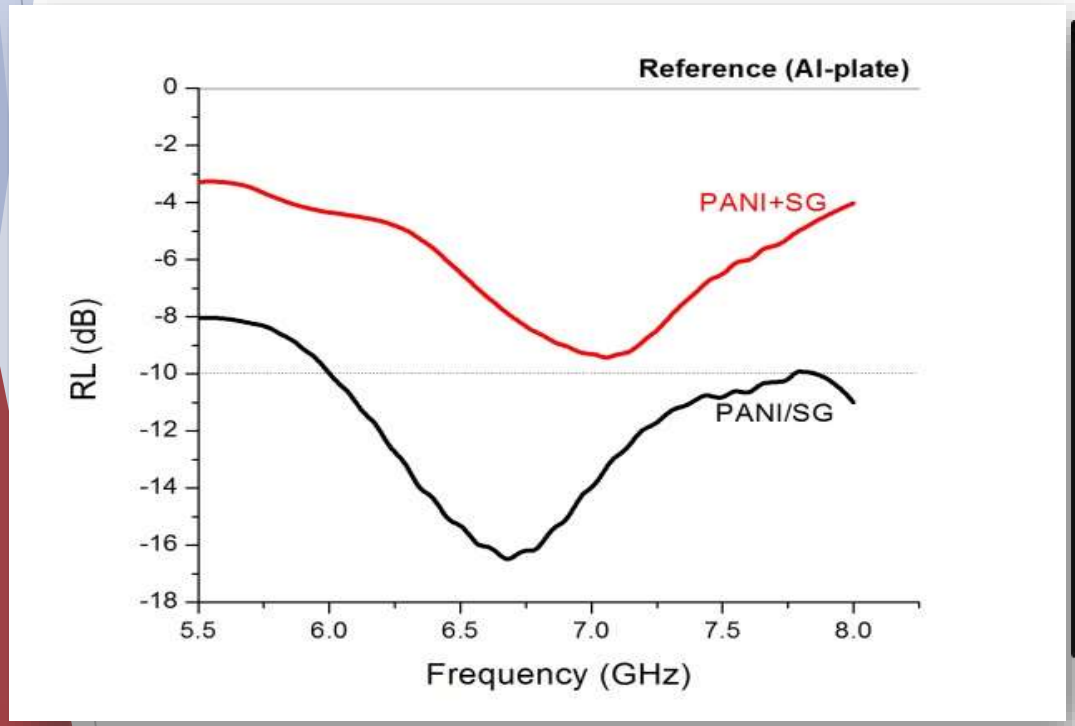
3. Nanoferrites against EM pollution

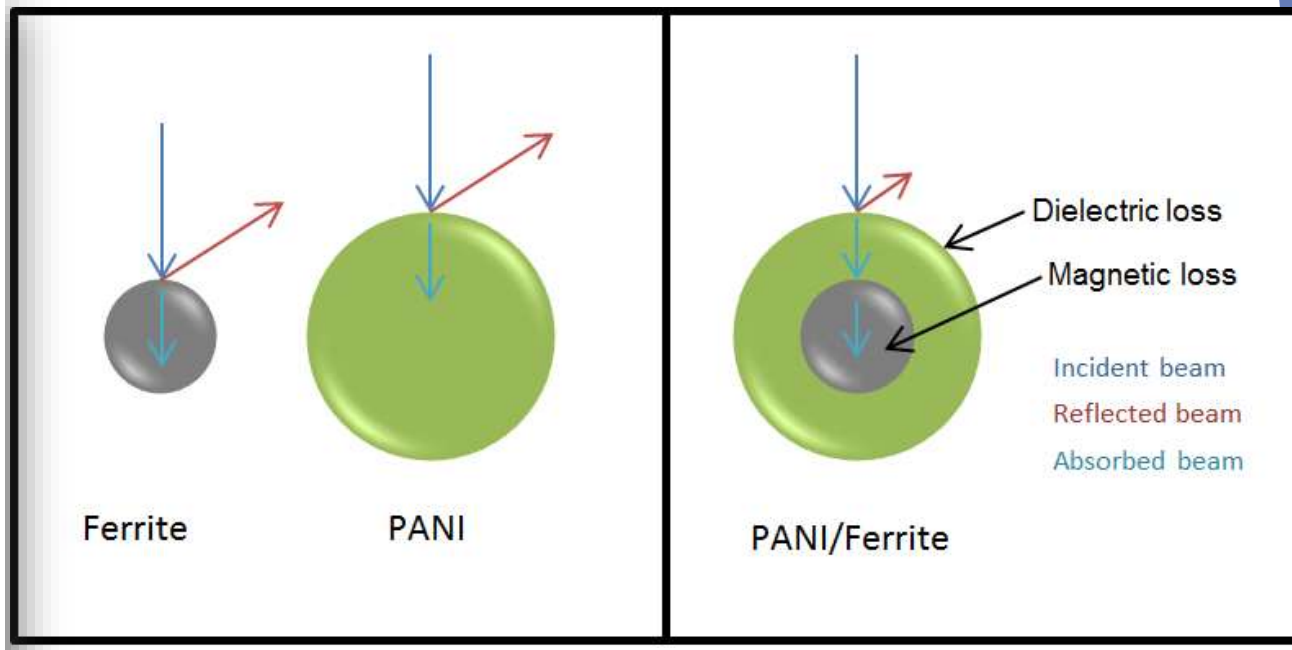


Journal of Magnetism and Magnetic Materials 453 (2018) 53–61

Density (kg/m^2)	B_W10 (GHz)	f_m (GHz)	RL (dB)	Loading (%)	Sample
5.8	1.77	6.68	-16.4	25	PANI/SG
4.1	0	-	-7.5	25	PANI/CON

3. Nanoferrites against EM pollution





J Mater Sci: Mater Electron, 2019
DOI 10.1007/s10854-019-01002-y

Agricultural Applications

Clay based hydrogel nanocomposites (soil remediation)

Advantages:

- Cost-effective hydrogel
- Better mechanical properties

Clay based hydrogel nanocomposites (soil remediation)

J Polym Environ (2018) 26:3937-3948

Polymer Science, Ser. B, 2015, Vol. 57, No. 6, pp. 750–758

Clay based hydrogel nanocomposites (soil remediation)

- Collaboration with GCSAR ministry of Agriculture,

Pharmaceutical/Medical Applications

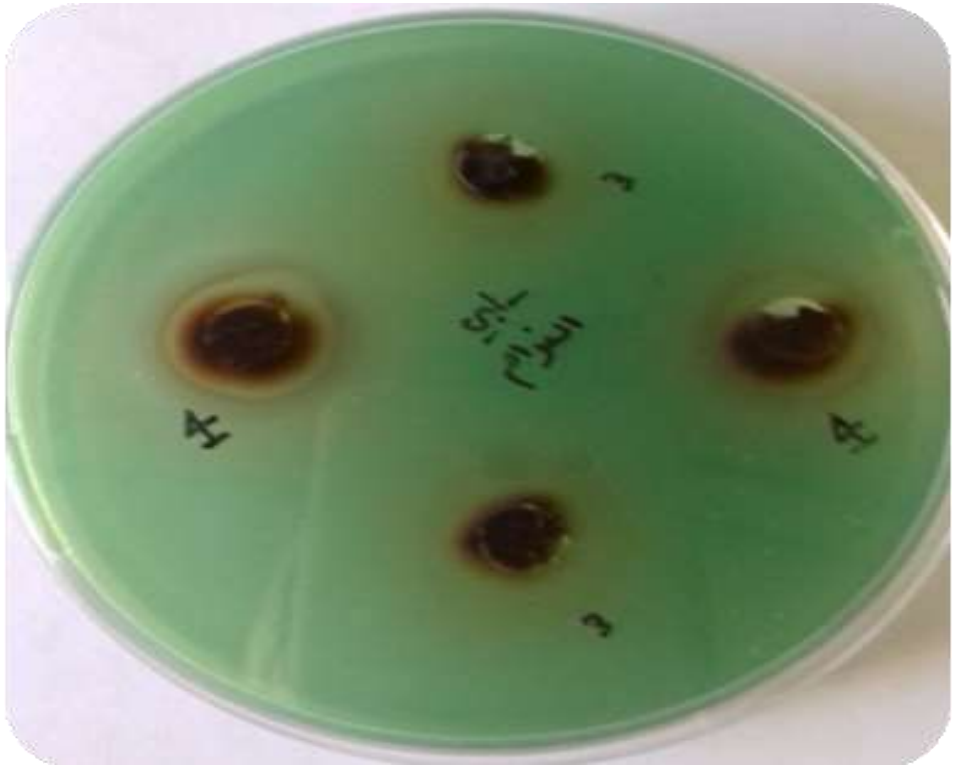
1. Nanosilver in hydrogels as bactericide
2. Scaffolds for tissue engineering (Poster Session)
3. Nanocomposite organogels/ Scaffolds/ PU foams for Hemostasis Applications (Poster Session, 2 Posters)
4. Drug delivery systems (Nanocubes, cubosomes, hexosomes)
5. CQDs for drug release monitoring (pharmacokinetics in vitro)

1.Nanosilver in hydrogels as bactericide

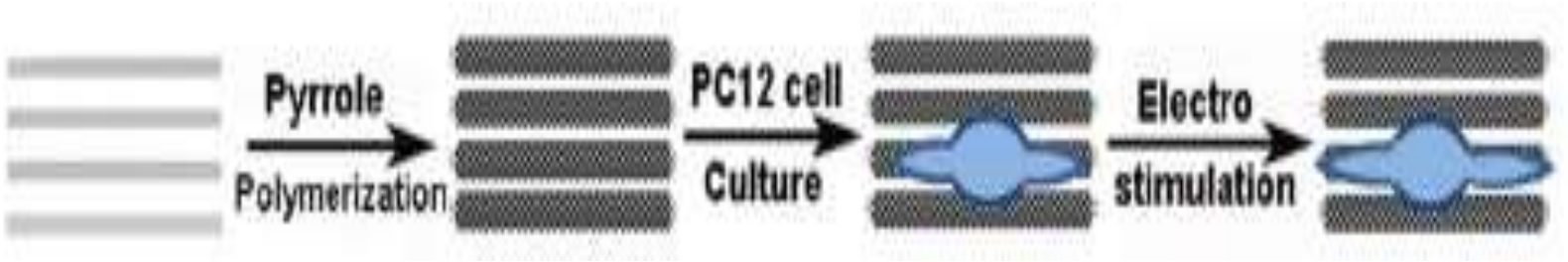
NANO SILVER ANTIBACTERIAL TECHNOLOGY

Pharmaceuticals

1.Nanosilver in hydrogels as bactericide



2. Scaffolds for Neural Tissue Engineering

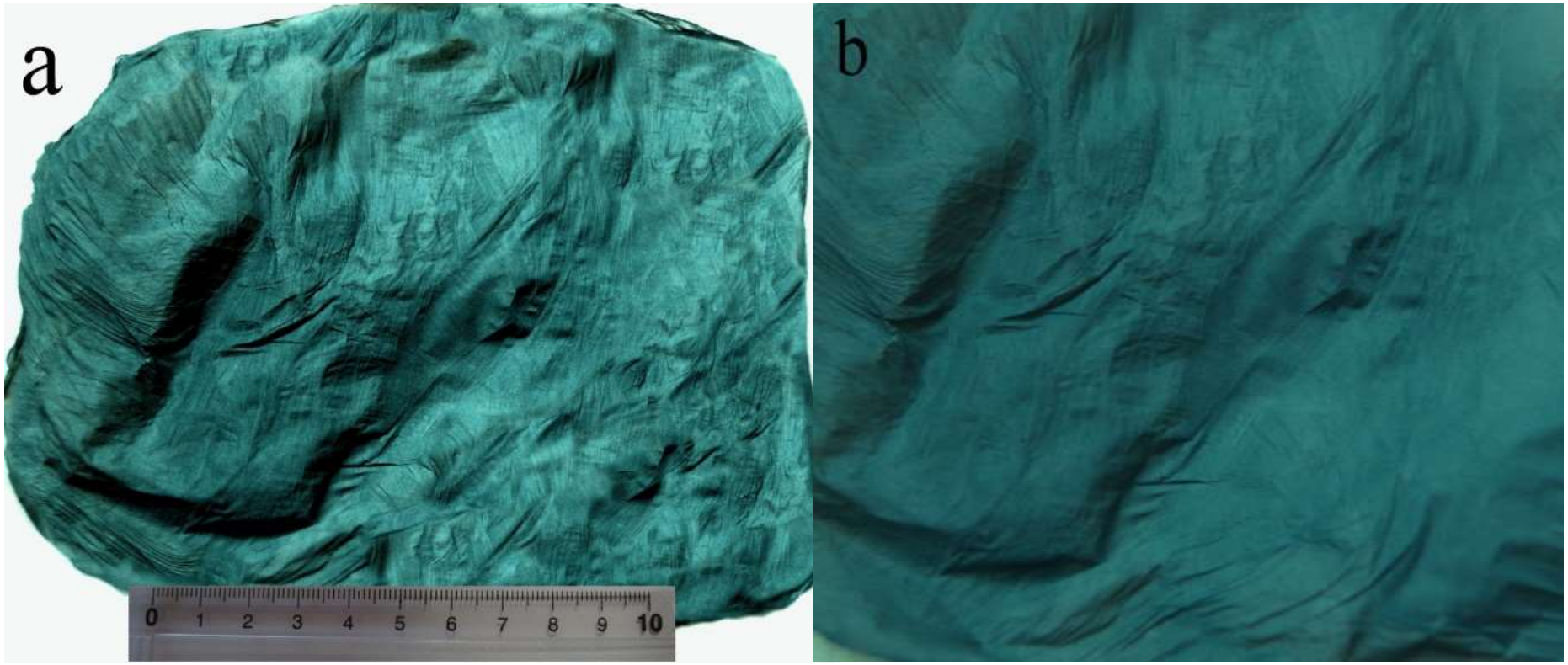


Aligned PPE scaffold (in-situ polymerisation) PPY @PFE fibers Cell Adhesion Neurite growth

Collaboration with MPIP-Mainz-Germany 2016

2. Scaffolds for Neural Tissue Engineering

Mat diameter: 18 cm, mat thickness: 90 µm



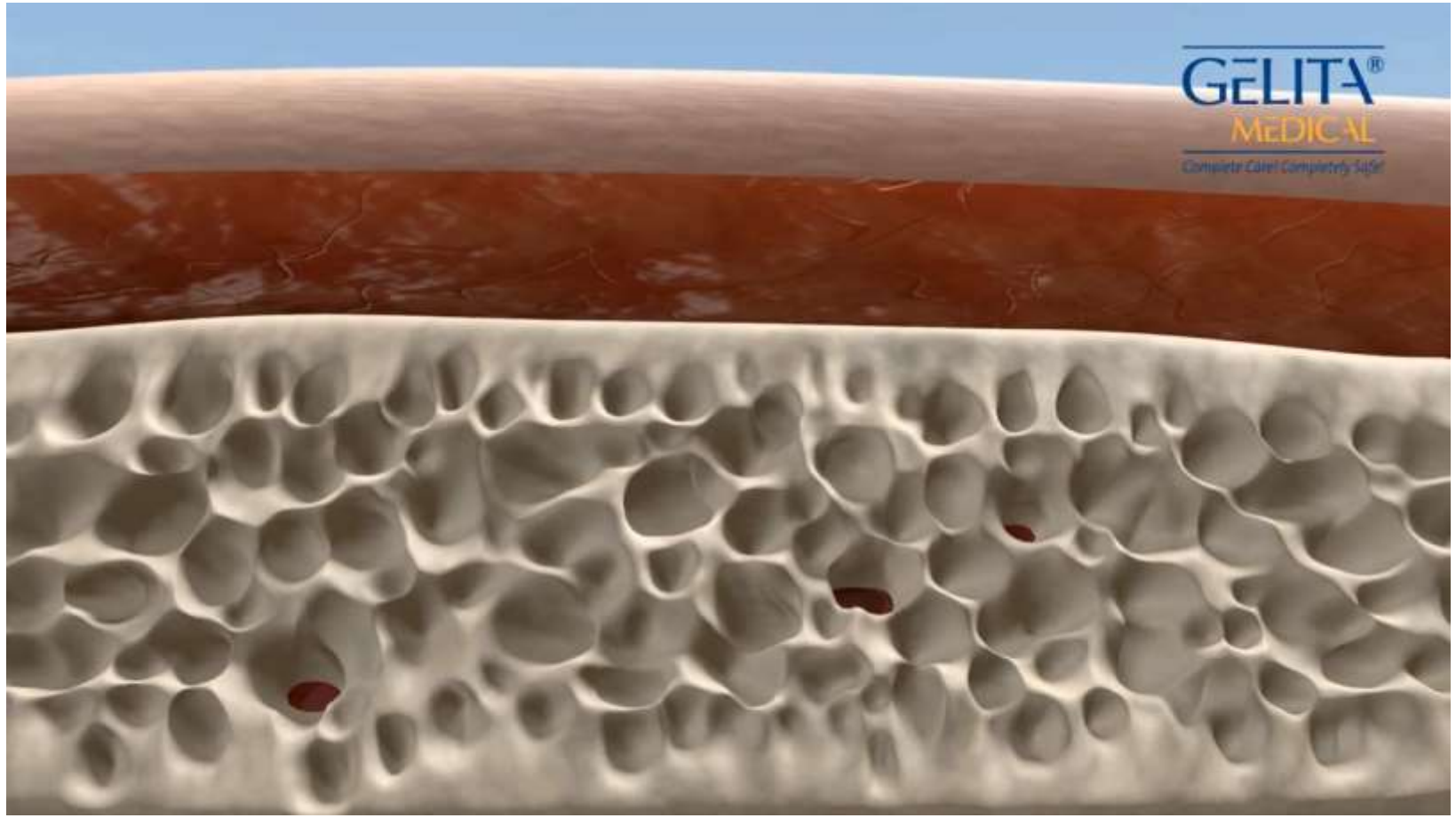
Mats from Spinnable solution of PANI:pTSA/PLLA

(a) Whole mat (b) Zoom in photo

J. Appl. Polym Sci. 133 (2016) 43687

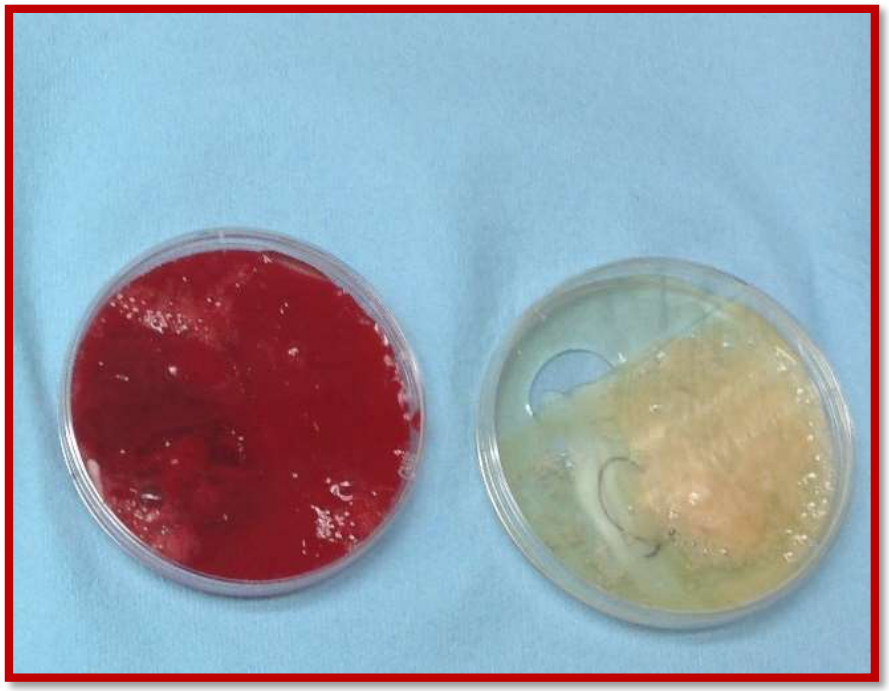
3. Nancomposites for Hemostasis

3. Organogel for Hemostasis



3. PU-foam for Hemostasis

3. Organogels for Hemostasis



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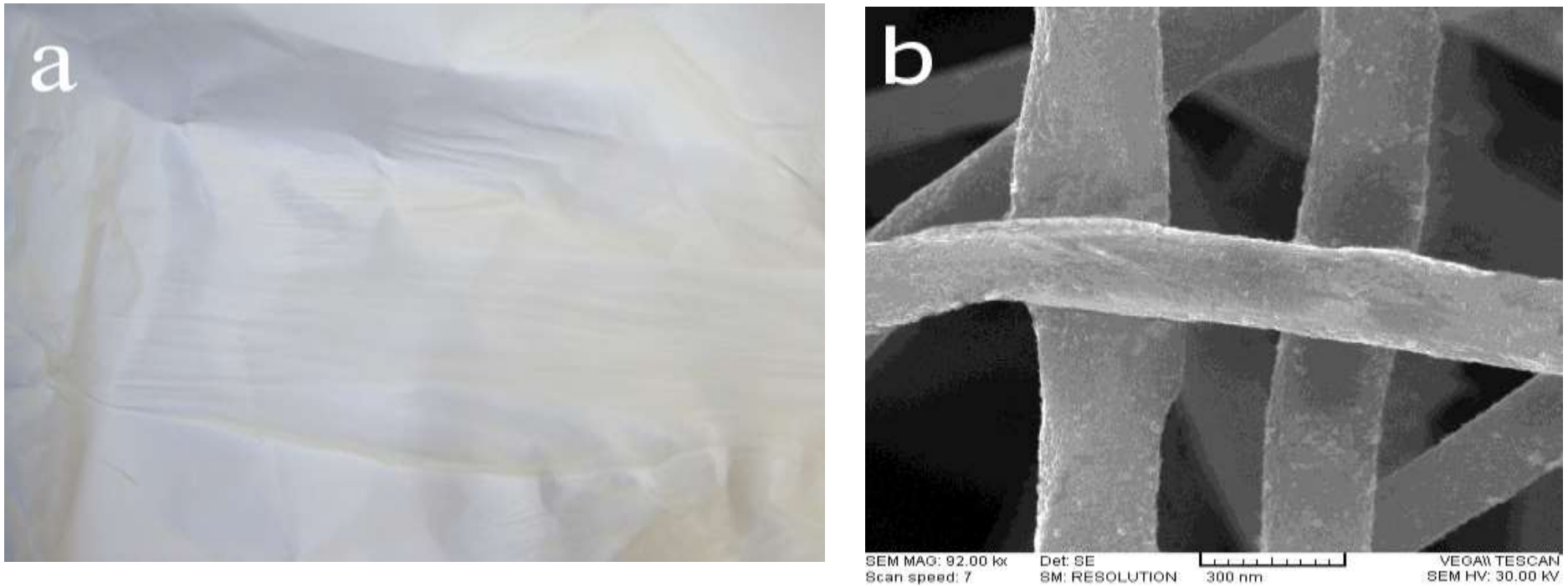
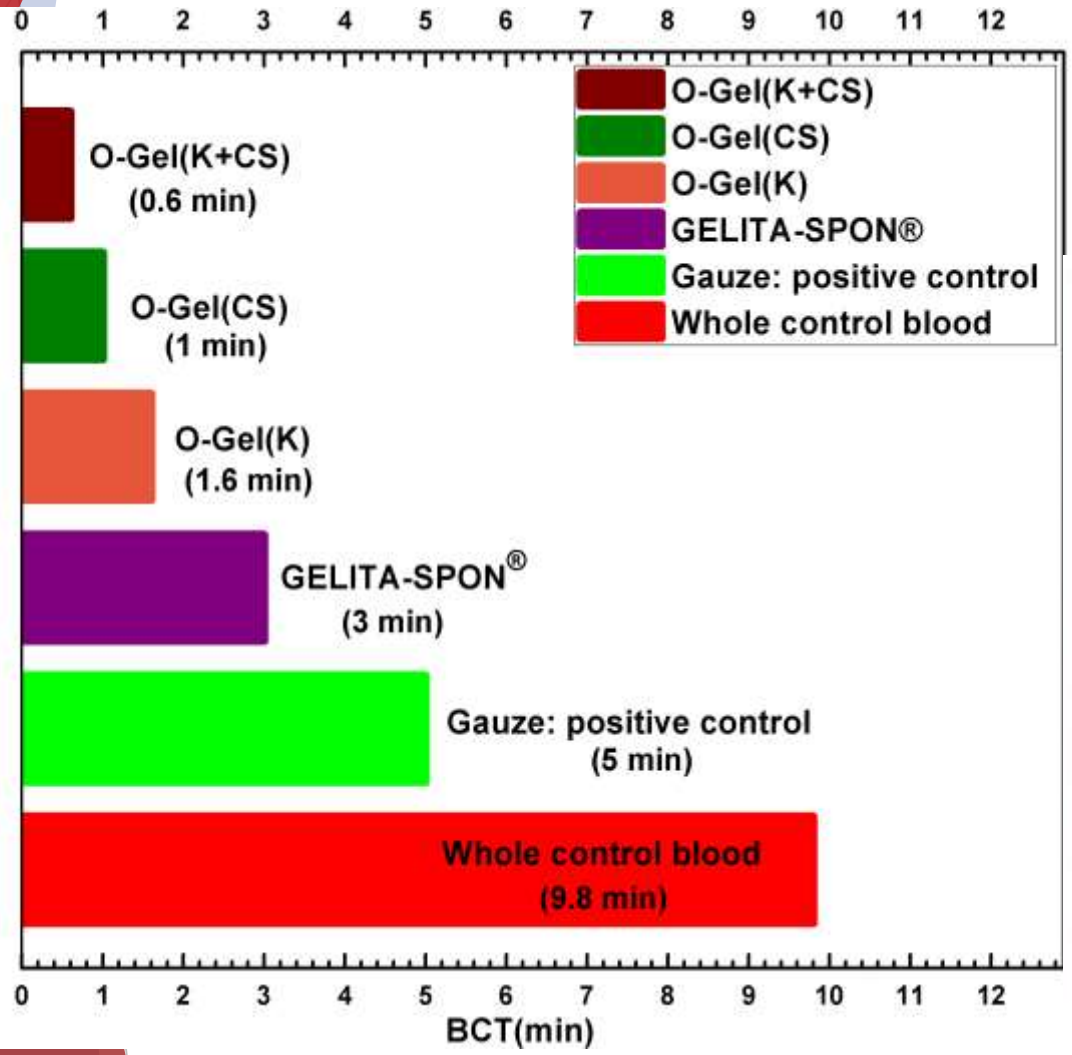


Mats from Spinnable solution of PLLA

(a) Whole mat (b) SEM image

J. Appl. Polym Sci. 133 (2016) 43687

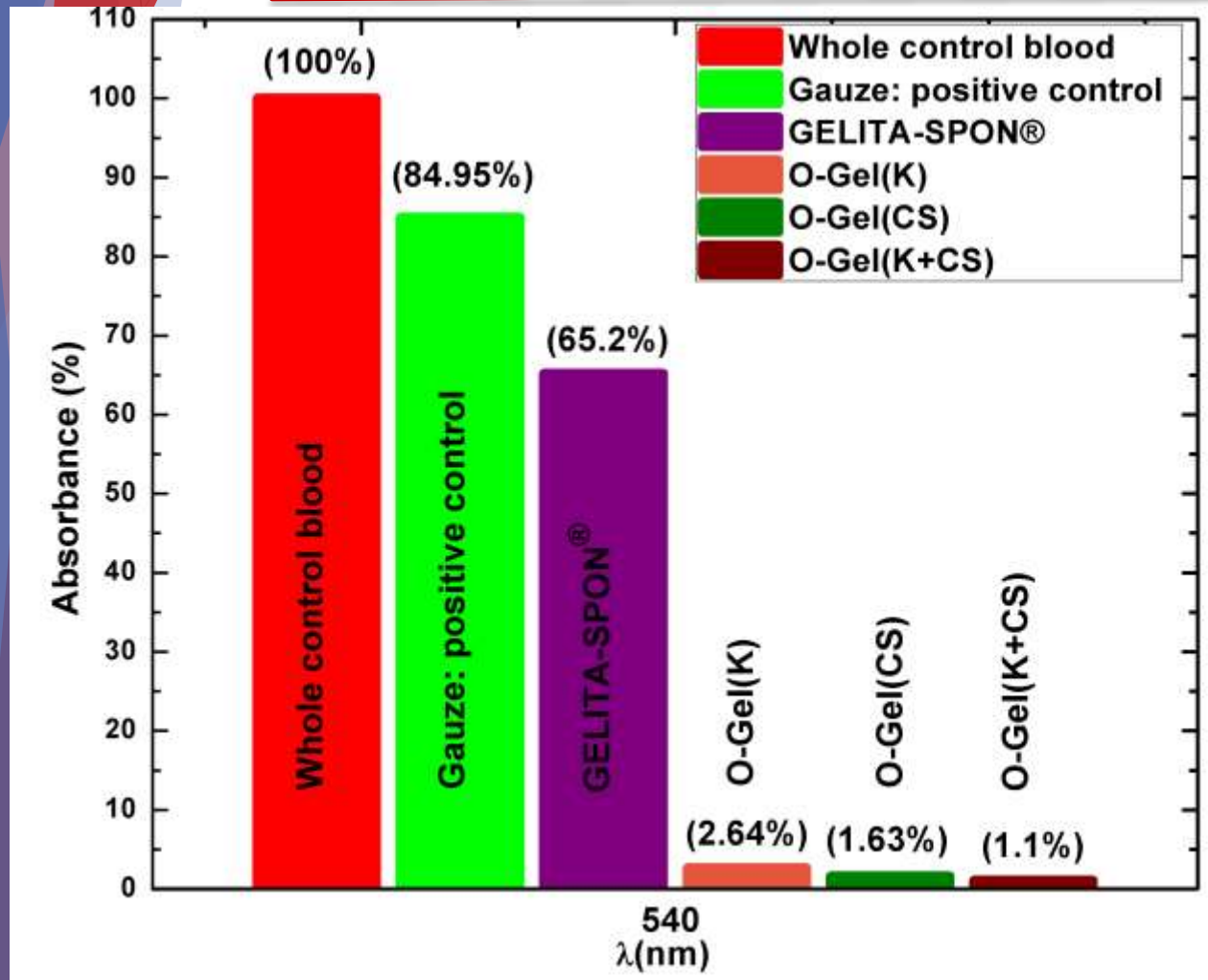
3. Organogels for Hemostasis



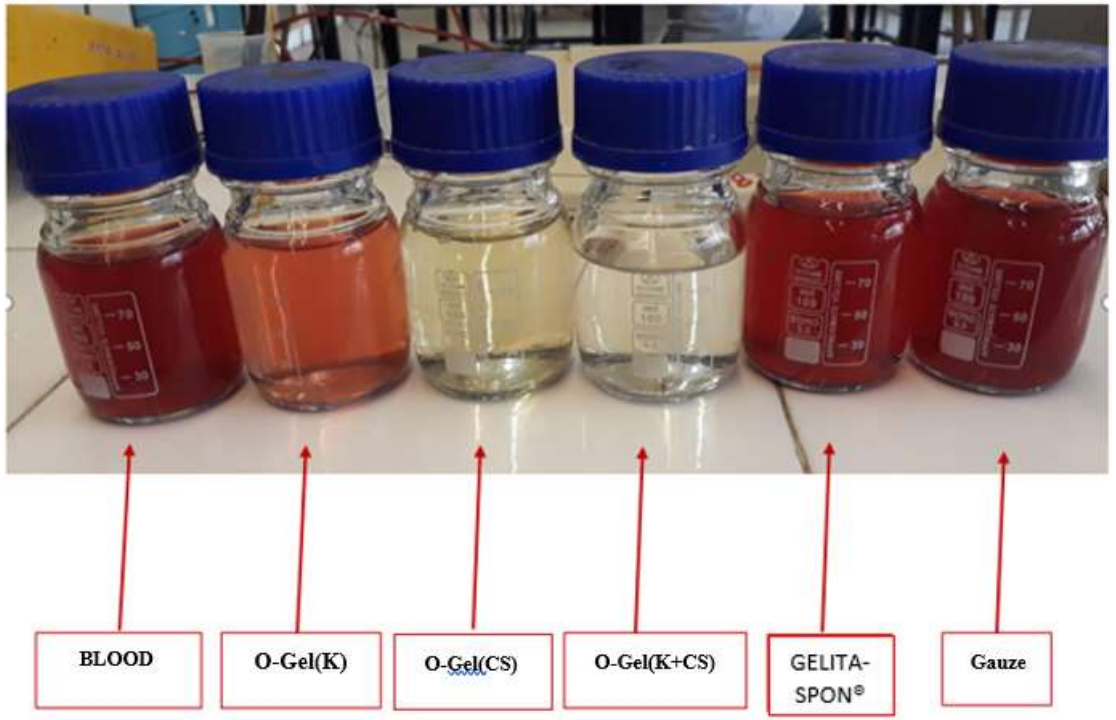
Clotting Time

O-Gel(K+CS) | O-Gel (CS) | O-Gel(K) | GELITA-SPON® | Gauze | BLOOD

3. Organogels for Hemostasis

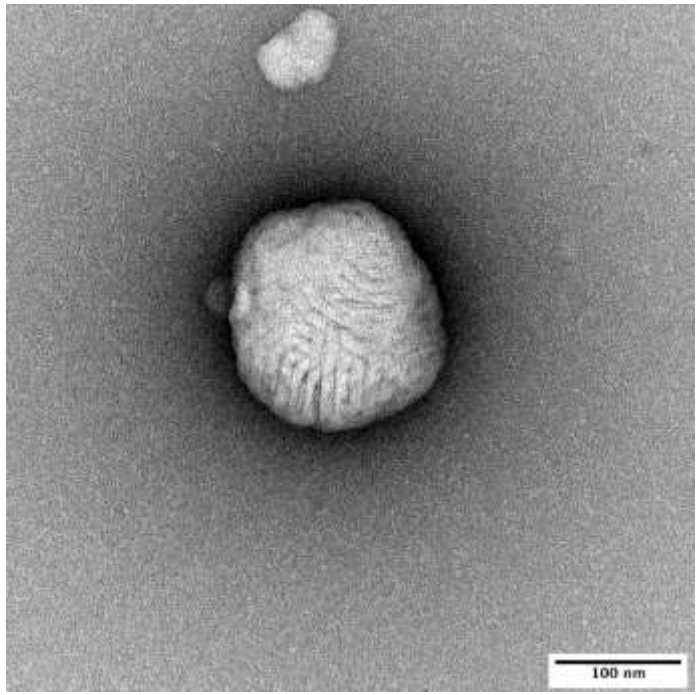


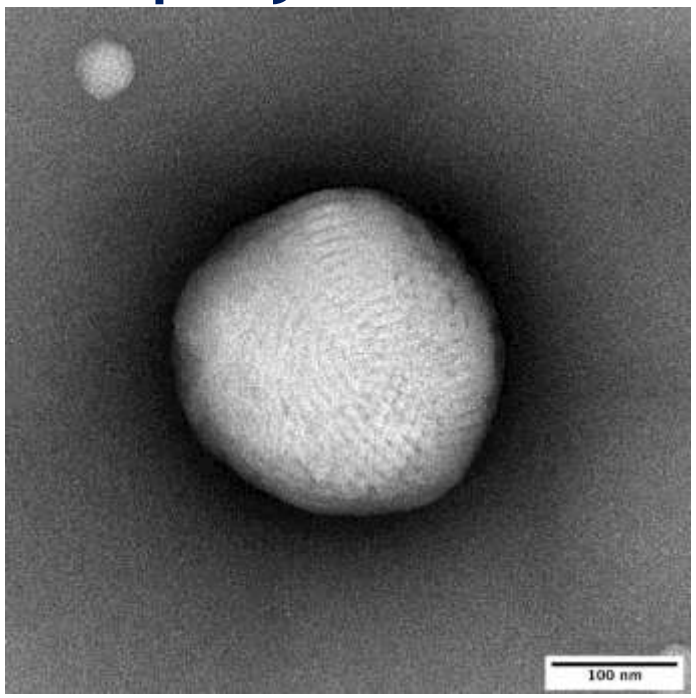
UV/Vis absorption of non-coagulated Hemoglobin



4. Drug delivery systems: Cubosomes, hexosomes

TEM images of bio-sourced copolymers-1-

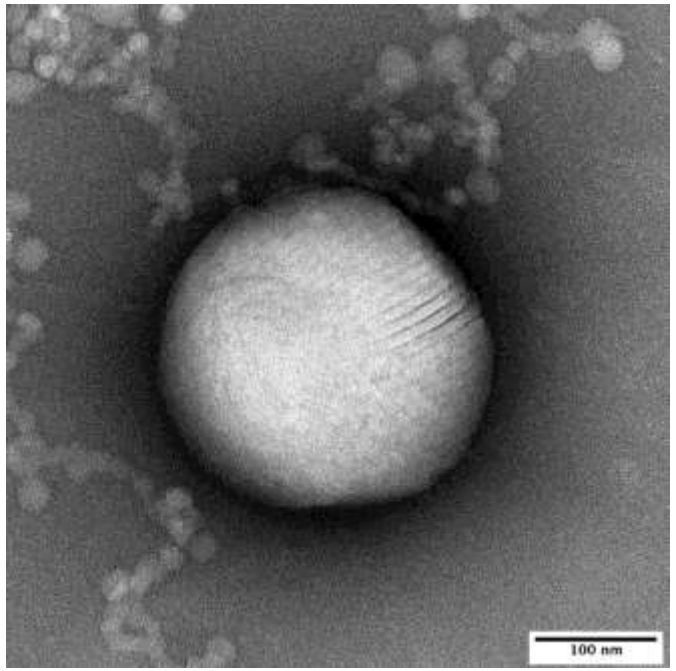


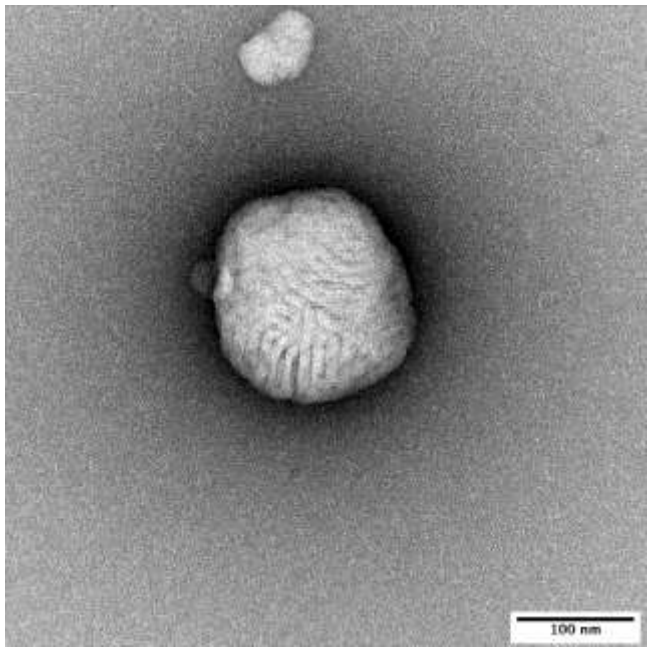


CERMAV-Gernoble-France 2018

4. Drug delivery systems: Cubosomes, hexosomes

TEM images of bio-sourced copolymers-2-

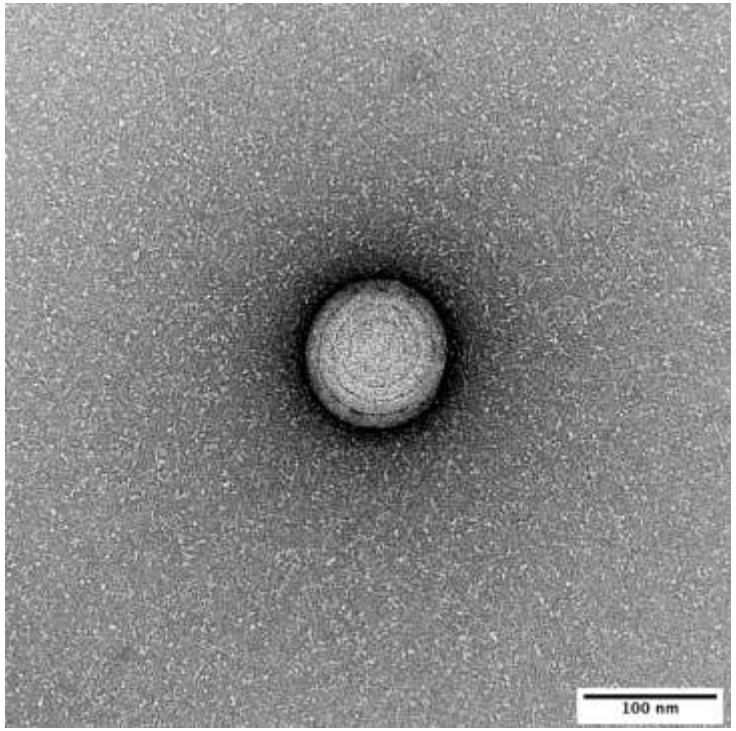


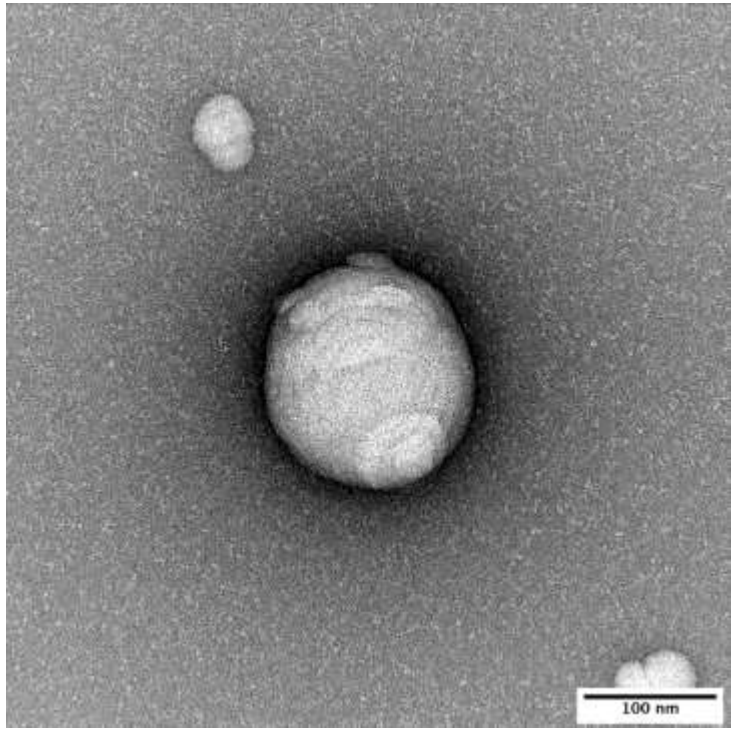


CERMAV-Gernoble-France 2018

4. Drug delivery systems: Cubosomes, hexosomes

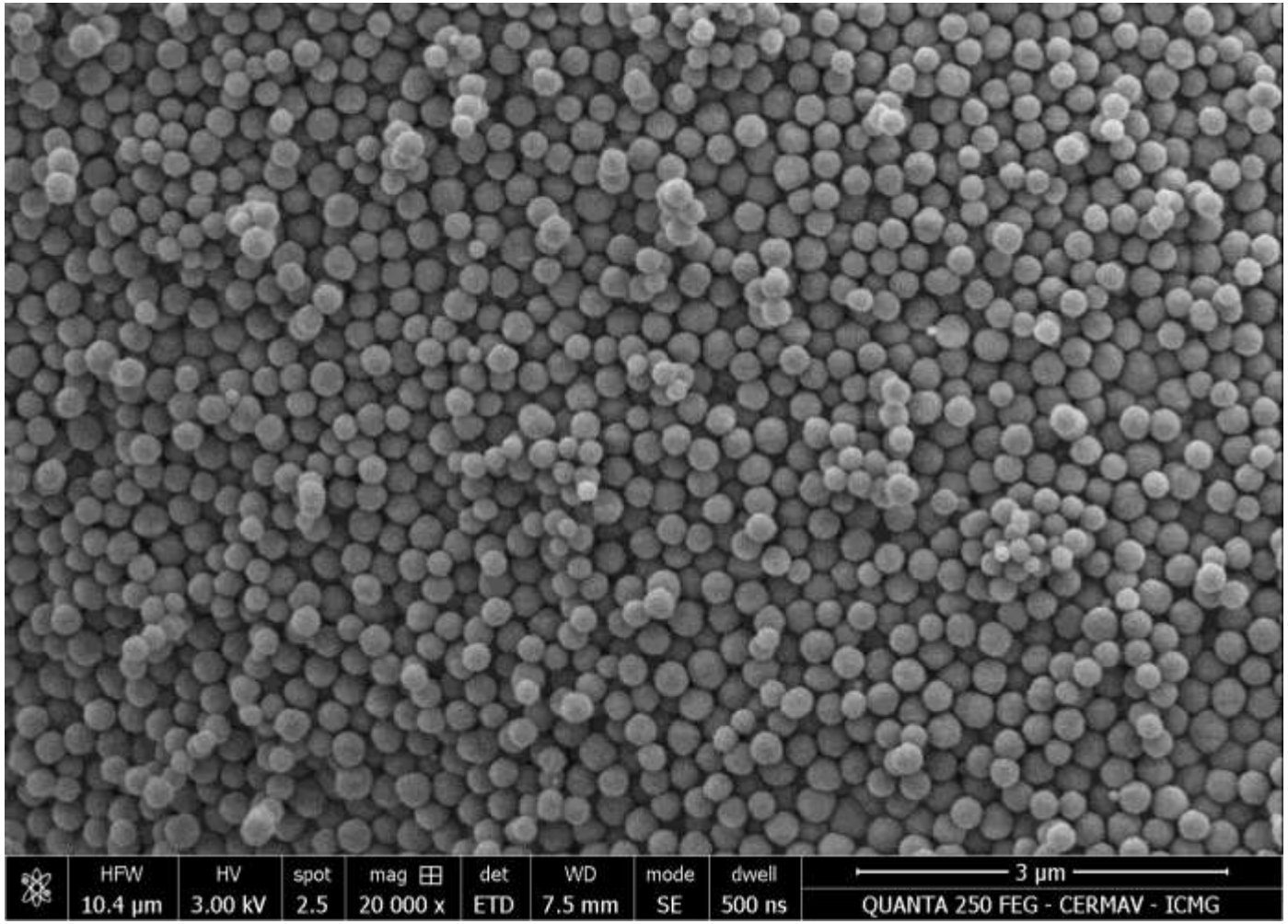
TEM images of bio-sourced copolymers-3-





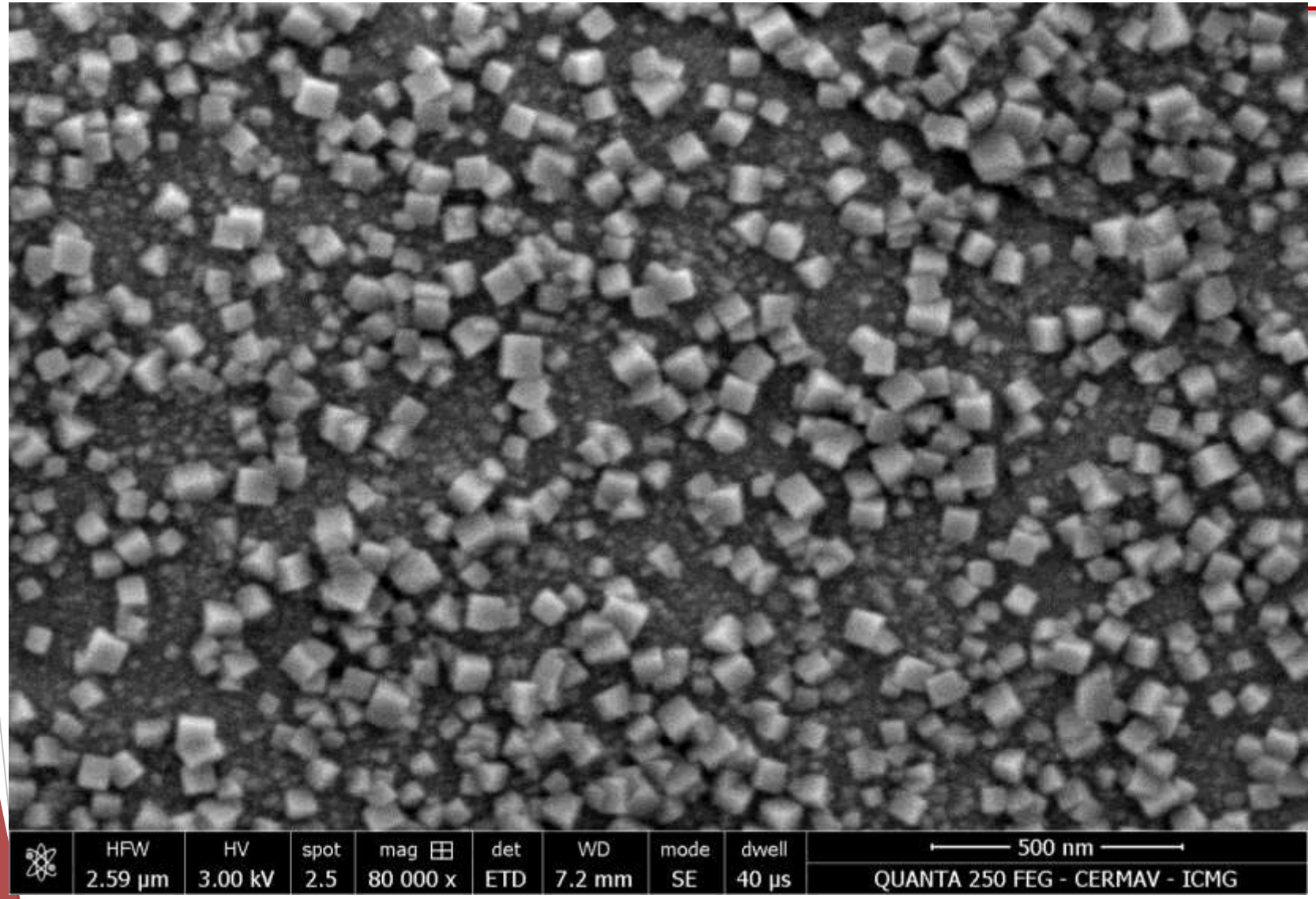
CERMAV-Gernoble-France 2018

Nano-encapsulation: Monodisperse spheres



CERMAV-Grenoble-France 2018

4. Drug delivery systems: Nanocubes



CERMAV-Grenoble-France 2018

Technical Applications

1. Gain medium for high energy lasers
2. Conductive latex (talk, session 5)

1. Gain medium for high energy lasers

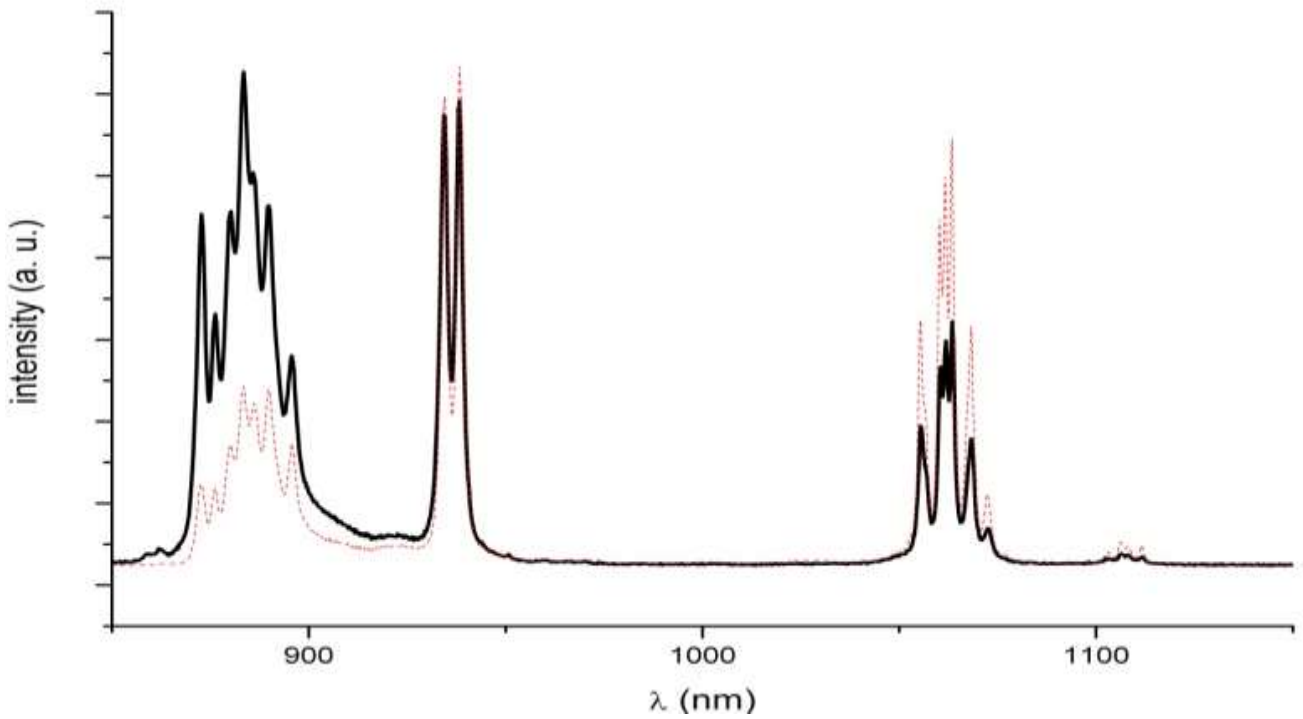
nanoceramics of Cr,Nd:GGG

1. Gain medium for high energy lasers

Advantages of polycrystalline ceramics over single crystals:

- Simple preparation process,
- Cost-effective,
- Higher doping concentrations without segregation

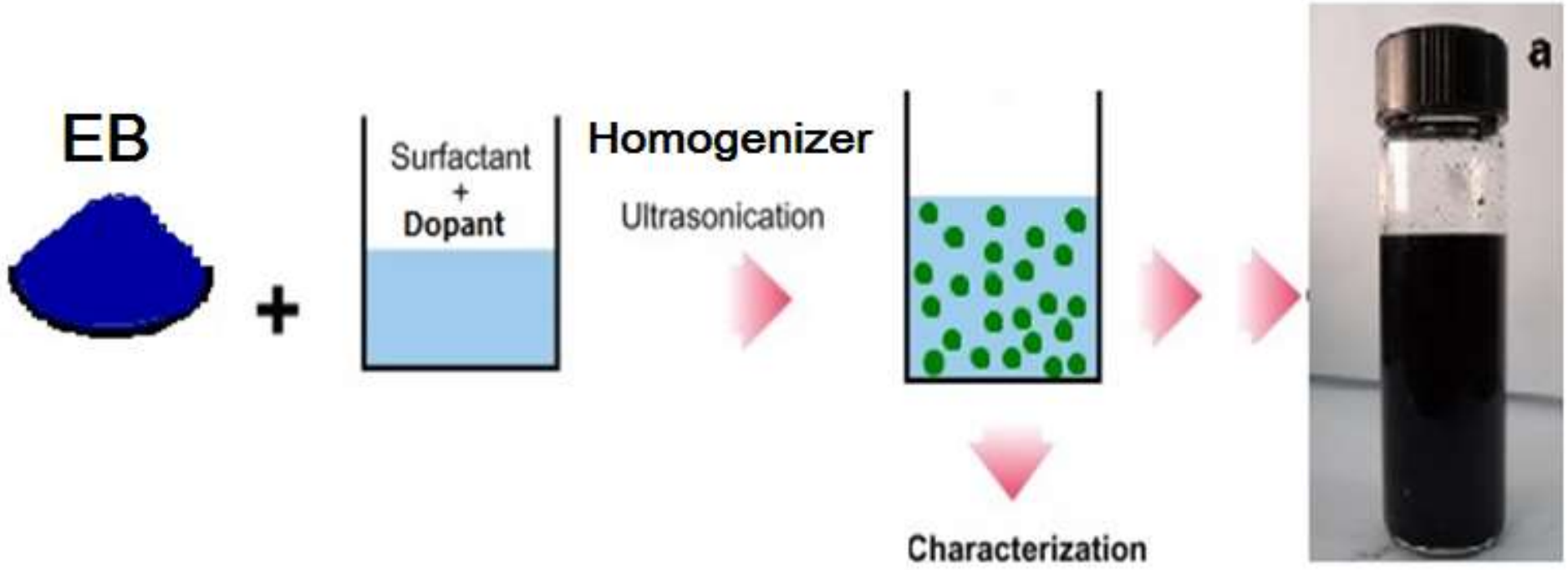
1. Gain medium for high energy lasers



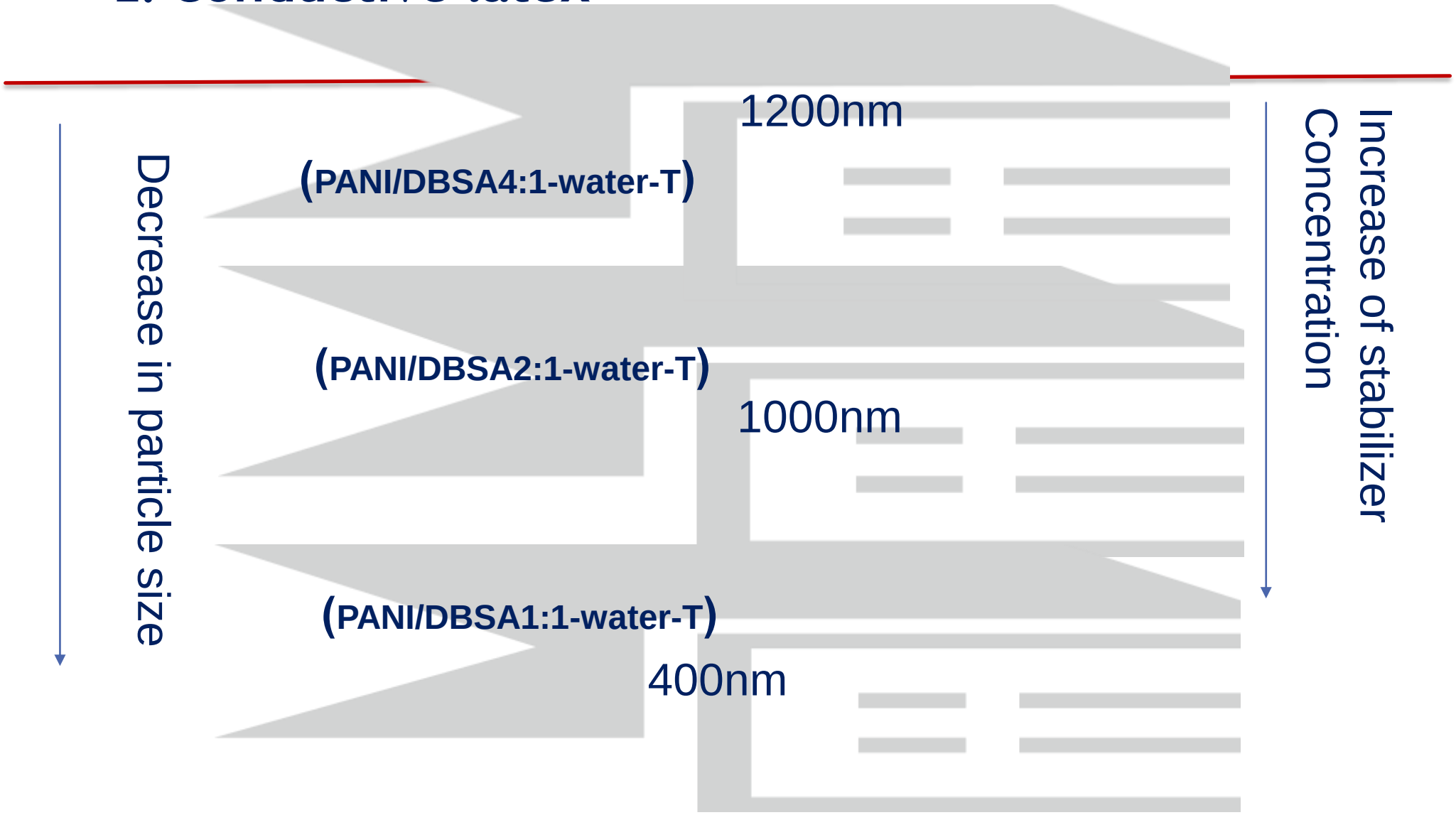
Journal ofLuminescence165(2015)1–5

Photoluminescence spectrum of nanopowder (continue line) and for monocrystal (dashed line)

2. Conductive latex



2. Conductive latex



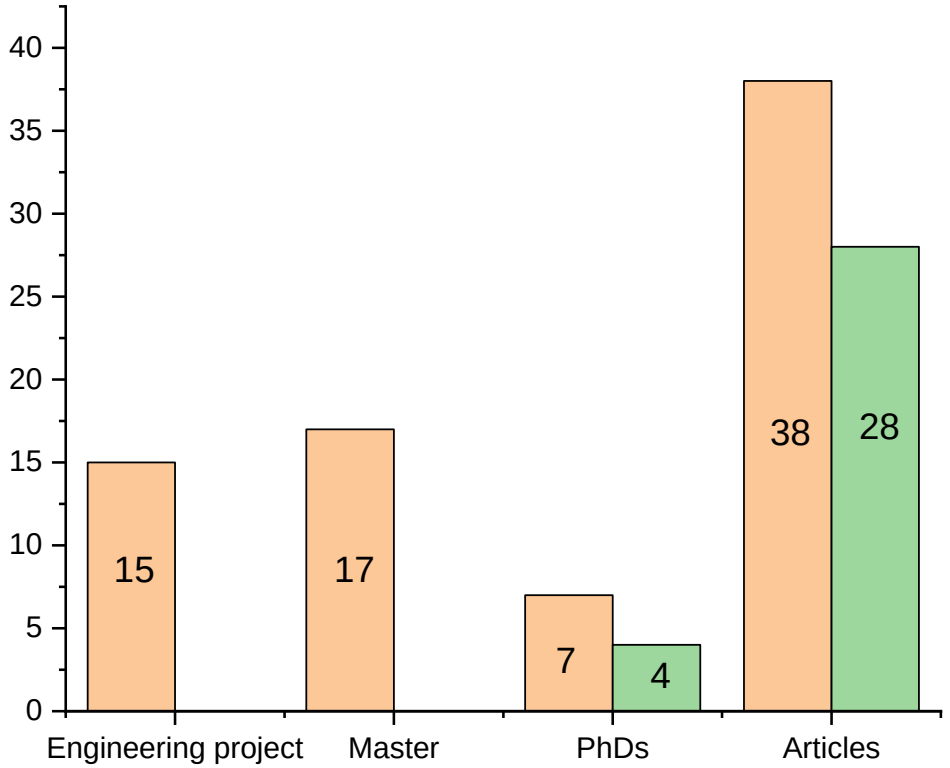
2. Conductive latex

Potential Applications of the colloids

Conductive Ink

Conductive fabrics

Outcomes of our experience 2008-2019



Outcomes of our experience 2008-2019 -continued

- International Collaboration:
  - MPIP, Mainz, Germany 2016
  - University of Tehran, Iran 2016
  - Imam Hossein University, Iran 2016
  - ENS-Paris Saclay, France 2017
  - Nanosciences Foundation, France 2018
  - Iran Nanotechnology Innovation Council, 2019

- National Collaboration:
  - Faculty of Science, University of Damascus, 2016
  - Faculty of Medicine, University of Damascus, 2019
  - General Commission for Scientific Agricultural Research (GCSAR), 2019

Challenges

- Poor high-tech infrastructure.
- Insufficient communication between local academic institutions.
- Difficulty in outsourcing measurements and purchasing chemicals due to embargo on Syria.
- A low budget for R&D.
- Research outcomes are either articles or academic degrees.

How to step forward?

- Learning how to up-scale the nanotechnology research products.
- Transforming universities and academic institutions into *Technology Parks:* incubators for startups and spin-off enterprises.
- Enhancing networking between academic institutions in Syria.
- Collaborating with the international academia in nanotechnology.
- Collaborating fruitfully with Iran Nanotechnology Innovation Council (INIC).
- Reforming the educational system:
  - Building teamwork mentality
  - Appreciating science and scientists
  - Including nanotechnology in school curriculum.

Thank you