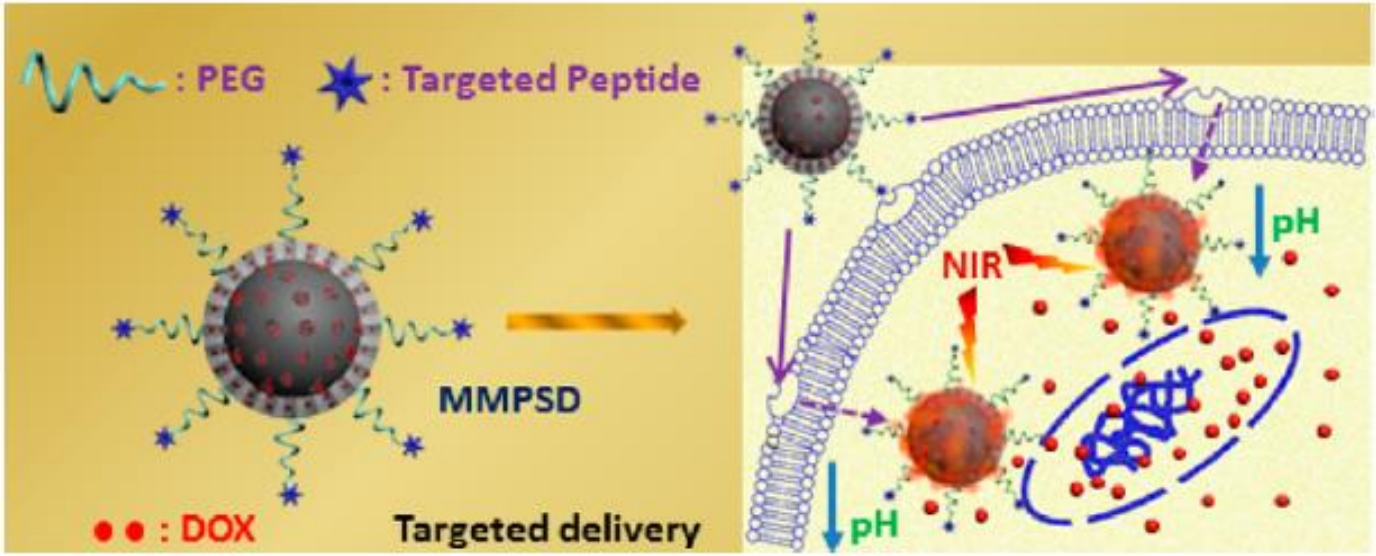
成功大學 National Cheng Kung University

Fabrication of Silica-coated Hollow Carbon Nanospheres Encapsulating Fe_3O_4 Cluster for Magnetically and MR Imaging Guided NIR Light Triggering Hyperthermia and Enhanced US Imaging

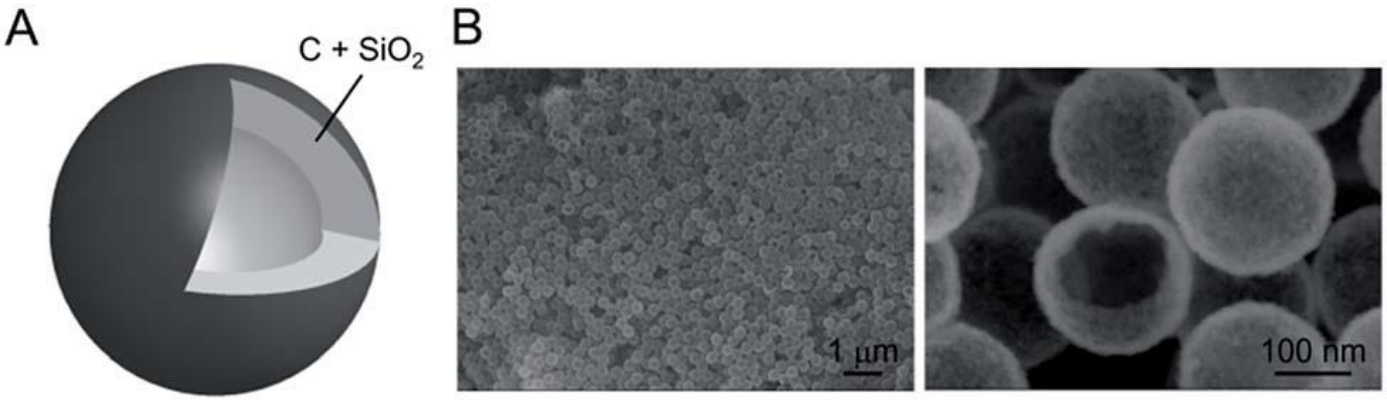
Presenter: Yun-Kai Huang

Adviser:Chen-Sheng Yeh

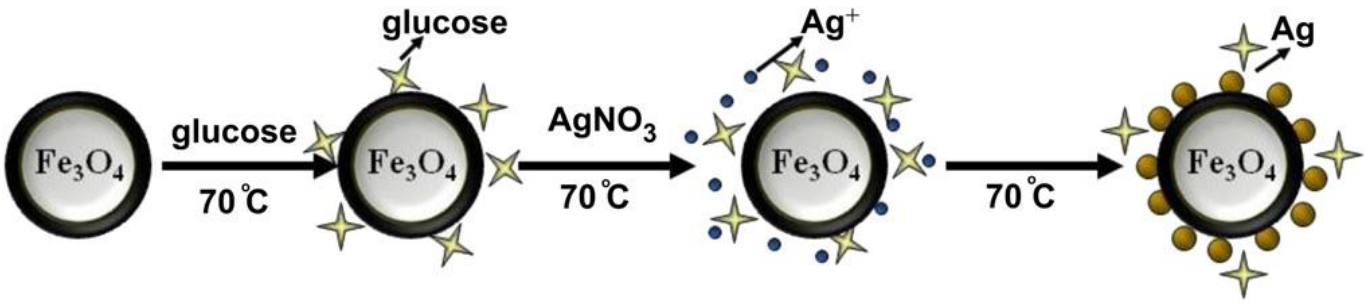
Date: 2016/07/25



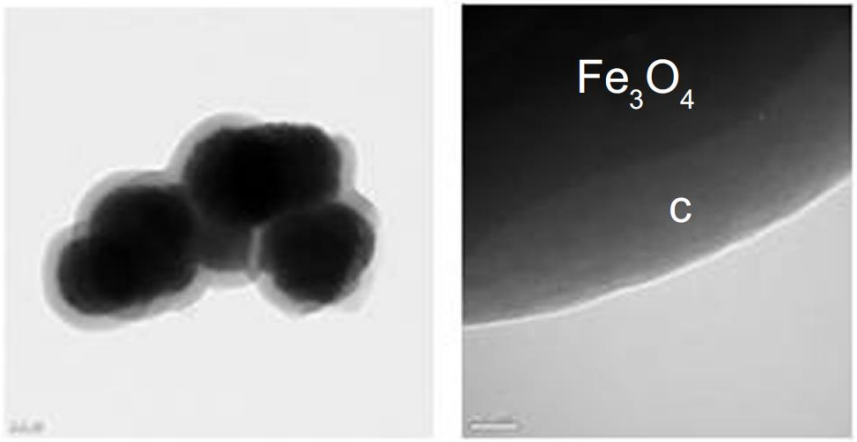
ACS Nano, **2014**, *8* (8), pp 7870–7879

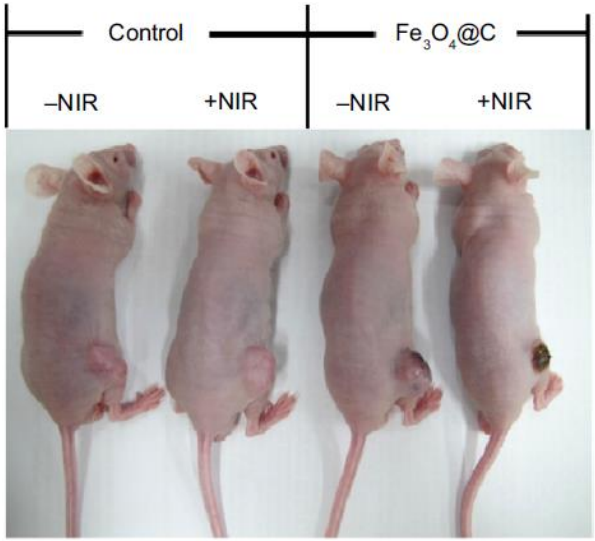


J. Mater. Chem. B, 2015, 3, 2447–2454



Biomaterials 34 (2013) 571-581

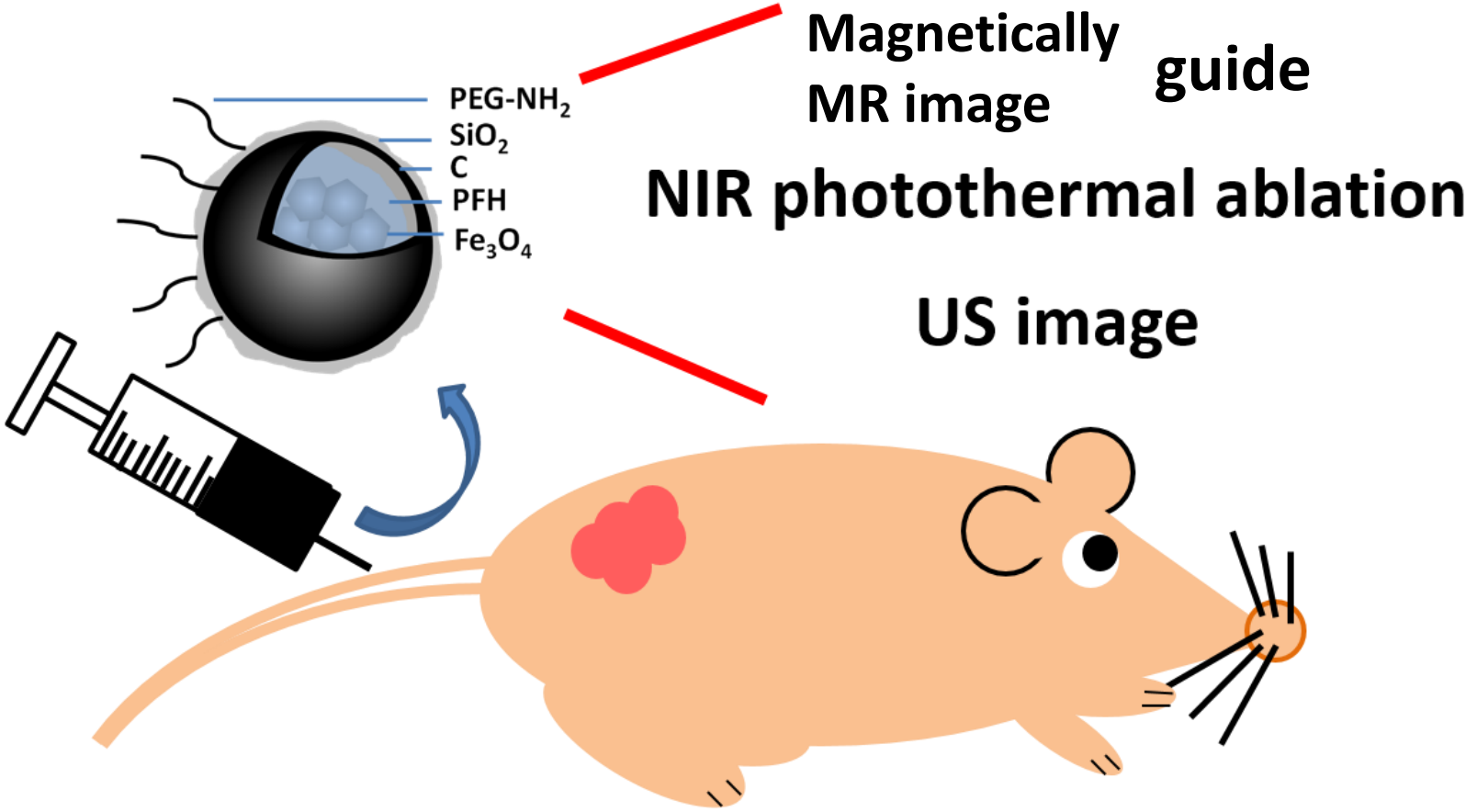




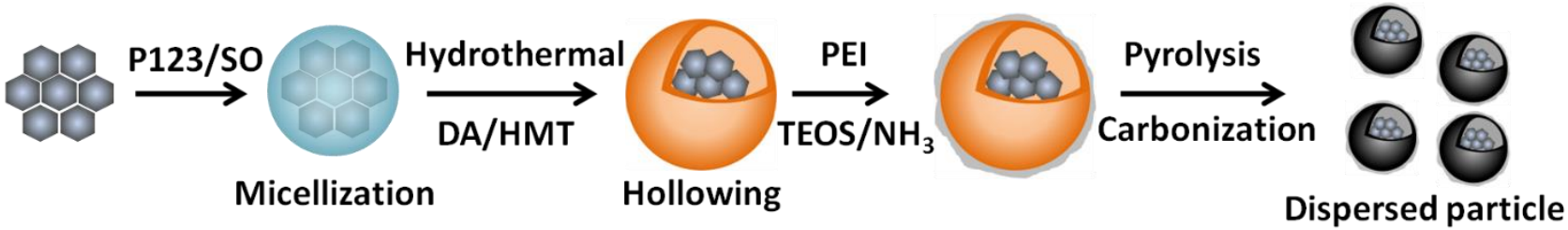
International Journal of Nanomedicine 2015:10 271–282

Motivation

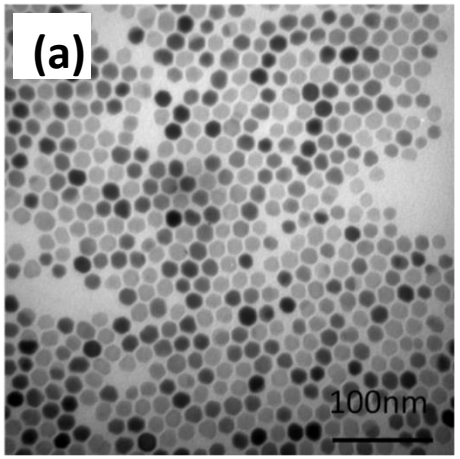
- Most of these study only have in vitro study, or using intratumoral injection
- Yolk-shell structure for more applications

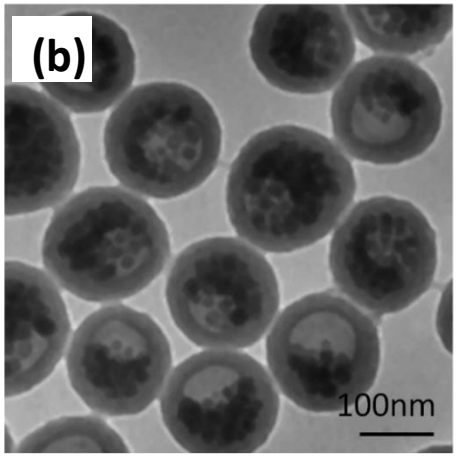

PEG-NH2
SiO2
C
PFH
Fe3O4
Magnetically guide
MR image
NIR photothermal ablation
US image

Characterization of nanoparticles



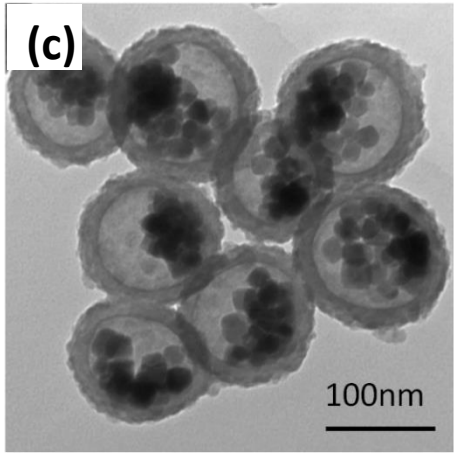
IONP

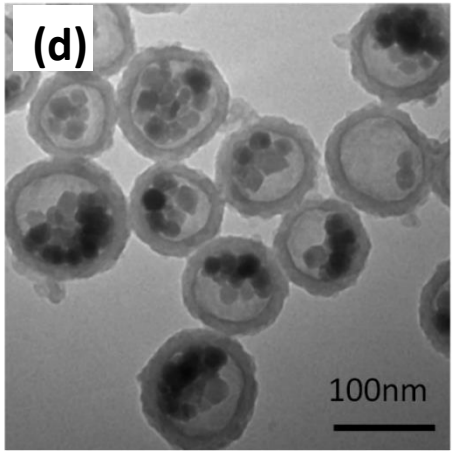




IONP@*h*-P

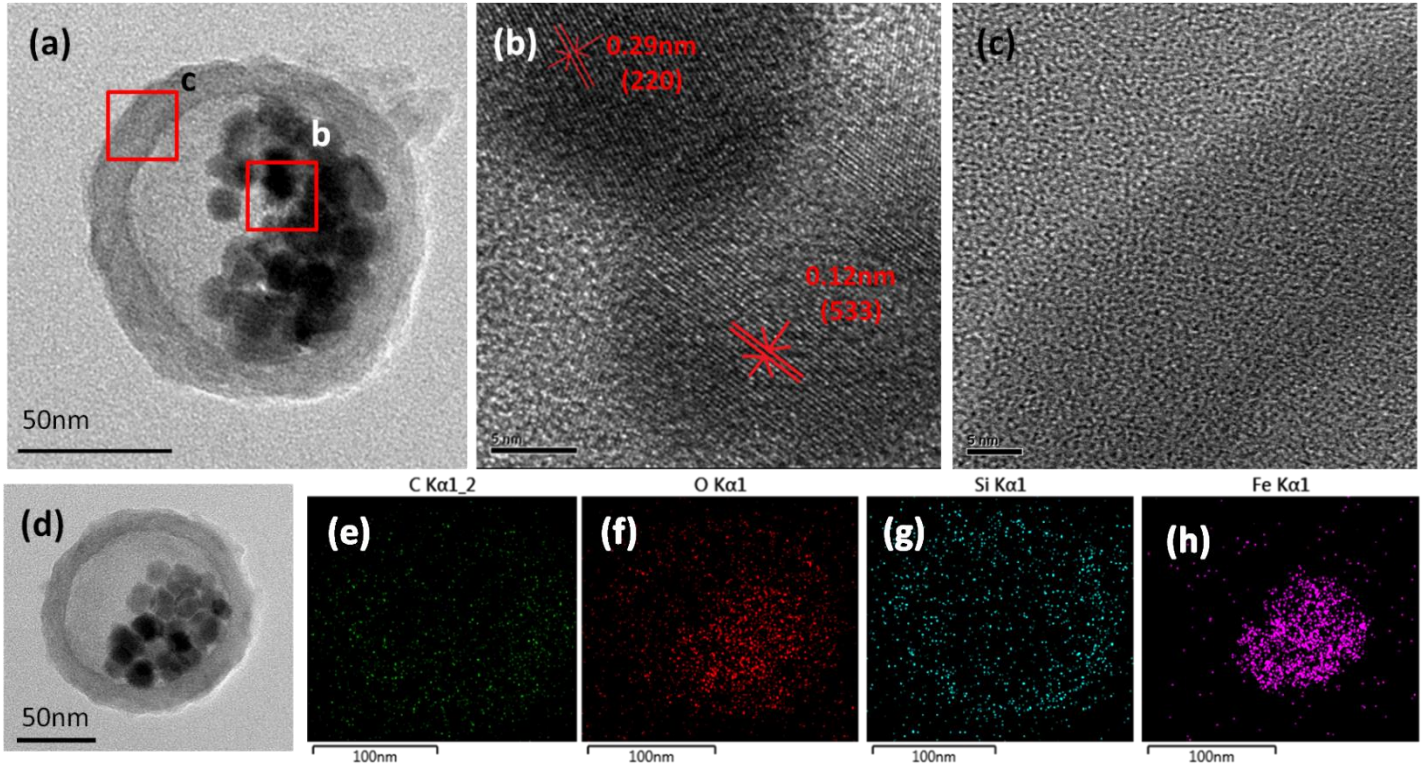
SiO_2/IONP@*h*-P



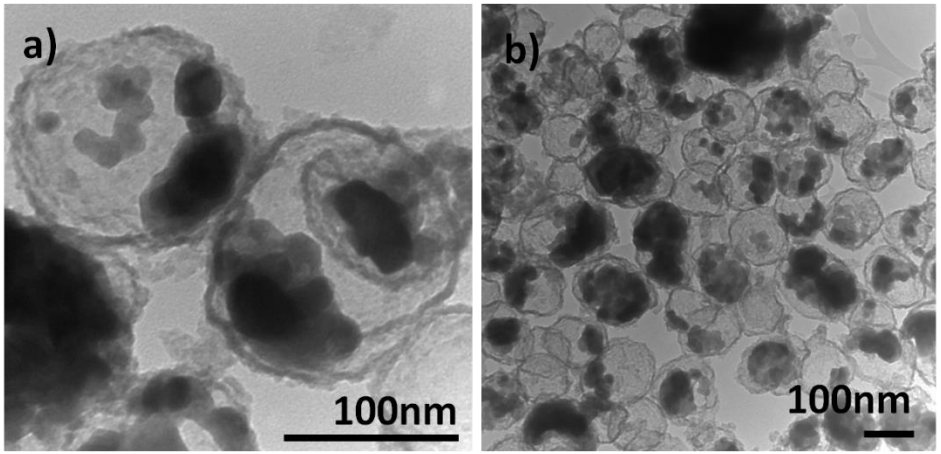


SiO_2/IONP@*h*-C

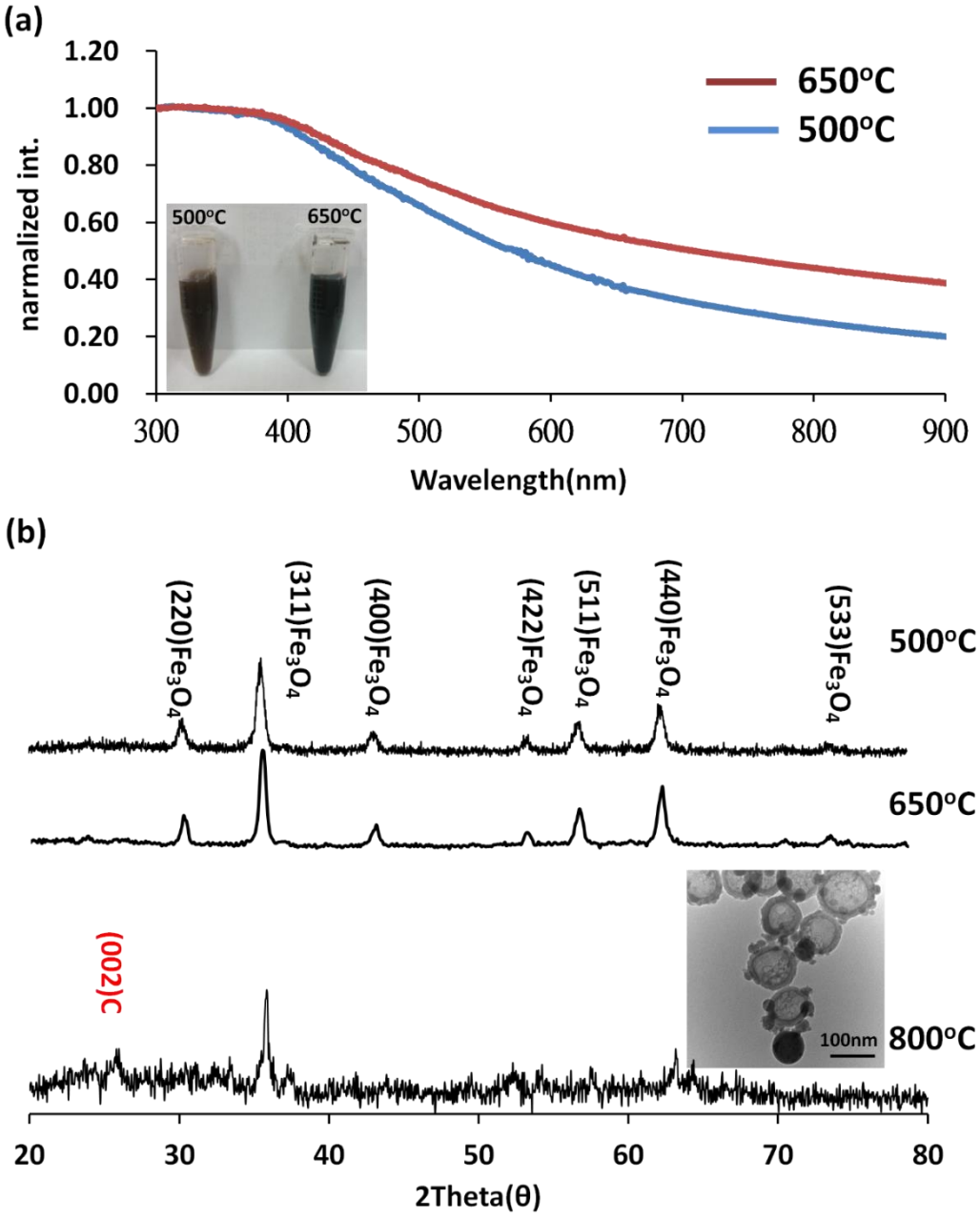
HR-TEM



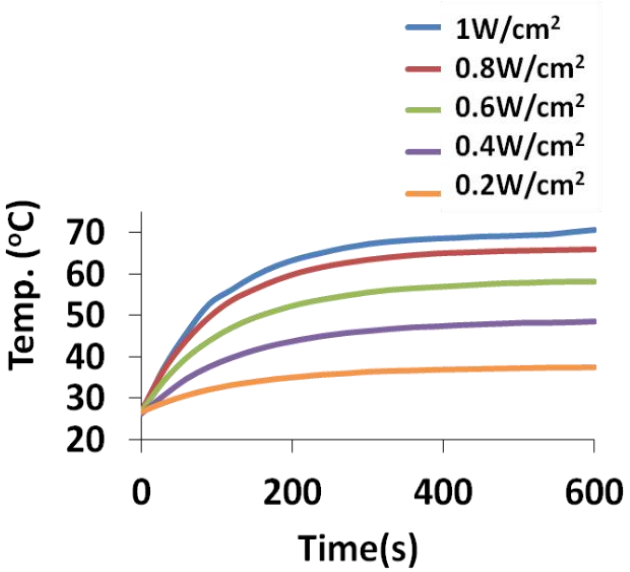
Pyrolysis in air
To remove polymer shell

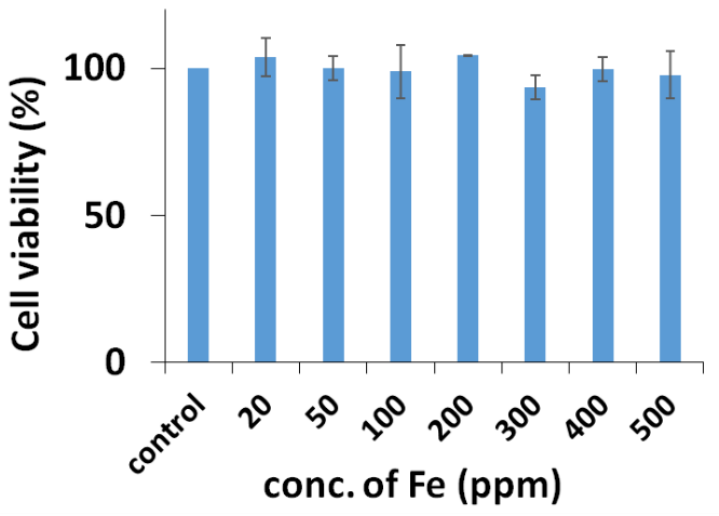


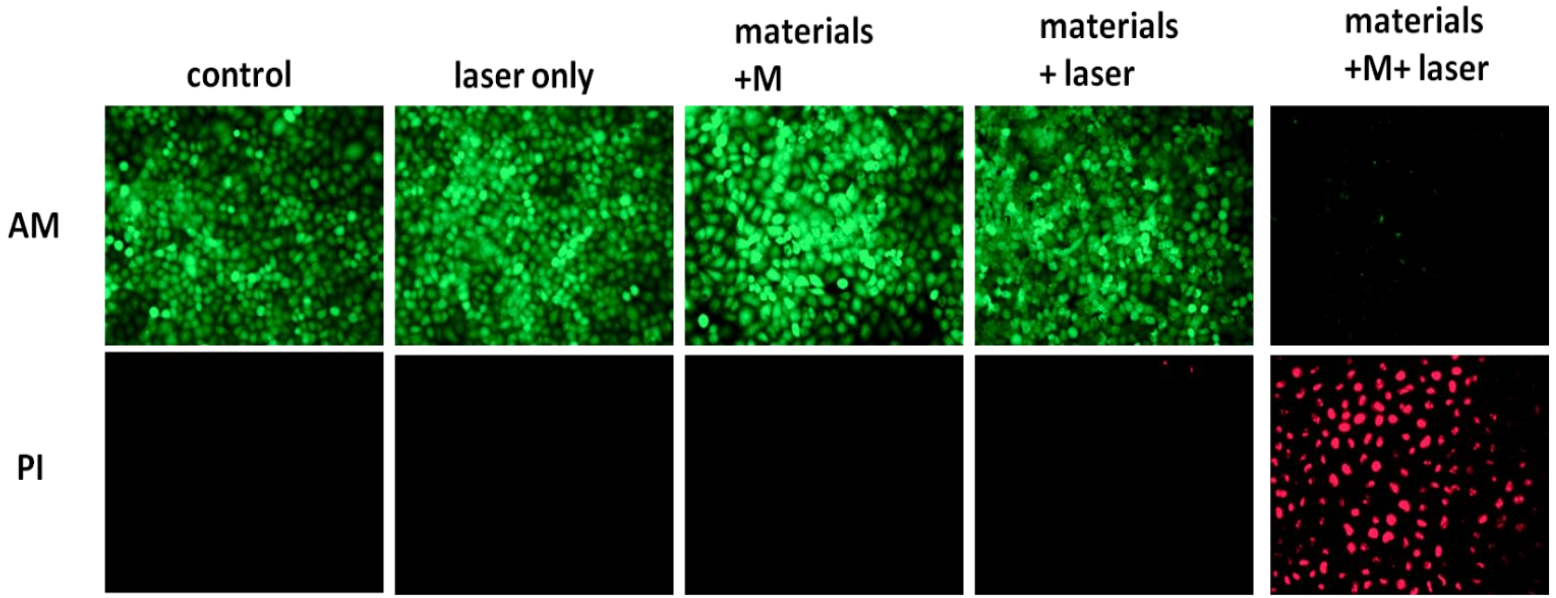
UV and XRD


(a)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
narmalized int.
650°C
500°C
500°C
650°C
300
400
500
600
700
800
900
Wavelength(nm)
(b)
(220)Fe3O4
(311)Fe3O4
(400)Fe3O4
(422)Fe3O4
(511)Fe3O4
(440)Fe3O4
(533)Fe3O4
500°C
650°C
C(002)
100nm
800°C
20
30
40
50
60
70
80
2Theta(θ)

temperature elevation and in vitro photothermal efficacy



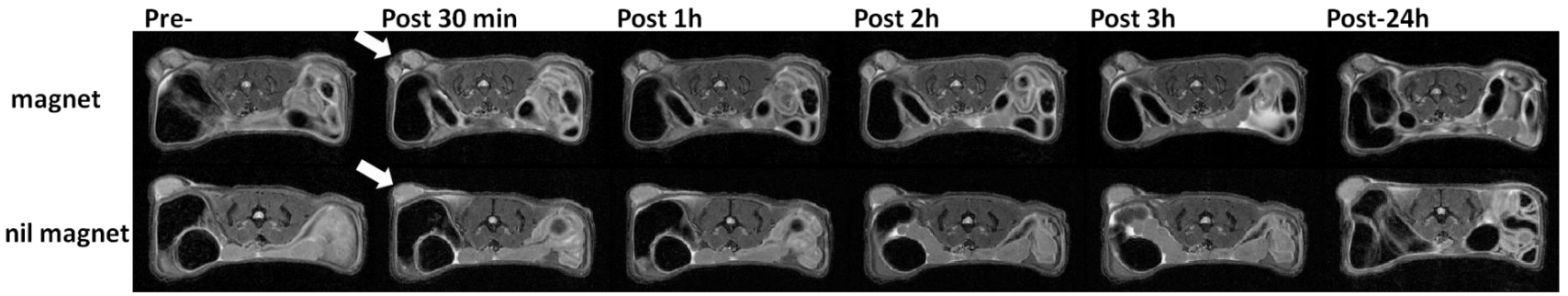


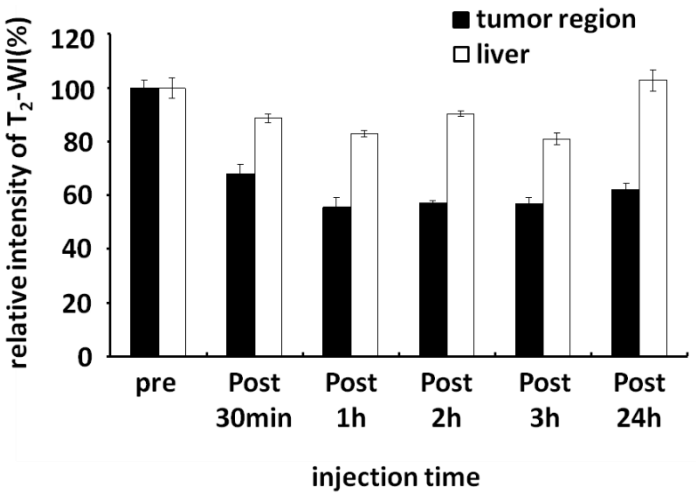


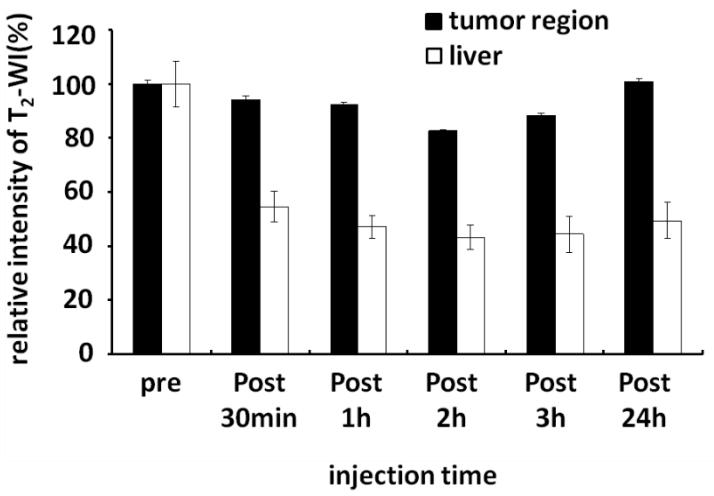
808nm laser 0.8W/cm² 10min

In vivo MRI

r_2=202.68 $mM^{-1}S^{-1}$

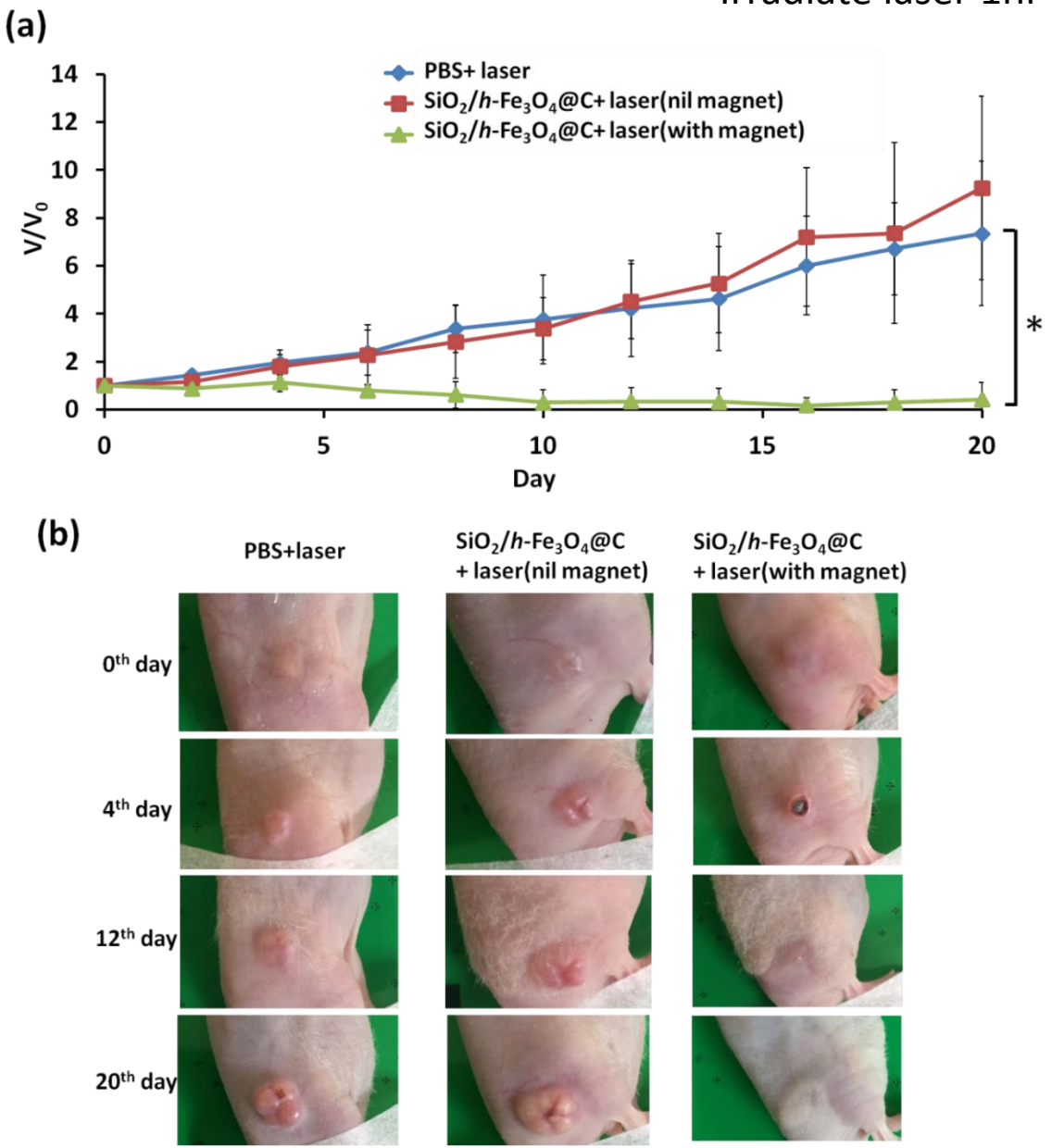




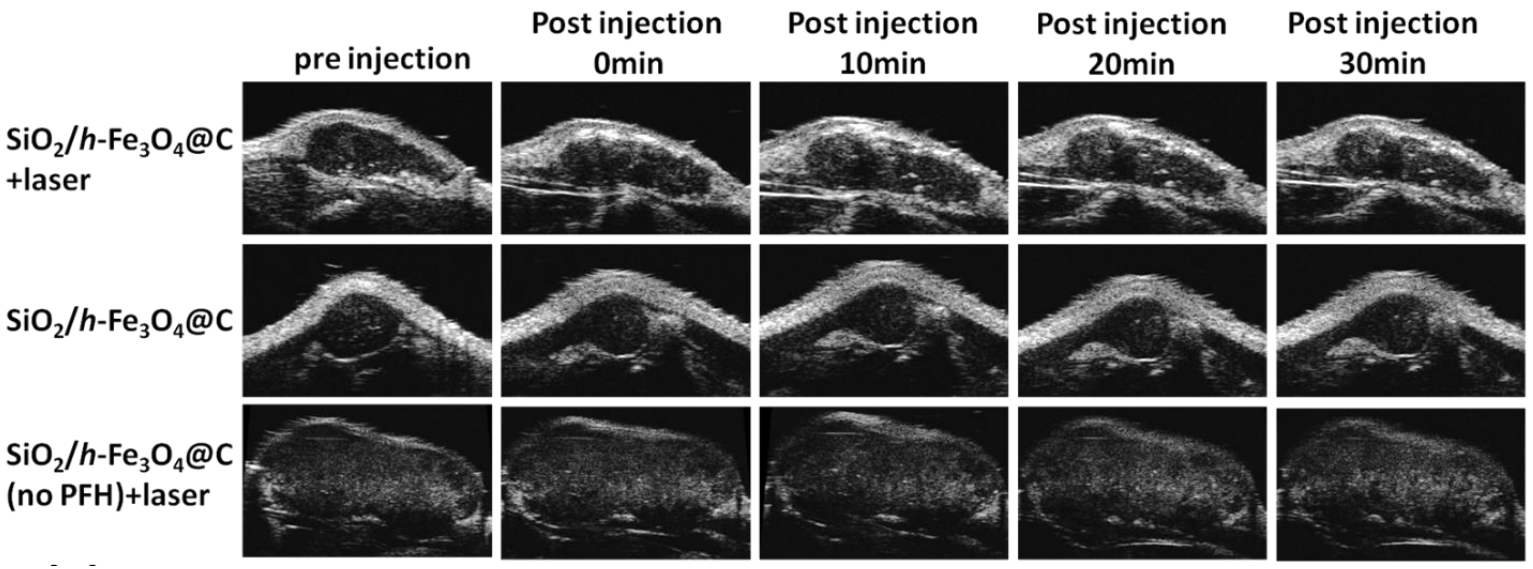


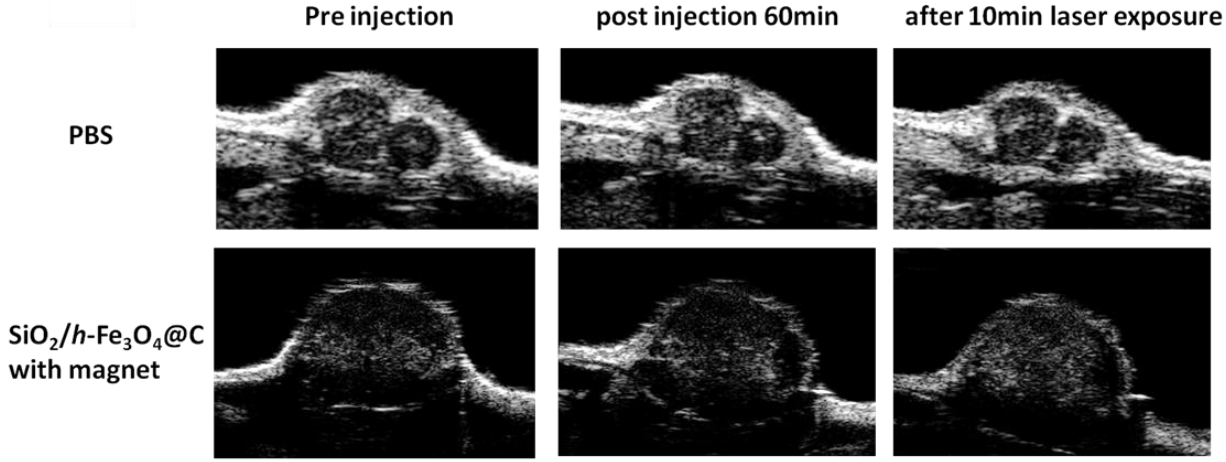
In vivo photothermal therapy

Irradiate laser 1hr post injection

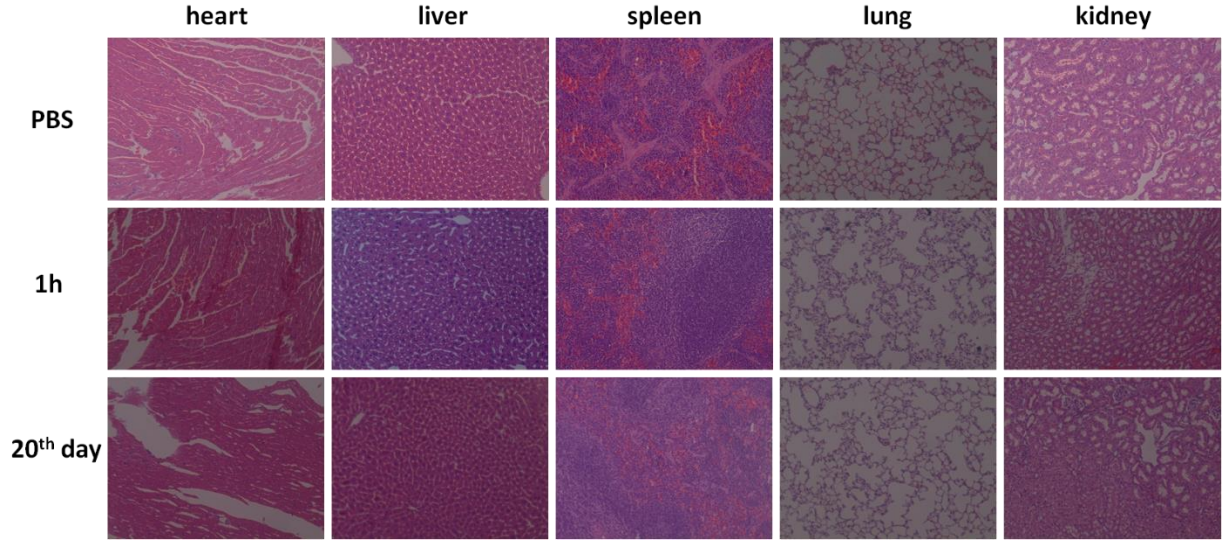


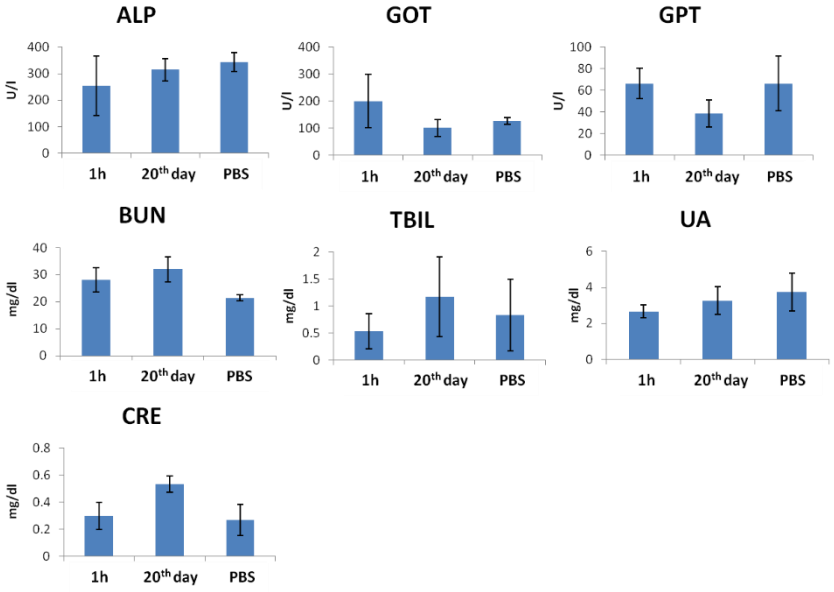
In vivo US image-intratumor, tail vein injection

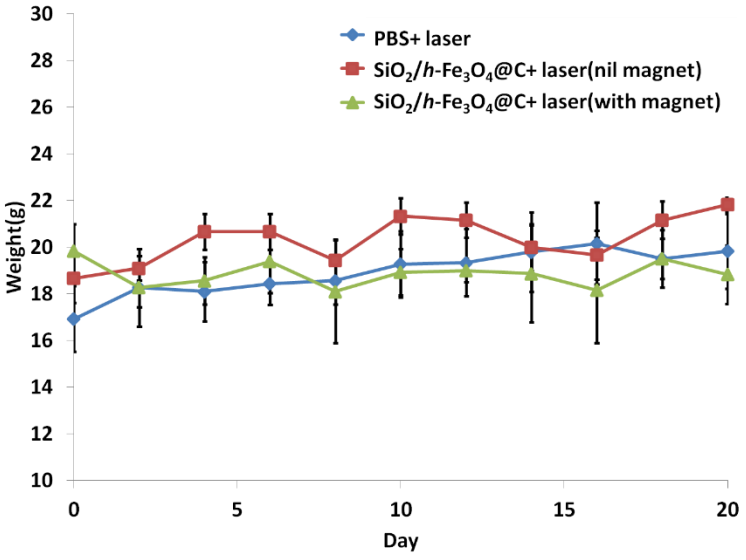




Toxicity-H&E stain, biochemical analysis, body weight







Conclusion

- Dispersed SiO_2/IONP@*h*-C nanoparticles
- Photothermal effect
- Magnetical and MR image guided photothermal therapy
- NIR triggered US enhanced image

Acknowledgements

- Chia-Hao Su, Jiu-Jeng Chen, Chun-Ting Chang, Yu-Hsin Tsai, Sheng-Fu Syu, Tsu-Ting Tseng, Chen-Sheng Yeh
- All member from nano-odyssey lab
- Prof. Hong-Ping Lin, Mr. Chin-Chan Huang
- Financial support from MOST and NCKU

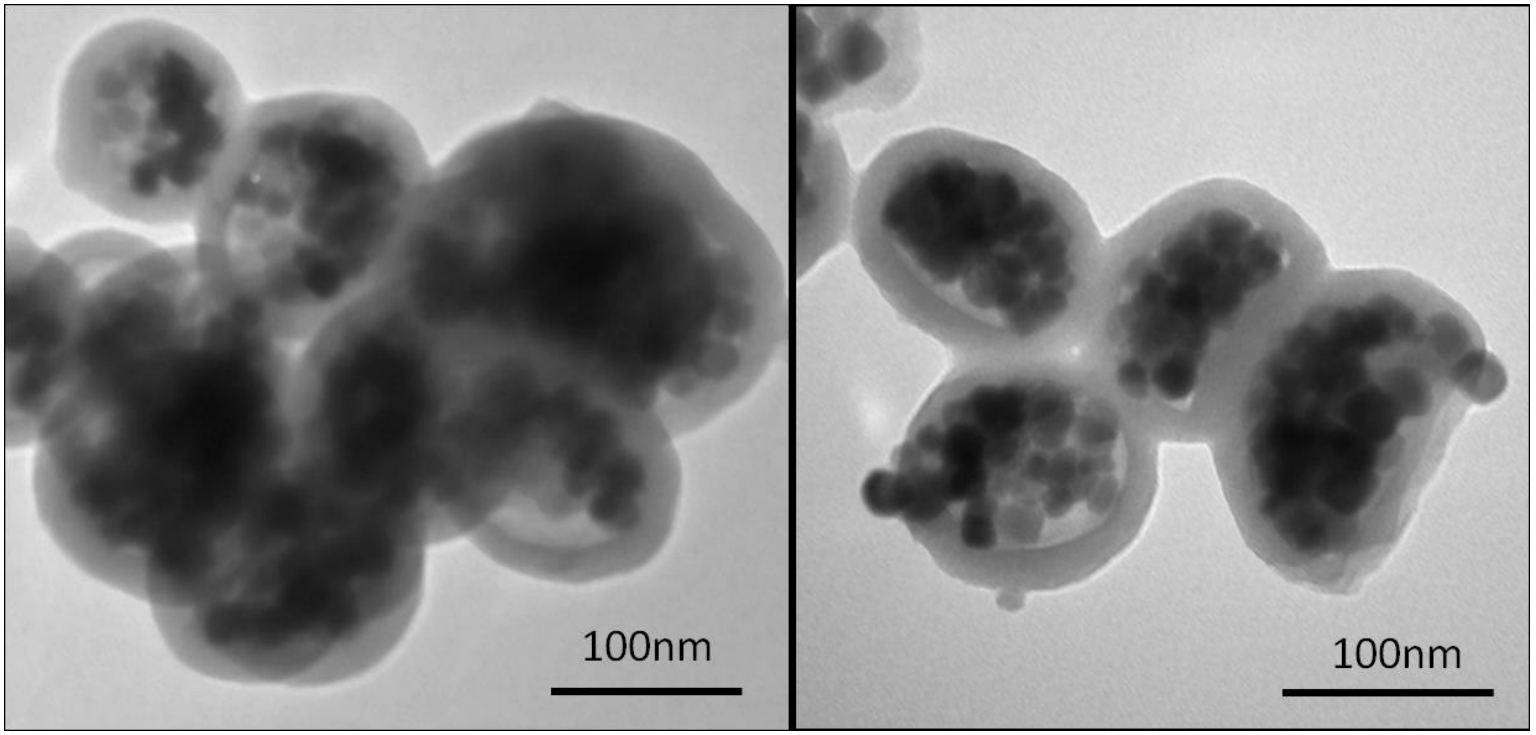
科技部
Ministry of Science and Technilogy

NATIONAL CHENG KUNG UNIVERSITY
1931

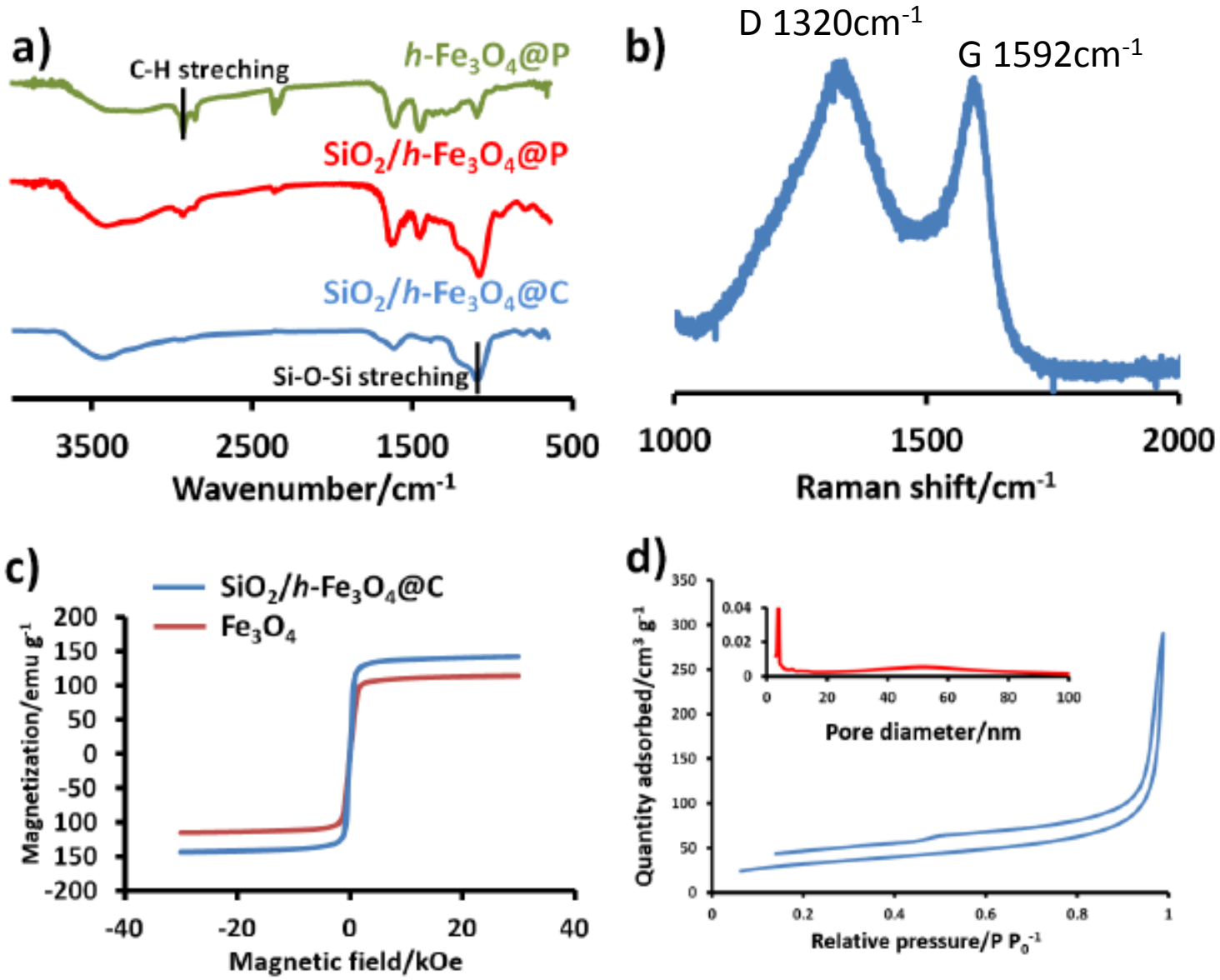


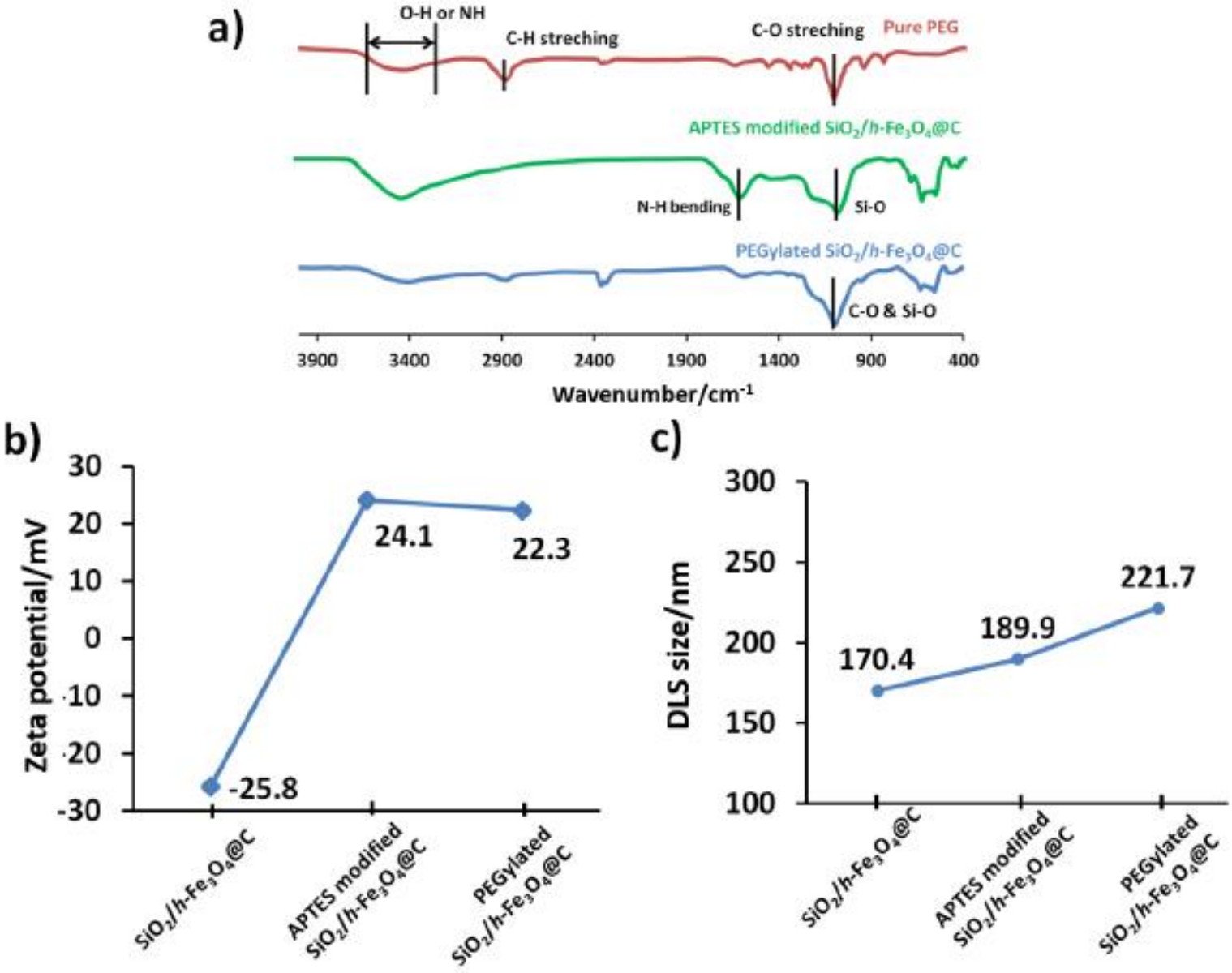


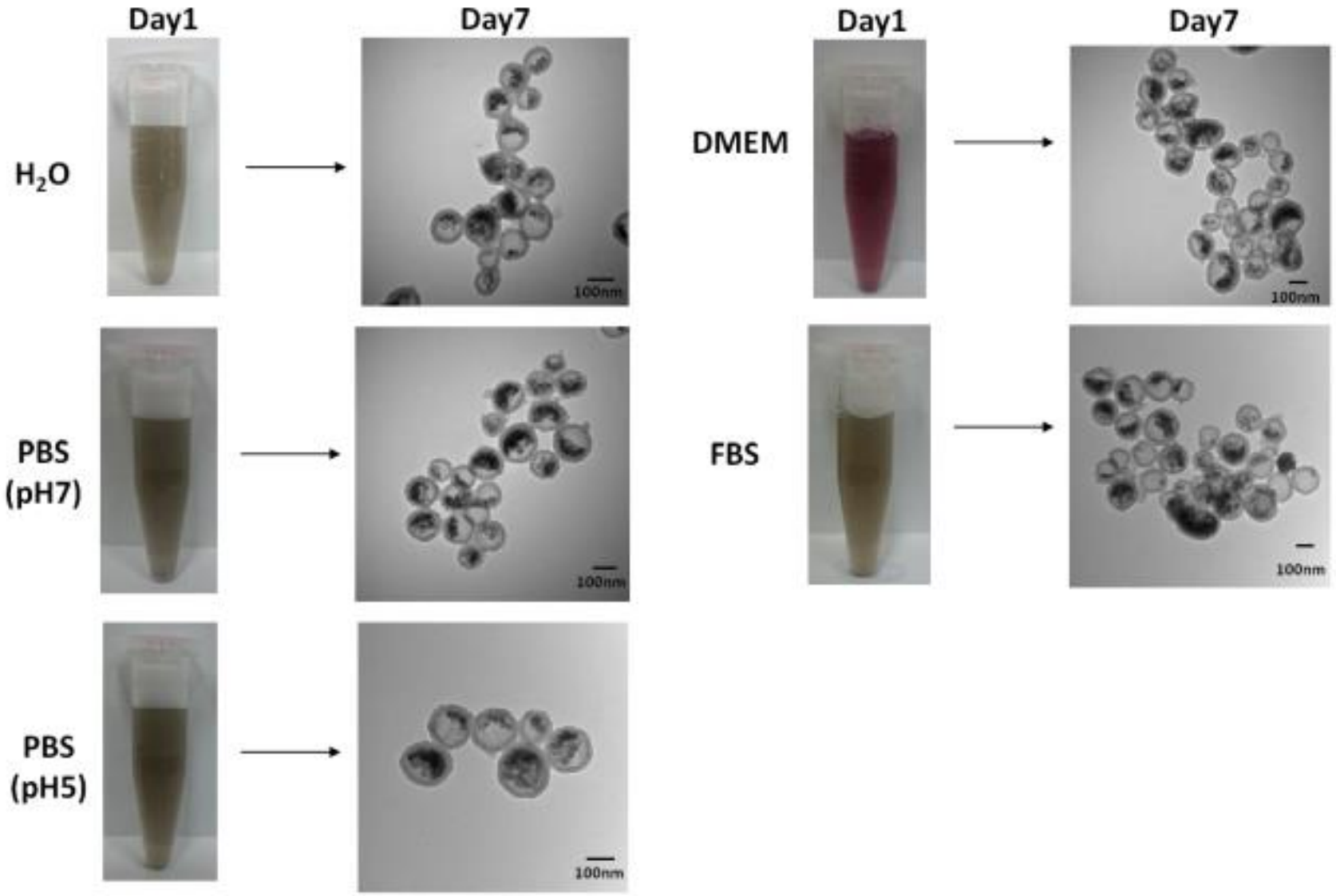
Thank you for your listening

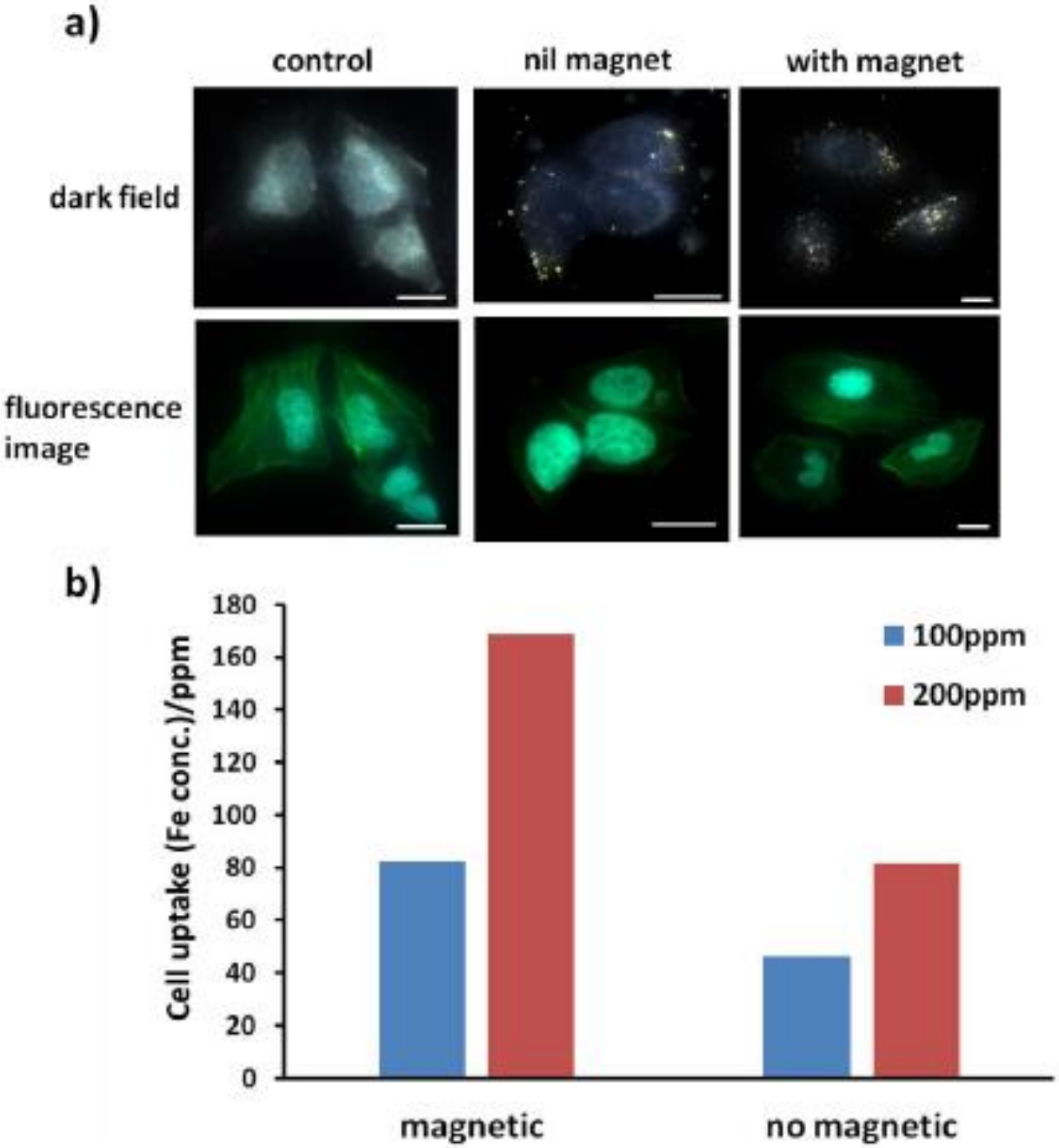

100nm
100nm

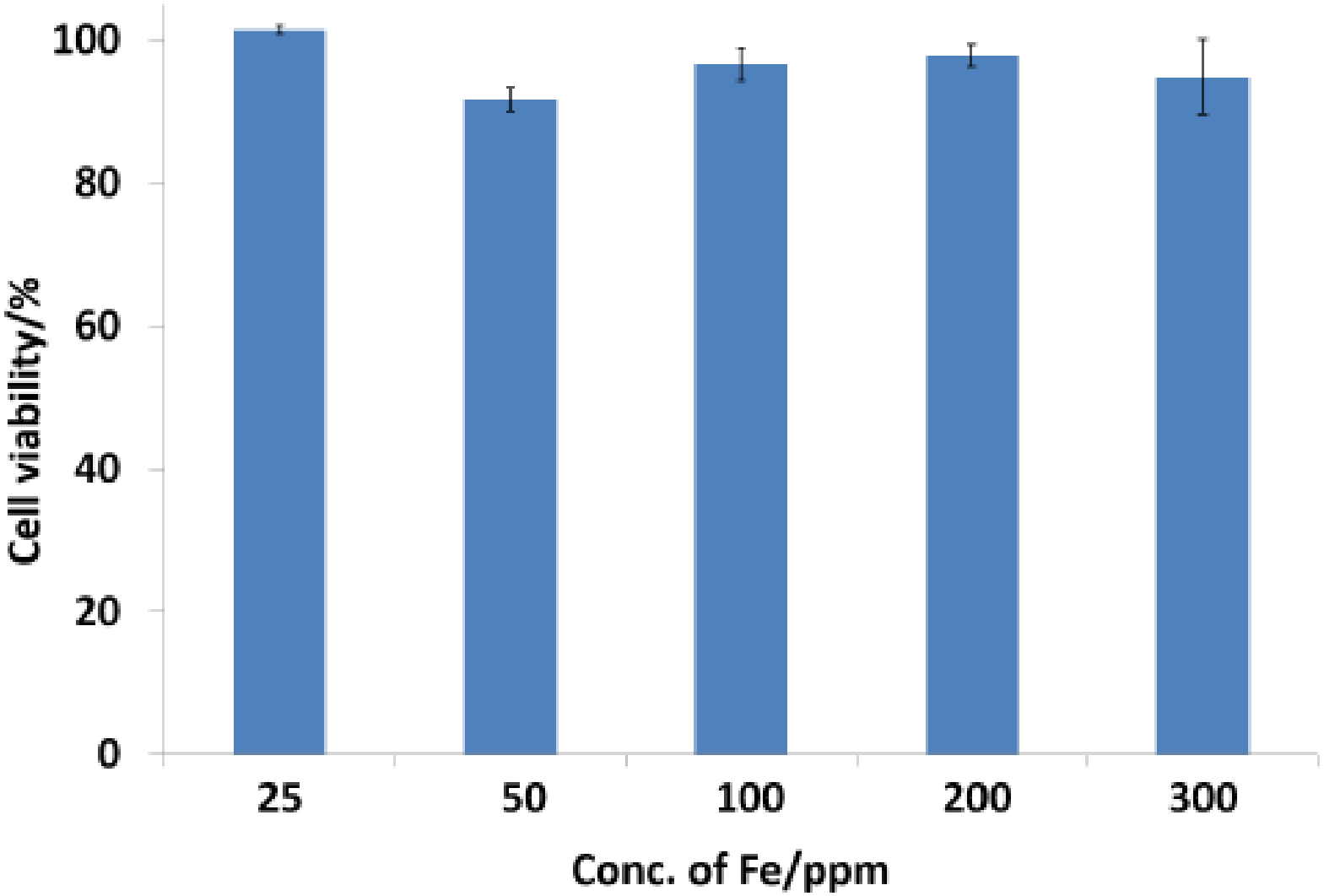
FTIR and raman spectra

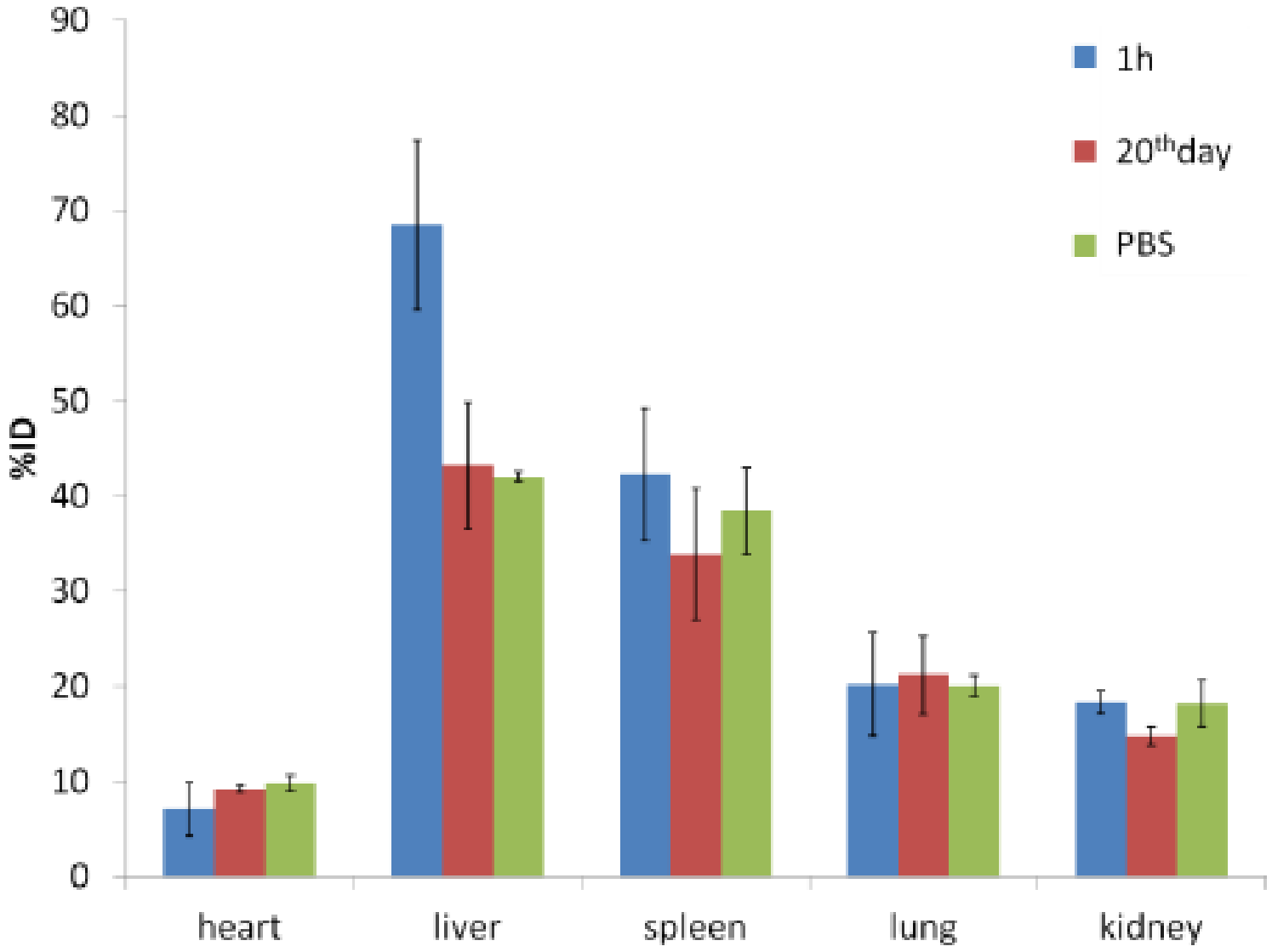



a)
O-H or NH
C-H streching
C-O streching
Pure PEG
APTES modified SiO2/h-Fe3O4@C
N-H bending
Si-O
PEGylated SiO2/h-Fe3O4@C
C-O & Si-O
3900
3400
2900
2400
1900
1400
900
400
Wavenumber/cm-1
b)
Zeta potential/mV
30
20
10
0
-10
-20
-30
24.1
22.3
-25.8
SiO2/h-Fe3O4@C
APTES modified SiO2/h-Fe3O4@C
PEGylated SiO2/h-Fe3O4@C
c)
DLS size/nm
300
250
200
150
100
221.7
189.9
170.4
SiO2/h-Fe3O4@C
APTES modified SiO2/h-Fe3O4@C
PEGylated SiO2/h-Fe3O4@C


Day1
Day7
H_2O
100nm
PBS
(pH7)
100nm
PBS
(pH5)
100nm
Day1
Day7
DMEM
100nm
FBS
100nm


a)
control
nil magnet
with magnet
dark field
fluorescence image
b)
Cell uptake (Fe conc.)/ppm
180
160
140
120
100
80
60
40
20
0
100ppm
200ppm
magnetic
no magnetic


100
80
60
40
20
0
Cell viability/%
25
50
100
200
300
Conc. of Fe/ppm


90
80
70
60
50
40
30
20
10
0
%ID
1h
20th day
PBS
heart
liver
spleen
lung
kidney