

Passion fruit-like nano-architectures: enabling the clinical translation of metal nanomaterials

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a) nest-scuola normale superiore

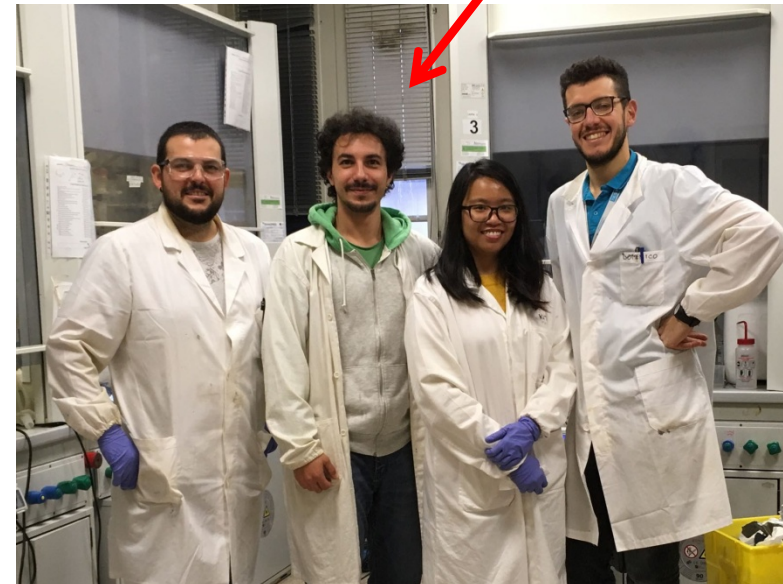
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NEST Lab



Dr. Valerio Voliani

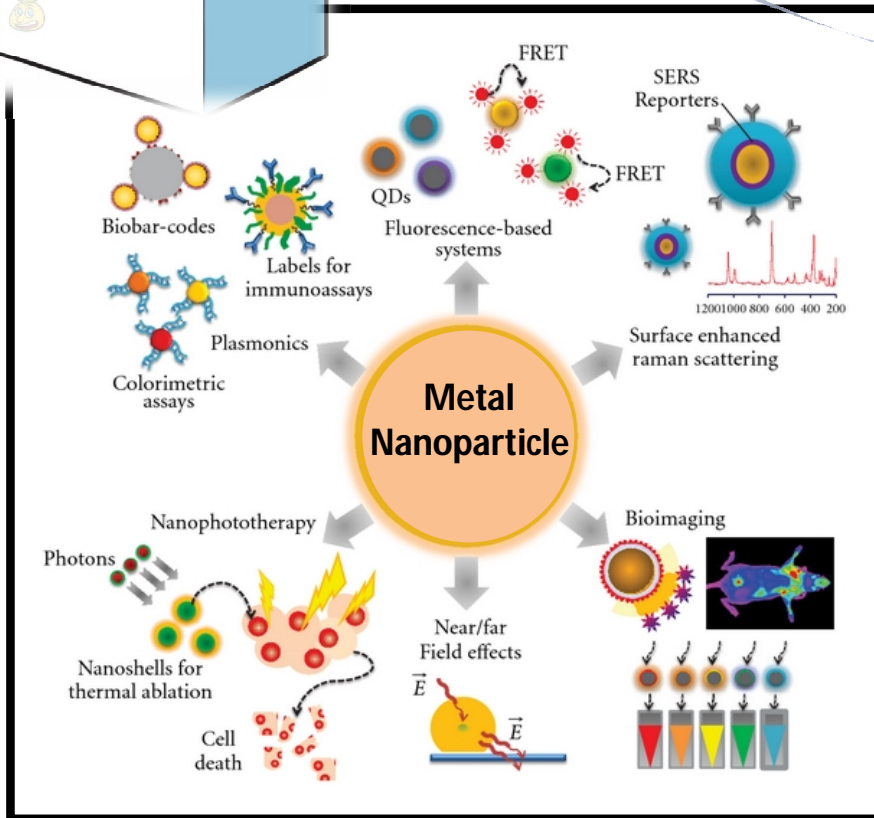


Metal nanoparticles: the great promise

Bench



Bedside



Nanocomponent	Investigational			Commercial		
	Therapeutic	Device	Total	Therapeutic	Device	Total
Hard NP	3	12	15	0	28	28
Nanodispersion	5	0	5	1	1	2
Polymeric NP	23	0	23	9	0	9
Protein NP	4	0	4	2	0	2
Liposome	53	0	53	7	1	8
Emulsion	18	1	19	9	0	9
Micelle	8	0	8	3	1	4
Dendrimer / Fleximer	2	2	4	0	3	3
Virosome	6	0	6	2	0	2
Nanocomposite	0	0	0	0	18	18
NP Coating	0	2	2	0	6	6
Nanoporous Material	0	3	3	0	2	2
Nanopatterned	0	2	2	0	2	2
Quantum Dot	0	1	1	0	4	4
Fullerene	0	1	1	0	0	0
Hydrogel	0	0	0	0	1	1
Carbon Nanotube	0	1	1	0	0	0
Totals	122	25	147	33	67	100

A critical hurdle: nanoparticles persistence in the body

Major organ sites of nanoparticle localization

Lungs

- Microparticle accumulation (>1000 nm)¹⁶
- Particles are trapped in capillaries

Spleen

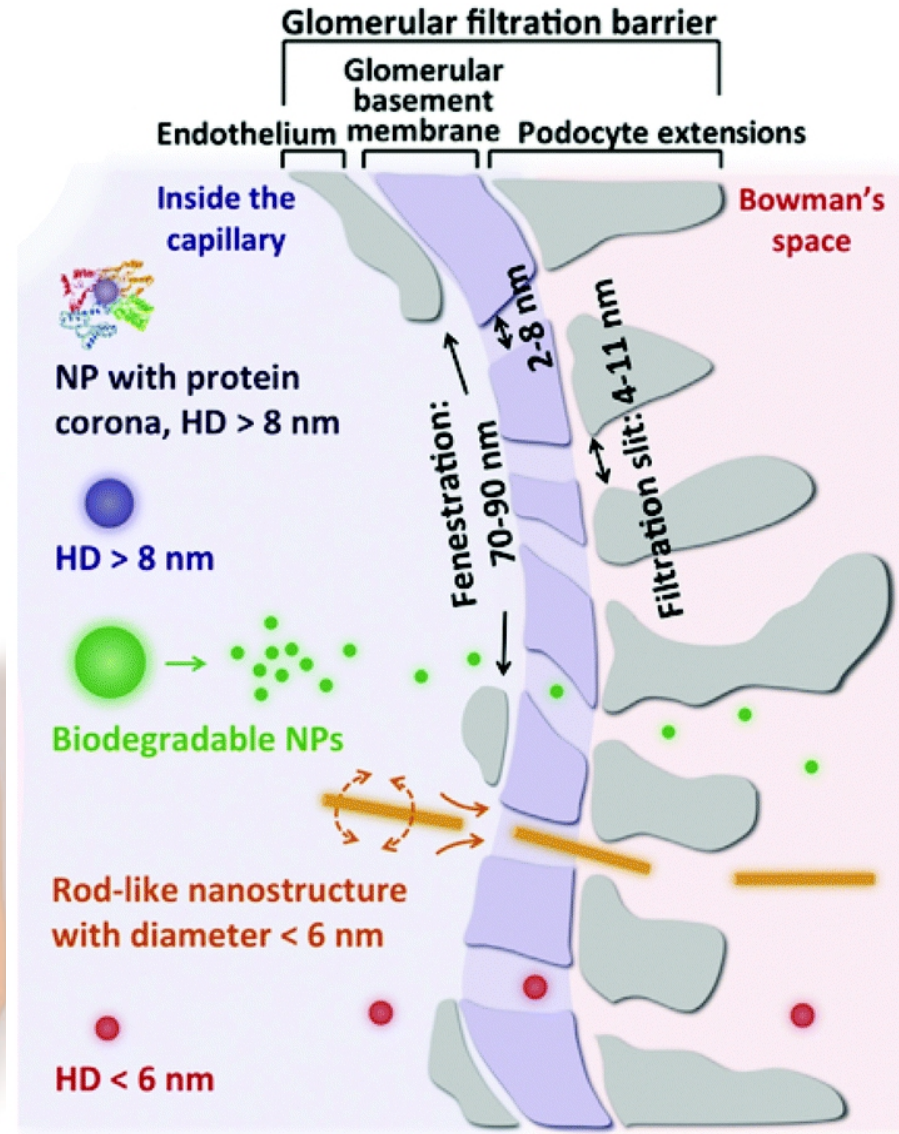
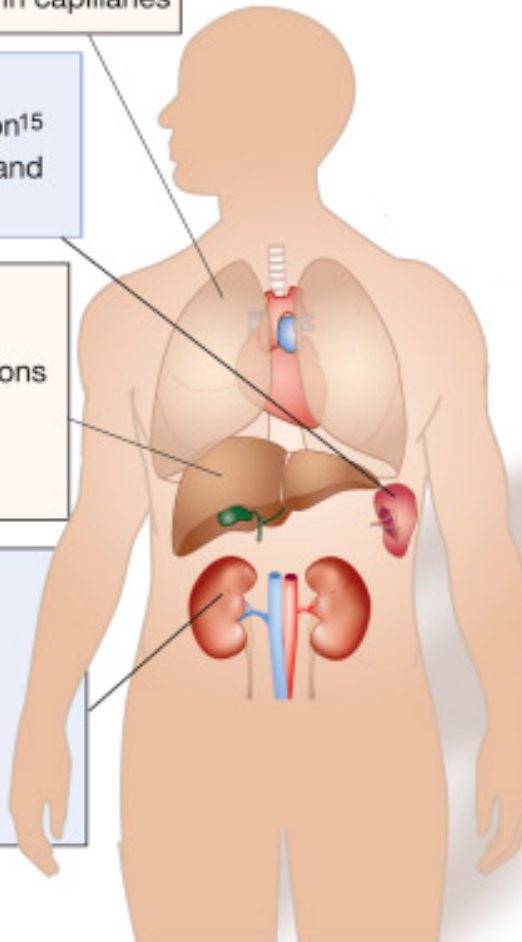
- Second most common¹⁵
- Macrophage uptake and trafficking

Liver

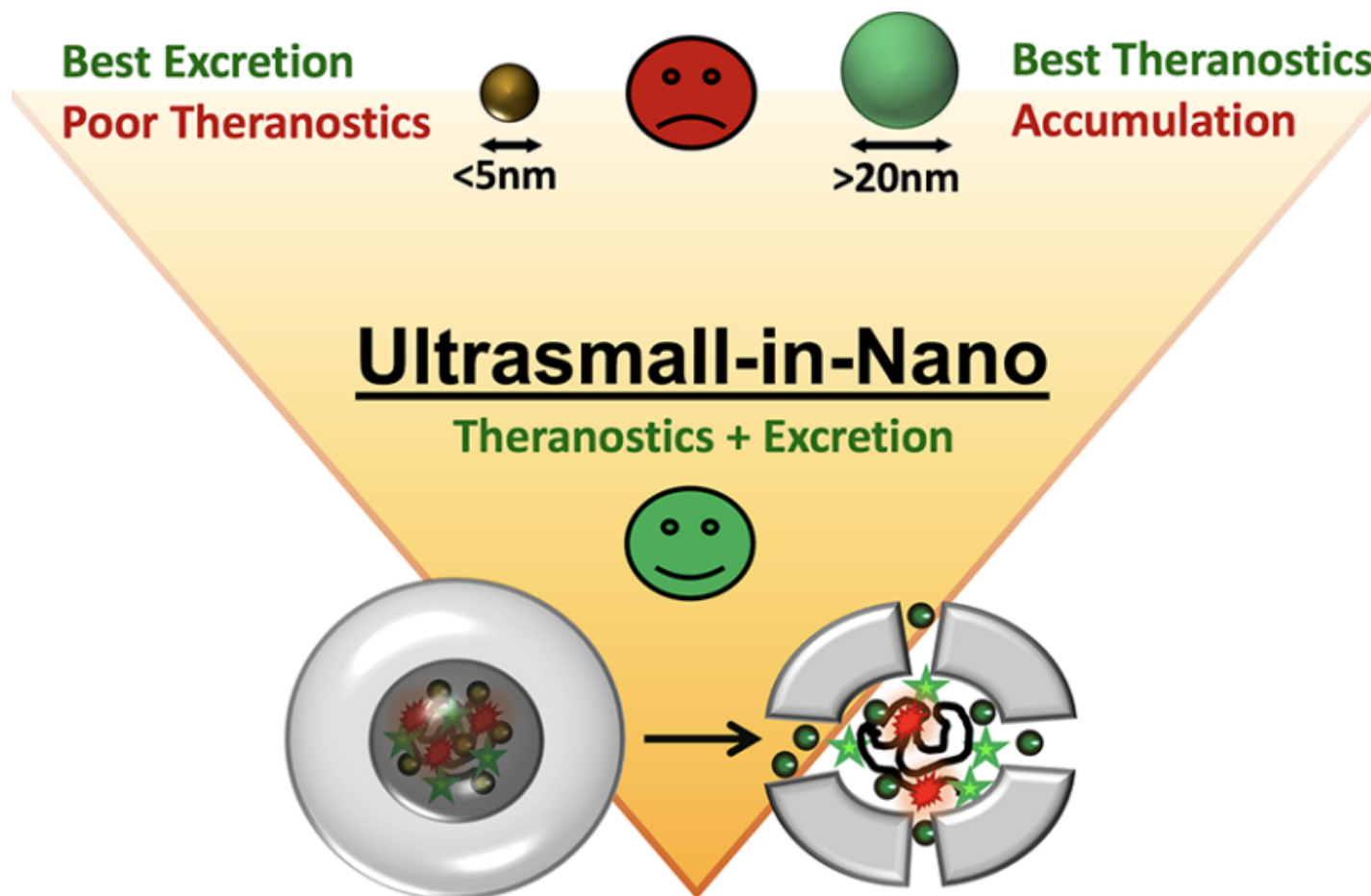
- Most common¹⁵
- Endothelial fenestrations (<200 nm)
- Kupffer cells uptake opsonized particles

Kidneys

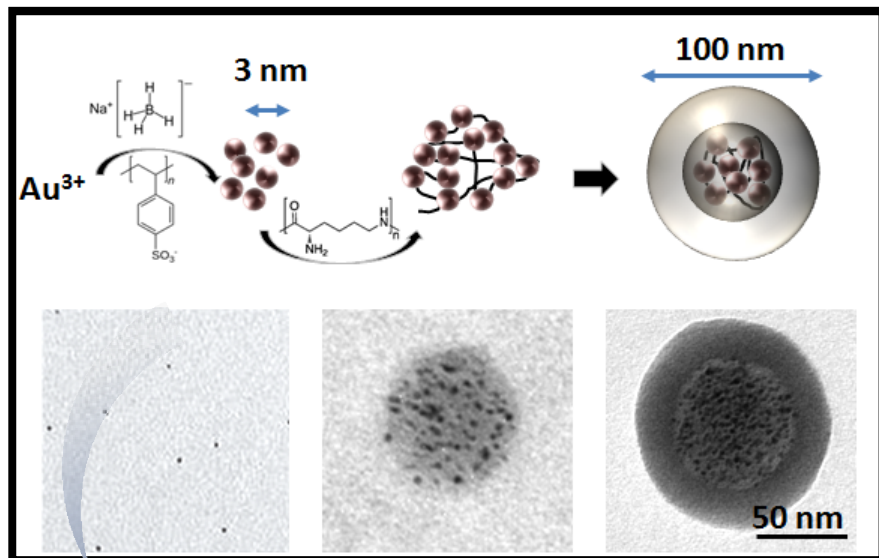
- Less common localization¹⁴
- Particle filtration and reabsorption



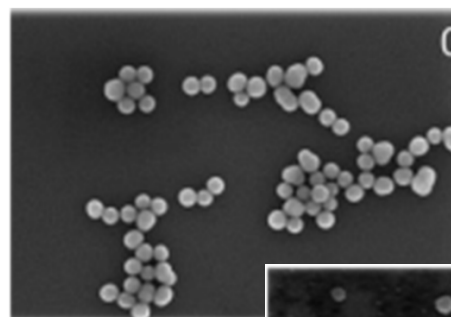
A smart approach: ultrasmall-in-Nano



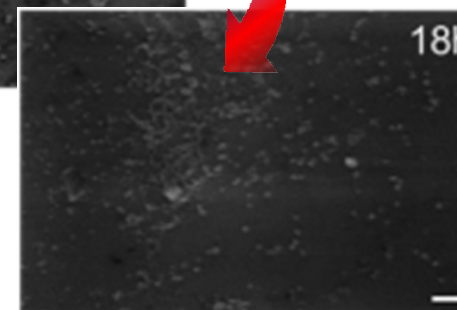
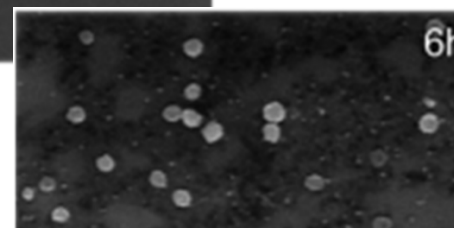
Passion fruit- like nano-architectures



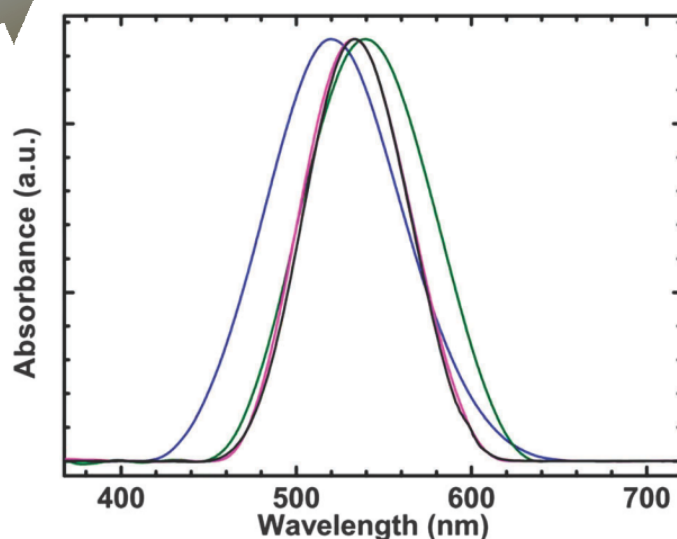
Biodegradable



Human Serum



Optical behavior



ChemComm



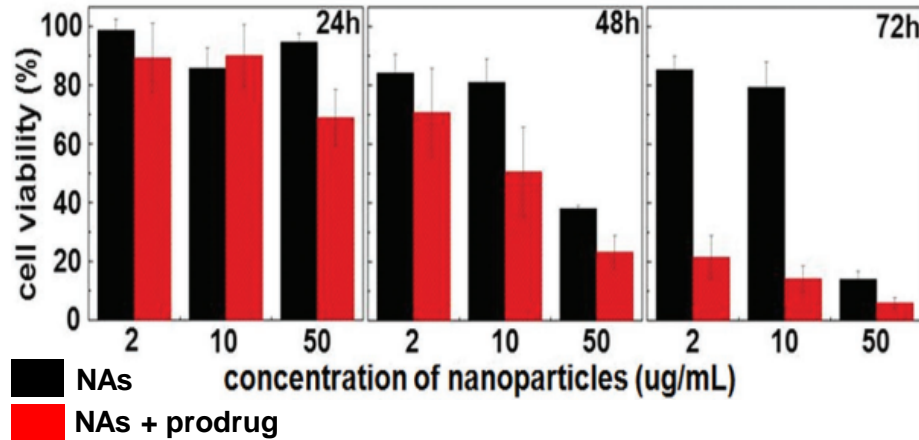
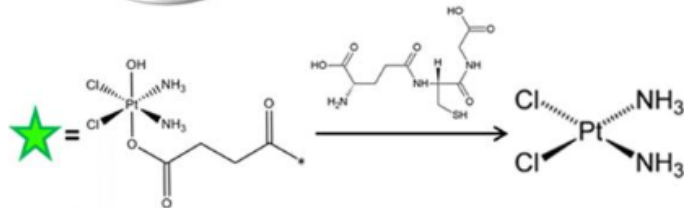
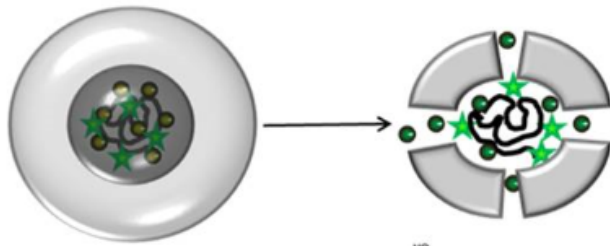
COMMUNICATION

Biodegradable hollow silica nanospheres containing gold nanoparticle arrays†

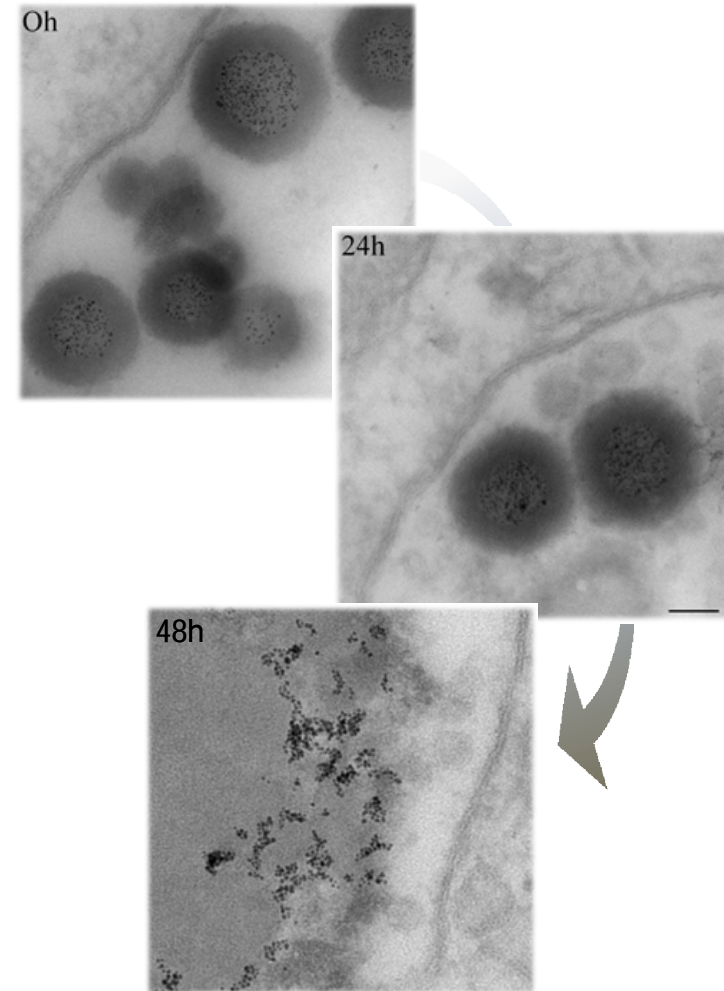

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In vitro drug delivery: cisplatin prodrug

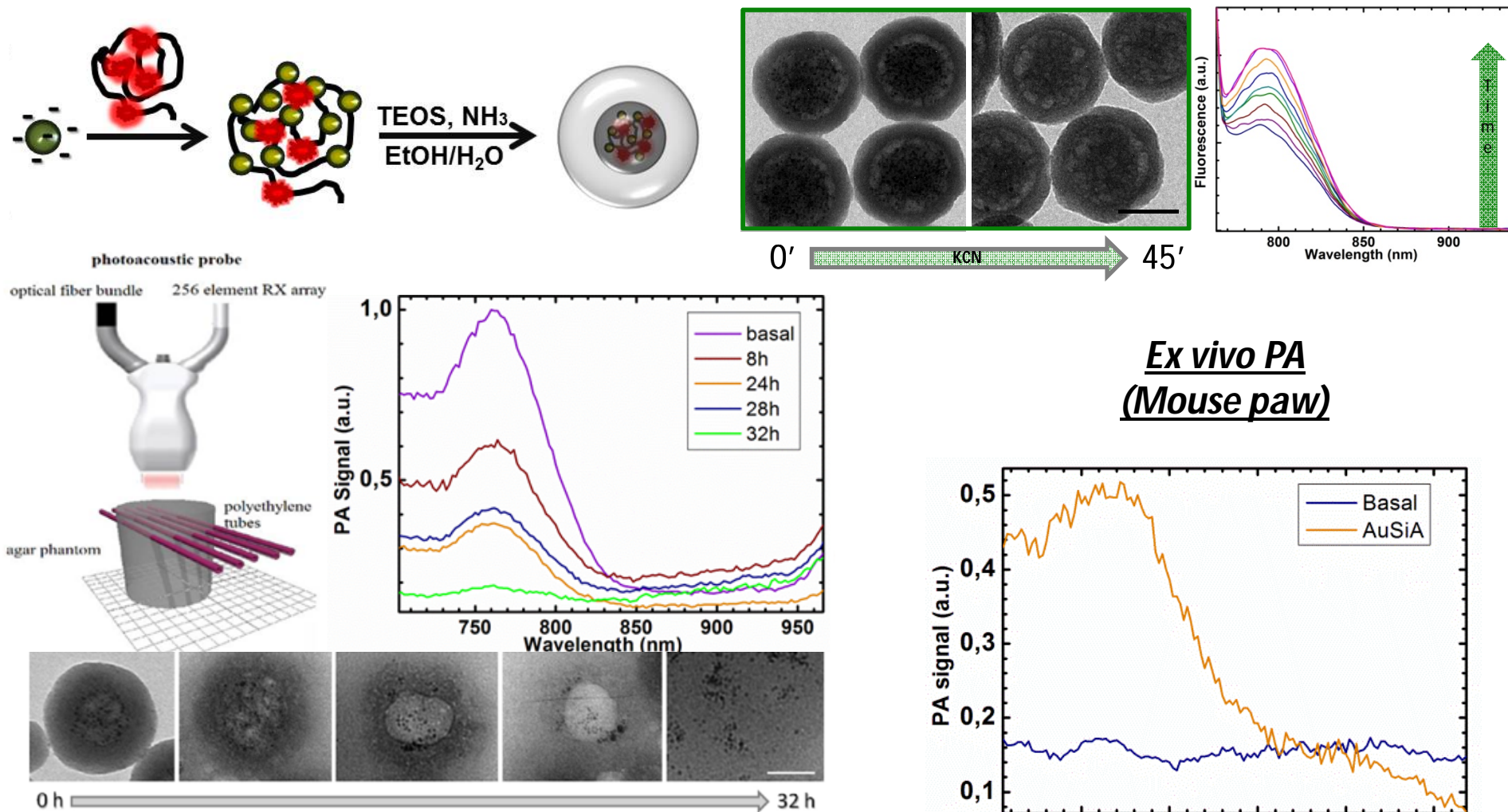


MIA PaCa-II cells line

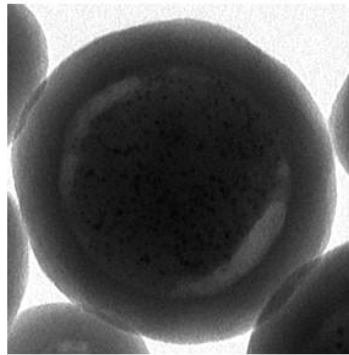


Photoacoustic imaging

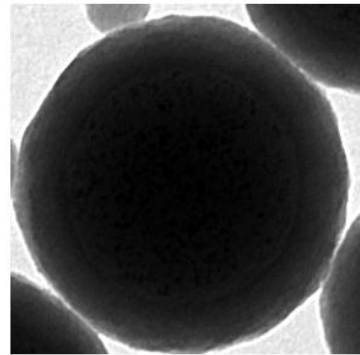
PA enhancement from fluorescence quenching



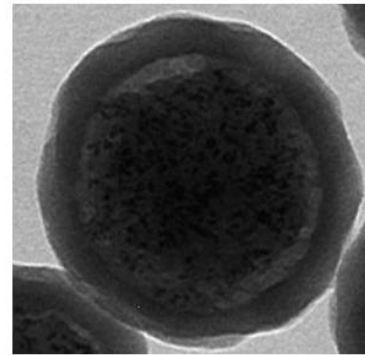
Passion fruit-like NAs: a versatile nanoplatform



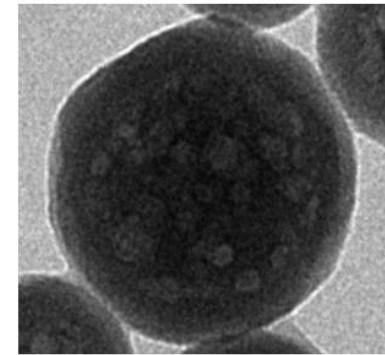
Pt NPs



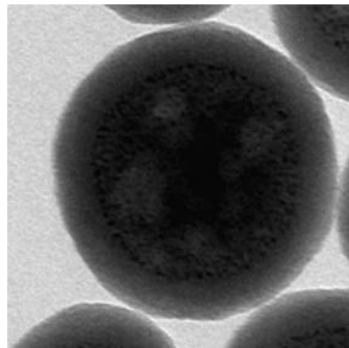
Ag NPs



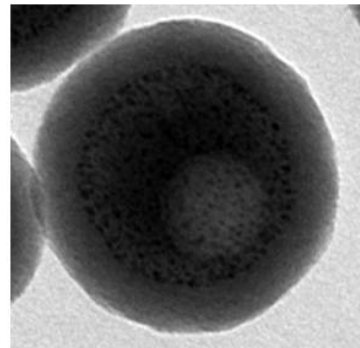
Mixed metals



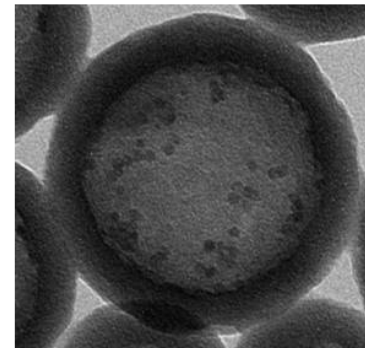
Metal-free



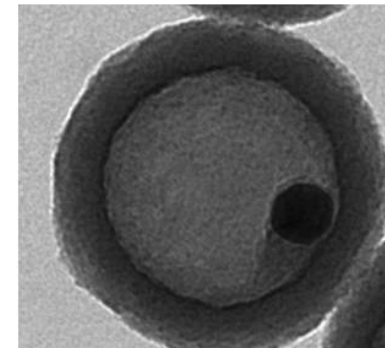
<1 nm Au NPs



<1 nm Ag NPs



4 nm SPIONs



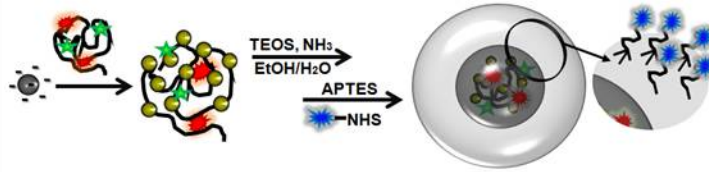
Yolk-shell NAs

SCIENTIFIC REPORTS

OPEN Passion fruit-like nano-architectures: a general synthesis route

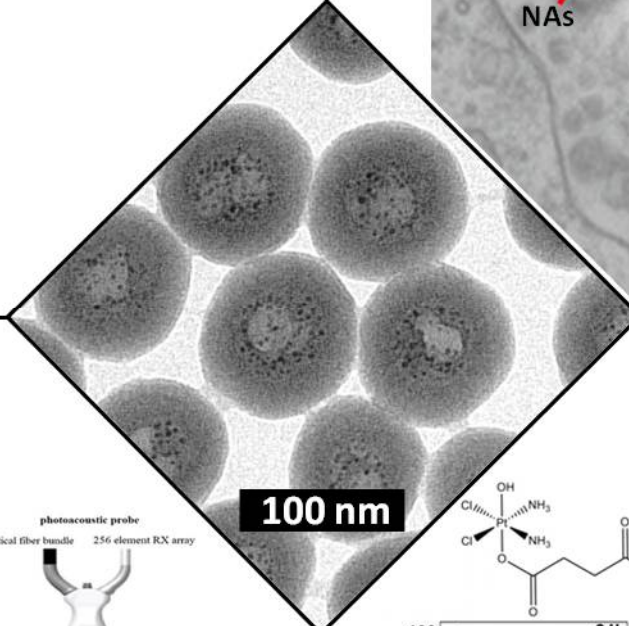
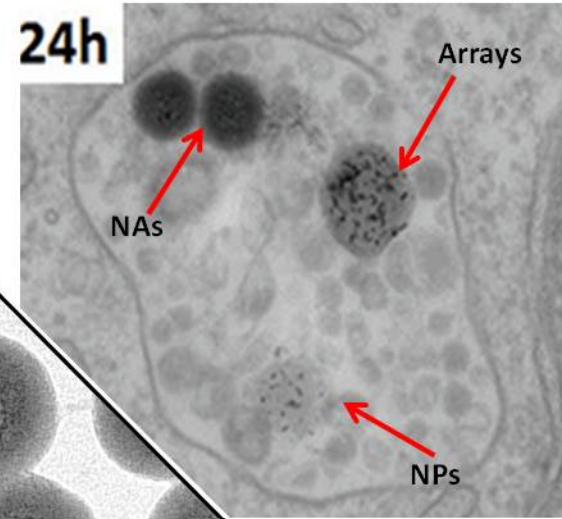
In summary

All-in-one nanoplatform

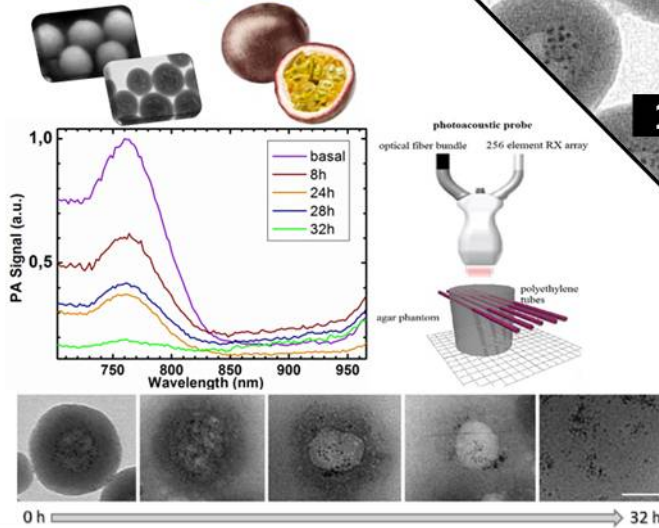


- ★ = prodrug
- ★ = chelating agent / dye
- ★ = targeting agent / dye

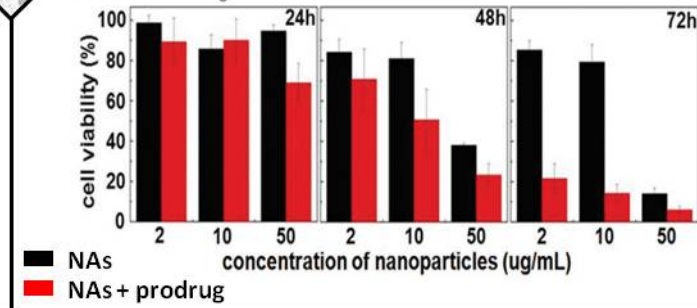
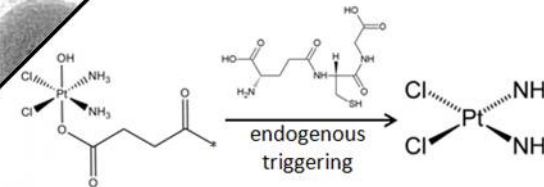
Biodegradable



Imaging



Drug delivery



Thank you
for your
kind
attention