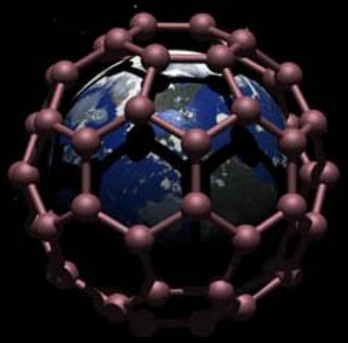
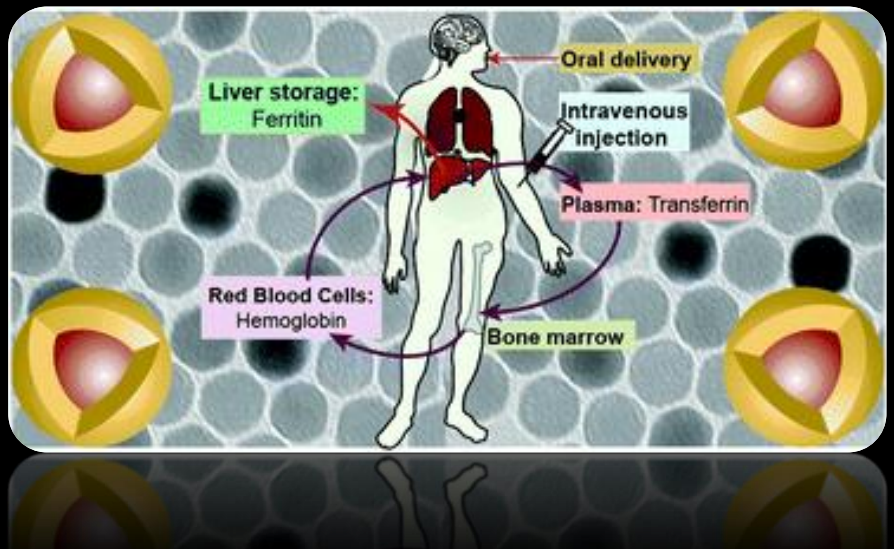


ICP-MS-based analytical method for engineered nanoparticles

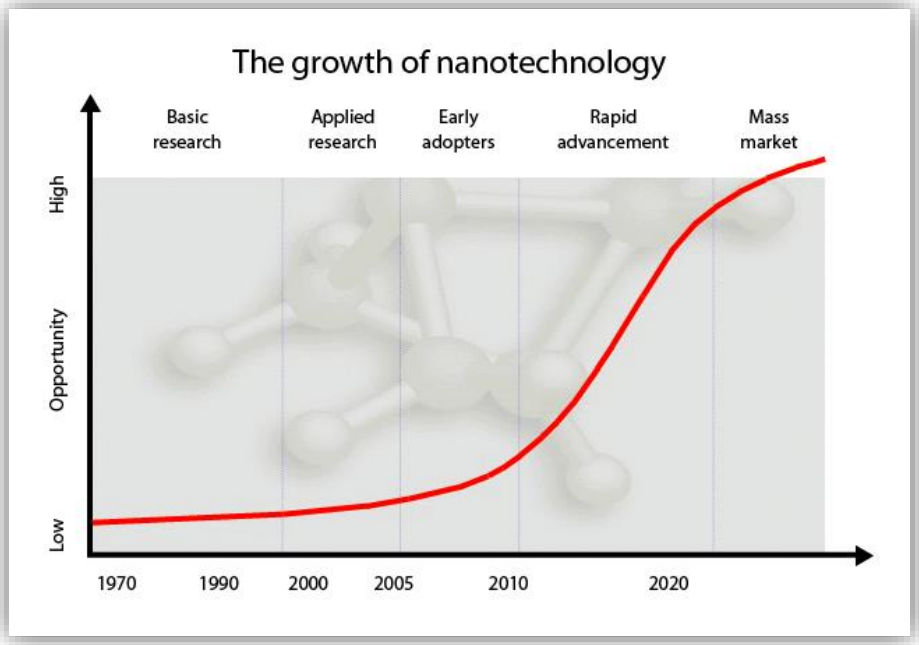


thesis

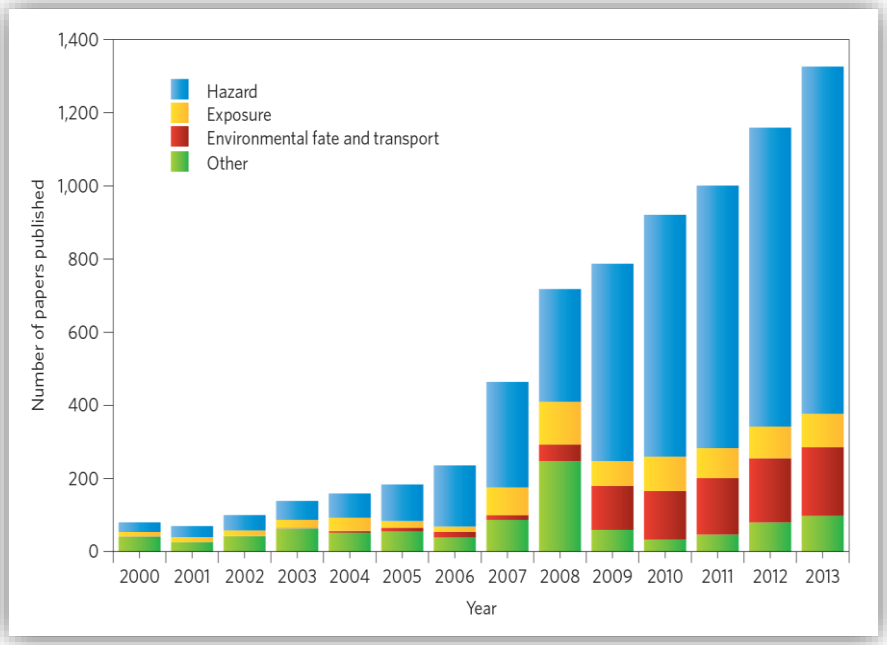
A decade of uncertainty

Ten years after the publication of an influential report on the uncertainties in nanoscale science and engineering, **Andrew D. Maynard** asks, are we in danger of creating a new metaphorical grey goo?

whatever you might think about the economic and societal benefits of this new suite of technologies, extensive further investment into possible applications would be foolish without direct investment in research and action on potential implications.



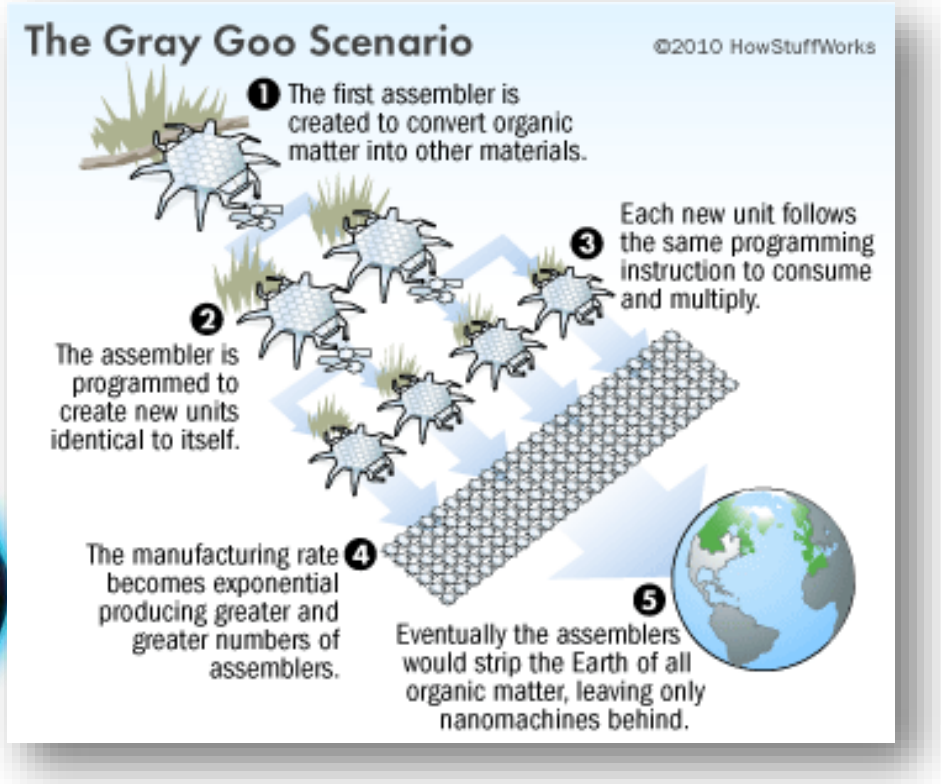
US Department of Energy



Nature Nanotechnology 9, 159–160 (2014)

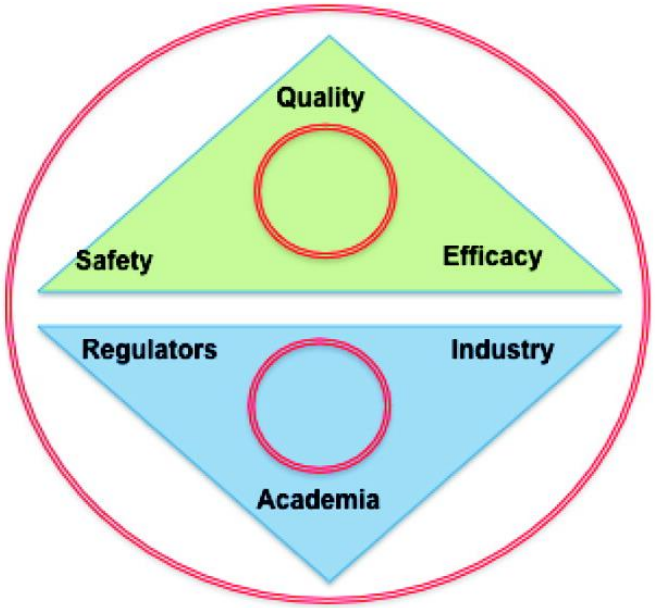
What is the gray goo nightmare?

Grey goo is a hypothetical end-of-the-world scenario involving molecular nanotechnology in which out-of-control self-replicating robots consume all matter on Earth while building more of themselves, a scenario that has been called ecophagy ("eating the environment").



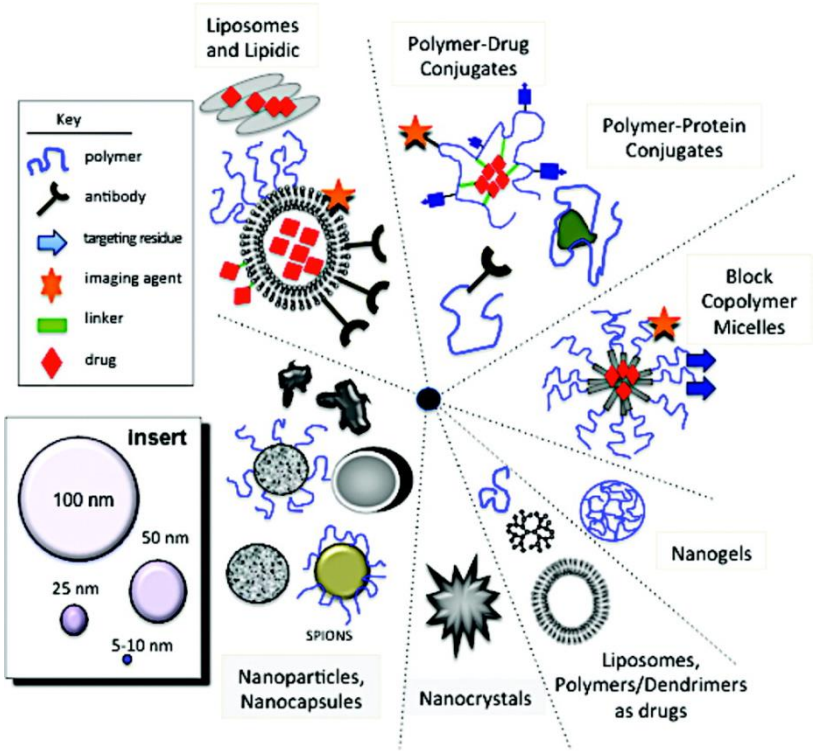
http://science.howstuffworks.com/gray-goo.htm

A realistic look at the promises and perils of nanomedicine



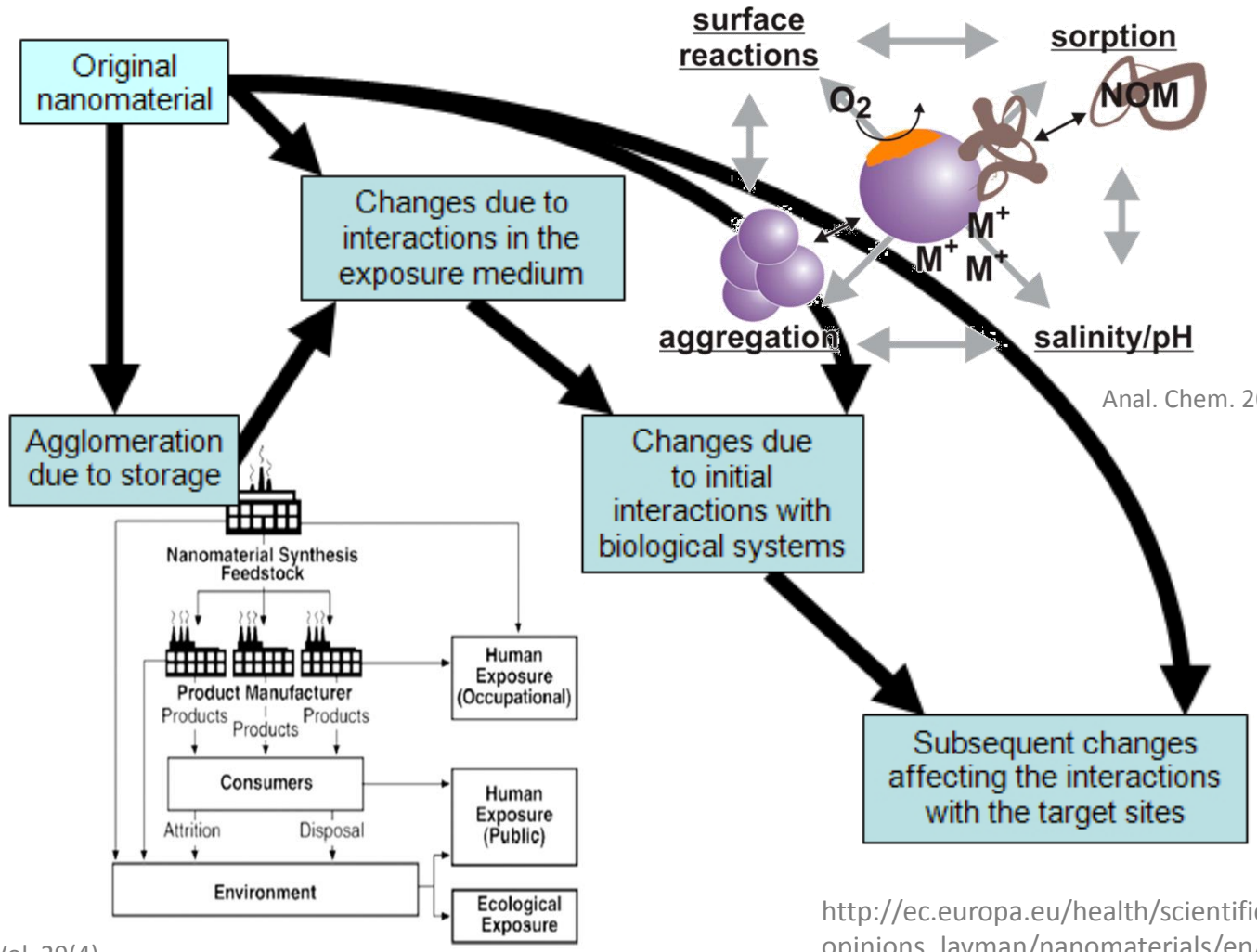
Is the emerging field of nanomedicine a breathtaking technological revolution that promises remarkable new ways of diagnosing and treating diseases? Or does it portend the release of dangerous nanoparticles, nanorobots or nanoelectronic devices that will wreak havoc in the body?

About 40 nano health care products actually are in use and nano-sized drugs, drug delivery devices, imaging agents, and other products are on the horizon.



Mol. Pharmaceutics, 2011, 8, 2101–2141

Dynamic transformations nanoparticles undergo in the body or the environment and the interplay between these transformations



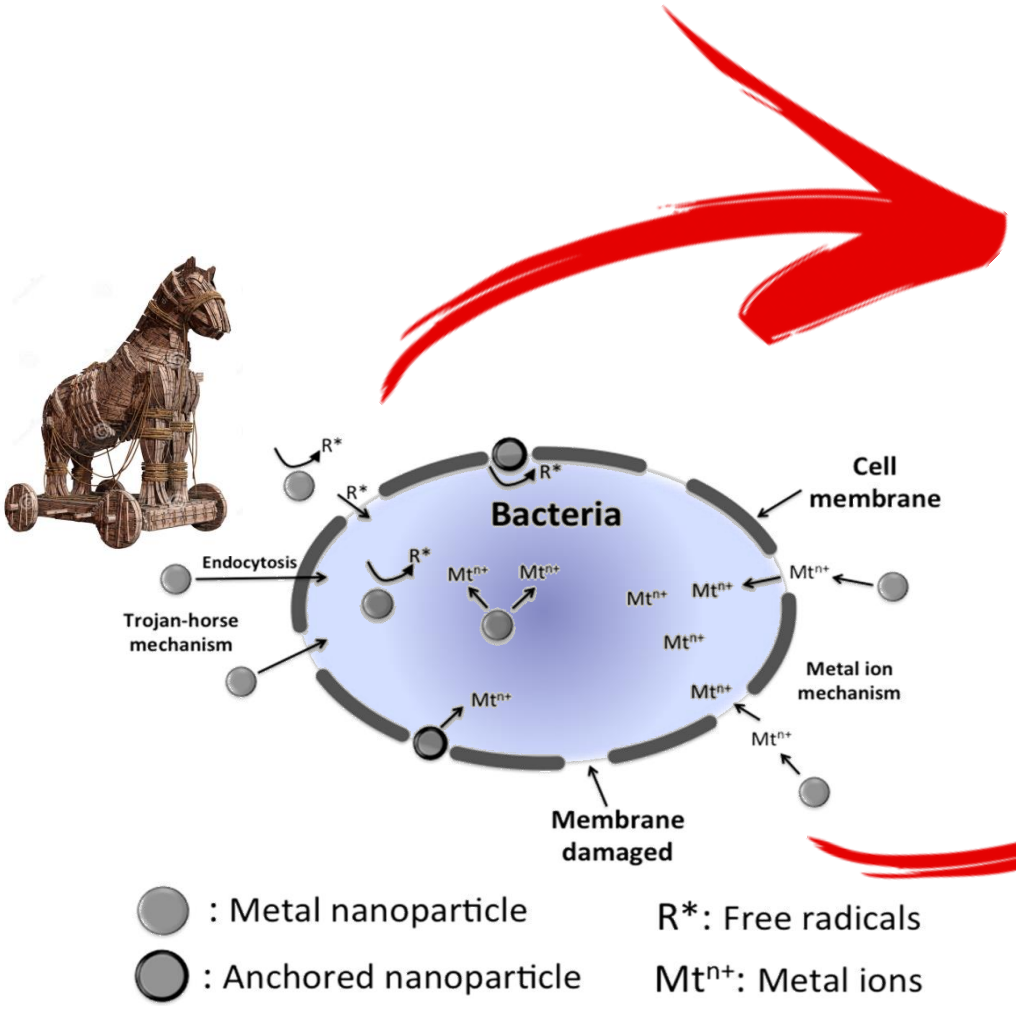
Anal. Chem. 2013, 85, 3036−3049

http://ec.europa.eu/health/scientific_committees/opinions_layman/nanomaterials/en/l-3/4.htm

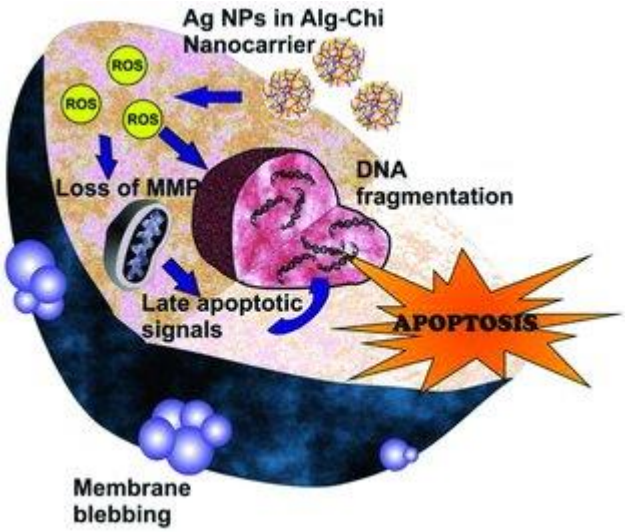
Orient. J. Chem., Vol. 29(4), 1399-1408 (2013)

Fig 3: Potentials to release and exposures

Antimicrobial behaviour of metal nanoparticles

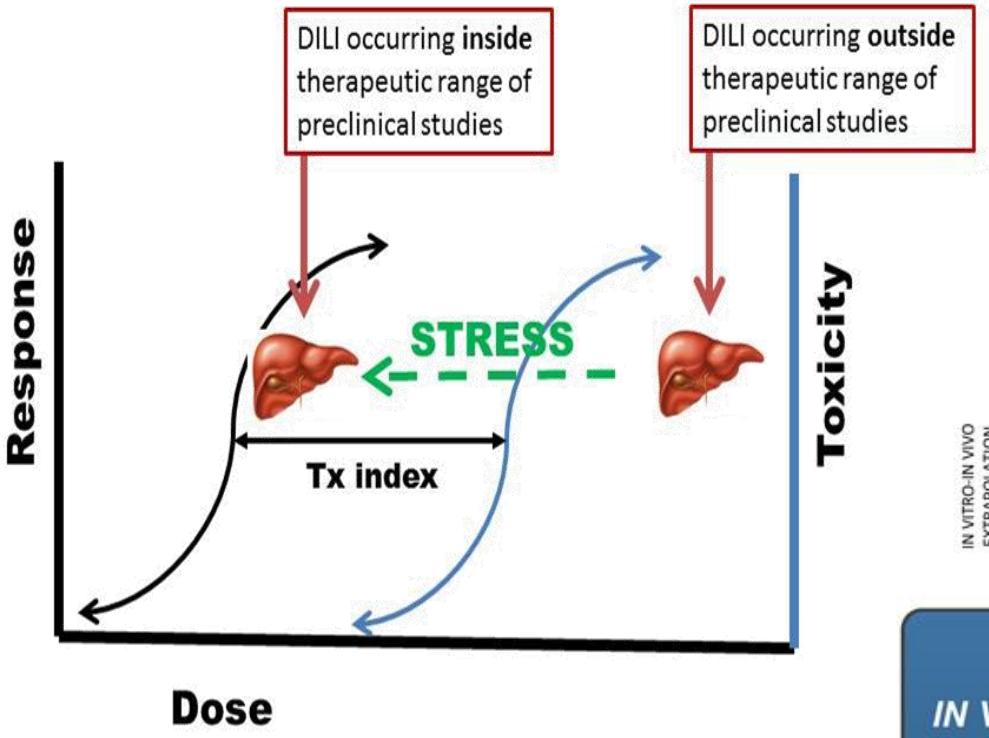


Int. J. Mol. Sci. 2015, 16, 2099-2116

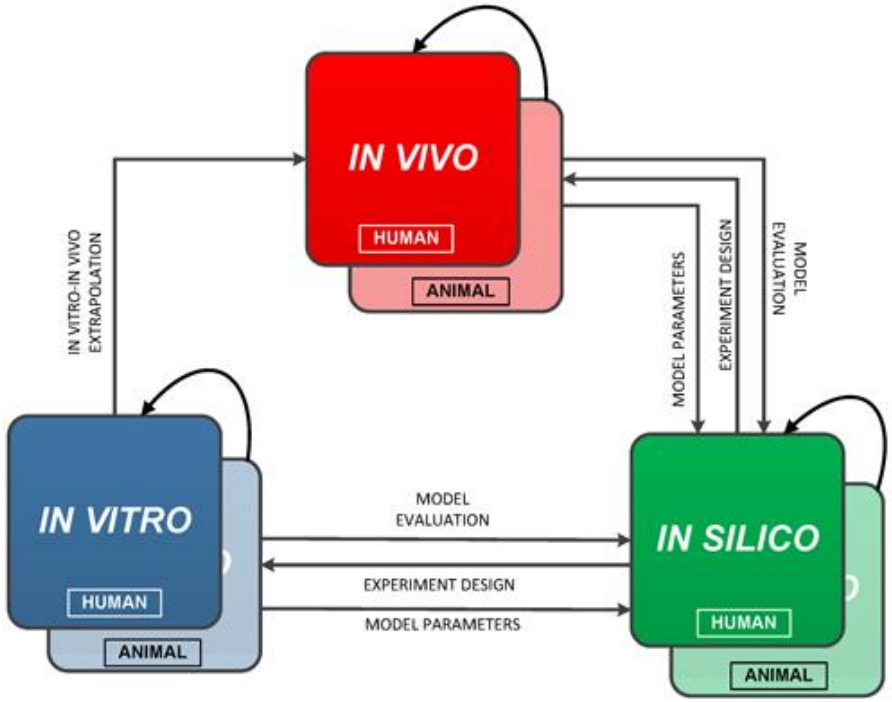


Adv. Healthcare Mater. 2014, 3, 106–114

Toxico-/Pharmacodynamics : Dose-Response Effect

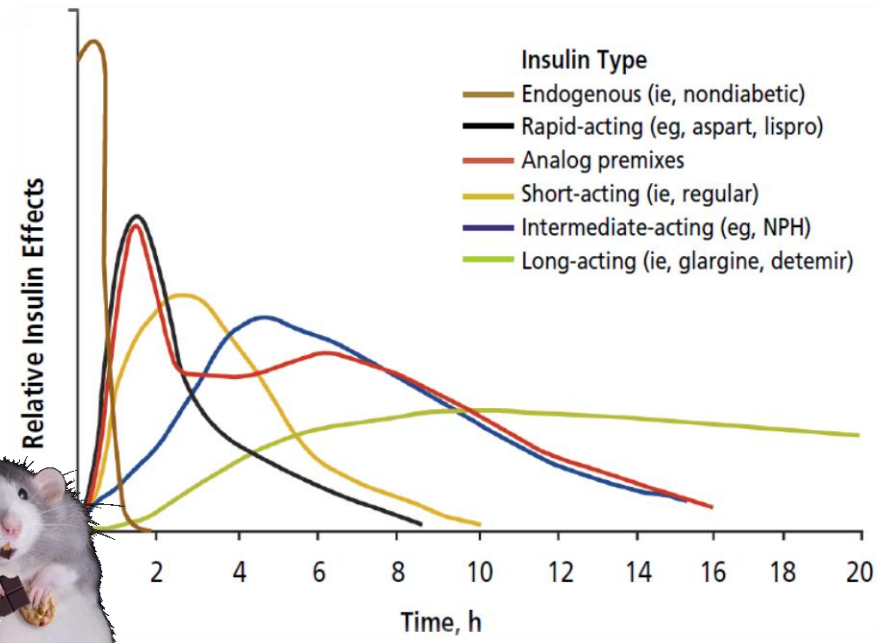


http://pharmaceuticalintelligence.com/tag/anti-cancer-therapy/



Journal of Toxicology , 2014, Article ID 852890

Pharmacokinetics of human insulins compared with insulin analogs and endogenous insulin



JAOA • Vol 109 • No 1 • January 2009

Factors Affecting the Clearance and Biodistribution of NPs

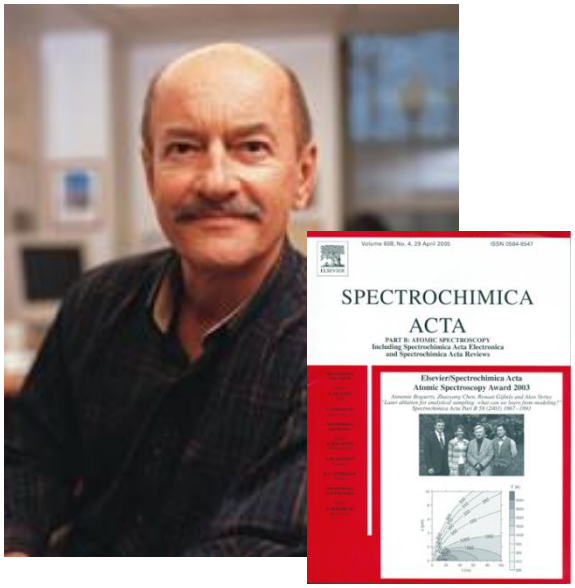
- Size
- Surface Charge
- Surface modifications
- Physiological Defects
- Active Targeting

Mol. Pharmaceutics, 2008, 5 (4), pp 505–515

Current focal areas

In order to fully understand how these metallodrugs behave in vivo, it is necessary to identify the products of their biotransformation and degradation. Such an analysis includes identification and characterization of chemically transformed species, as well as complexes of the drug with other species present in the biological system and with its target. In many cases, it has been found that the therapeutically active species is not the administered drug but rather a metabolite. Such discoveries can potentially help in the development of more effective or alternative drug products. Furthermore, many metallodrugs are known to have severe side-effects, and the margin between beneficial and toxic doses can be narrow, making it necessary to understand mechanisms of toxicity as well as therapeutic action, and to identify the toxicologically active species.

Gary M. Hieftje

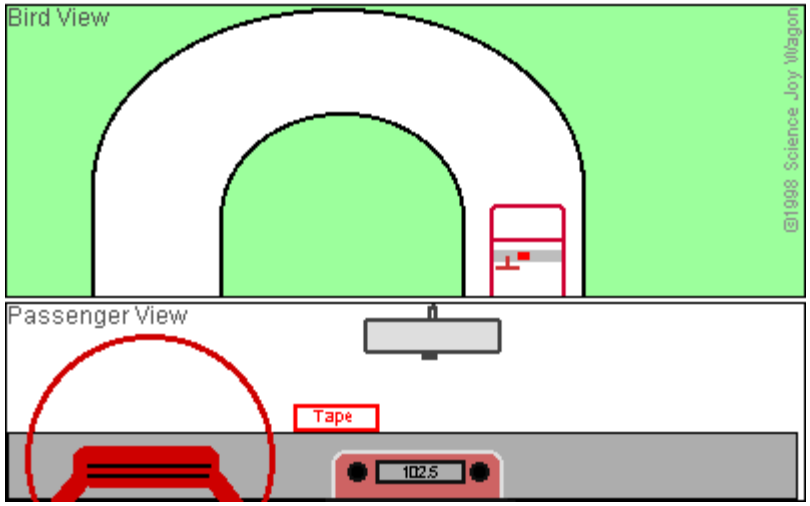


Department of Chemistry,
Indiana University

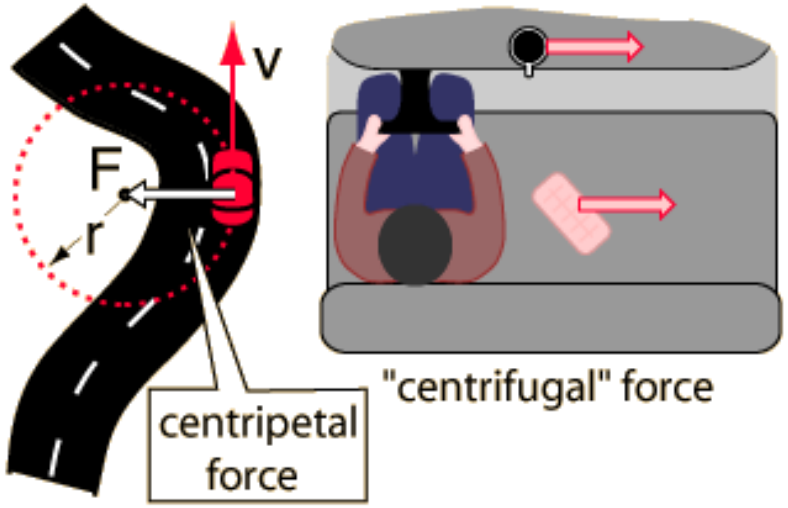
Spectrochimica Acta Part B 59 (2004) 135–146

Online Centrifugal Separation Technique

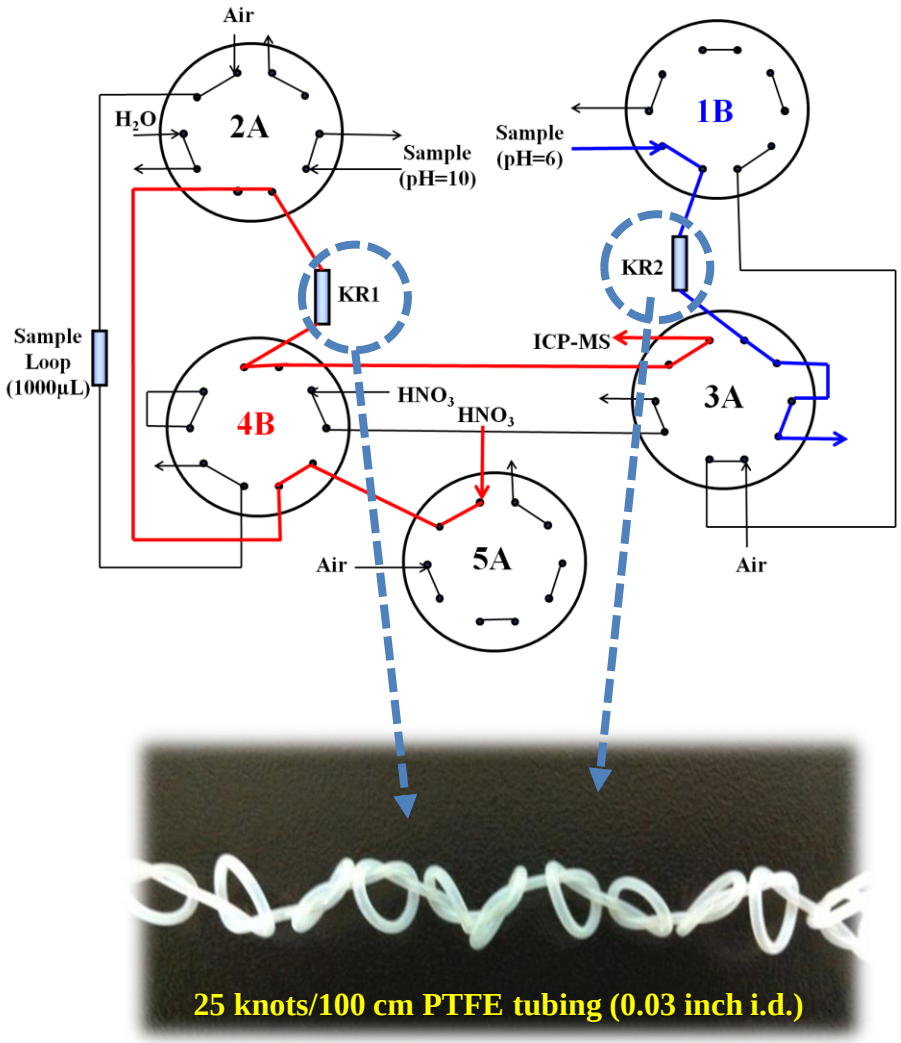
$$F = \frac{mv^2}{R}$$



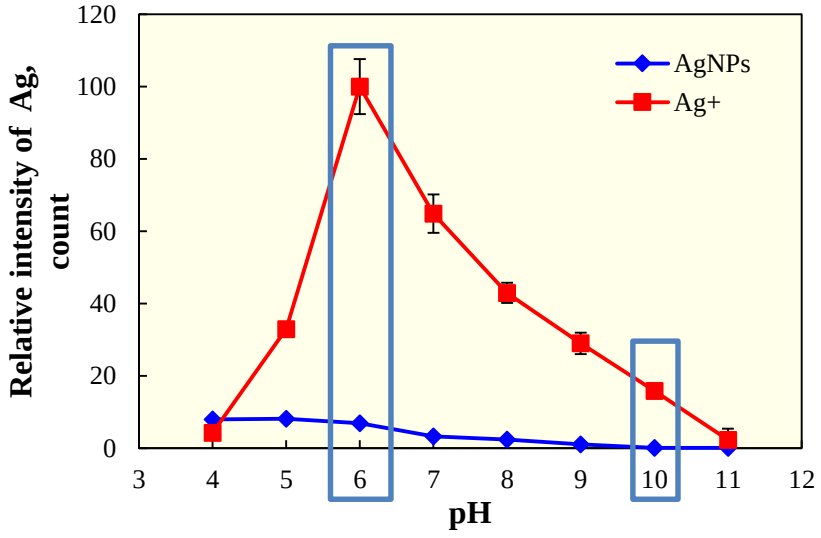
When you move along a curved path, unattached objects tend to move toward the outside of the curve.

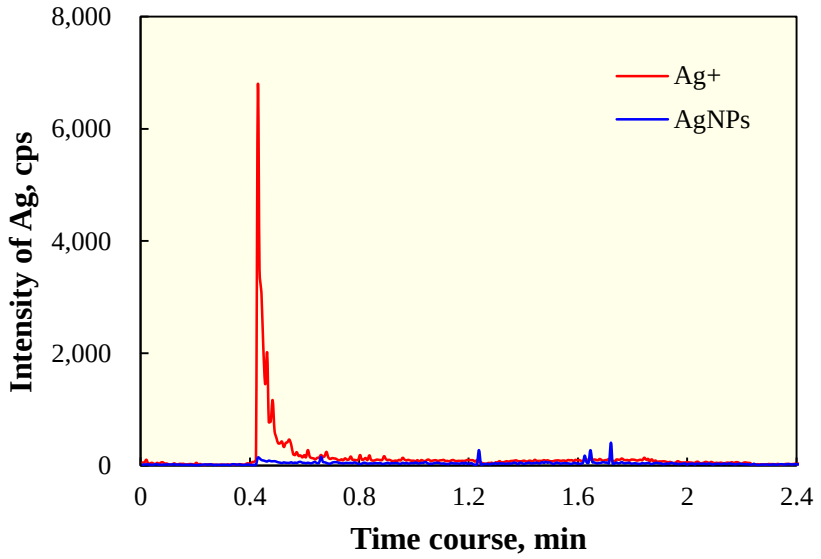


Differentiation of Ag^+/AgNPs by Dual-KR-SPE-ICP-MS System

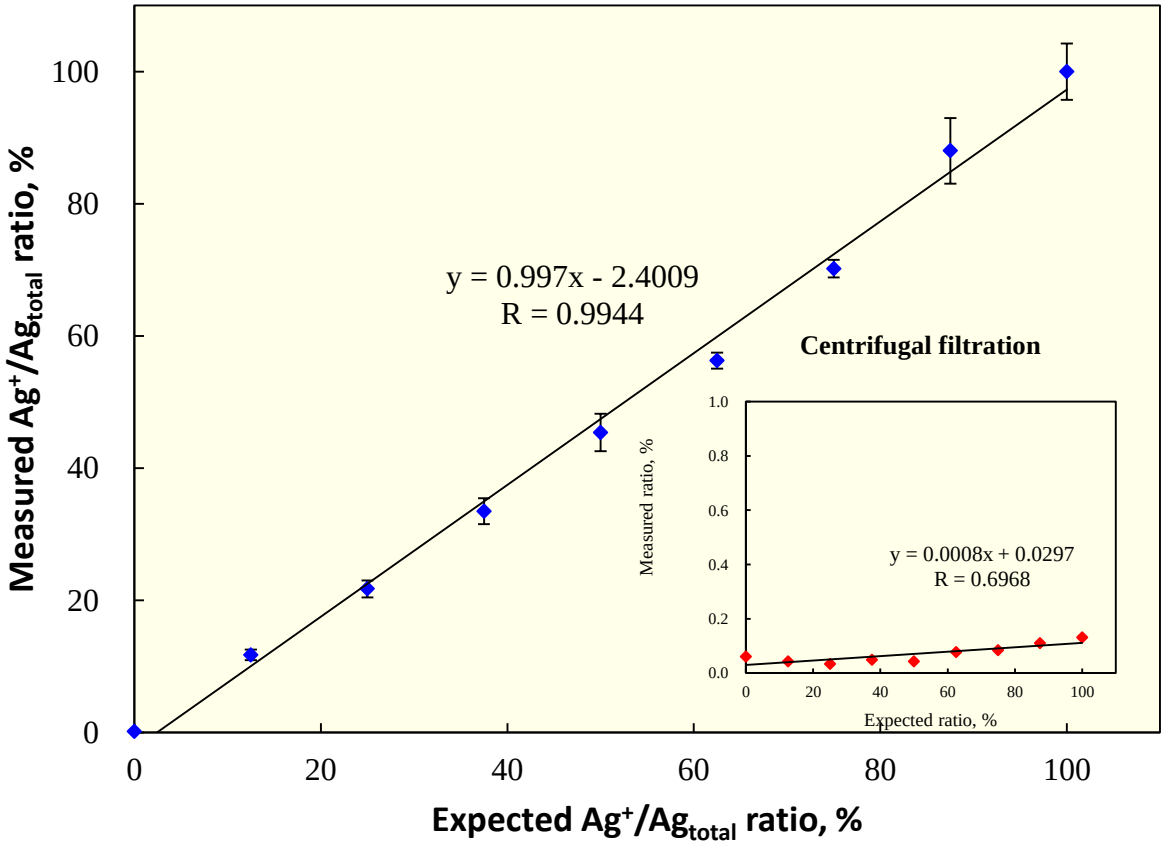


Knotted Reactor





Analytical Performance



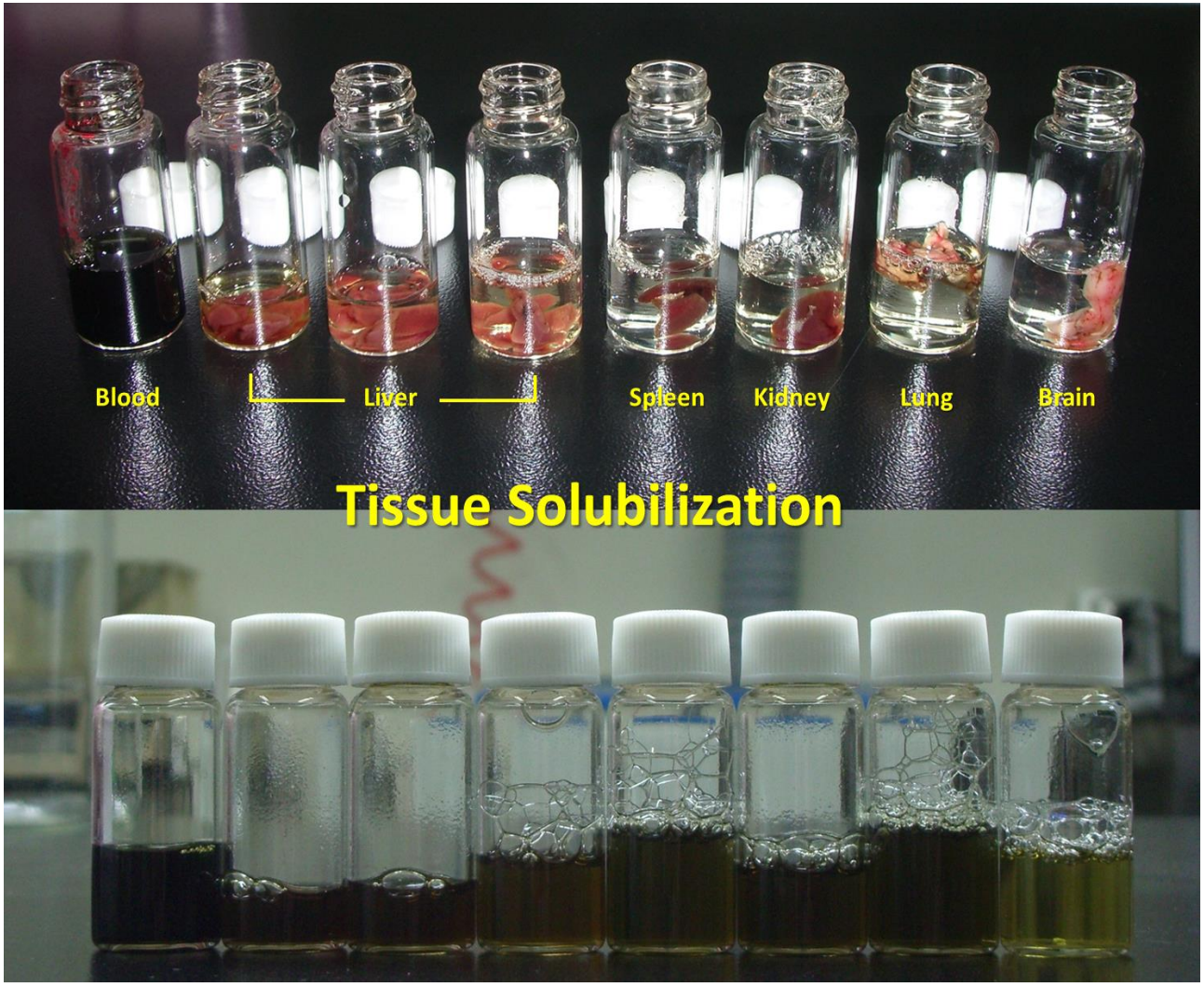
Knotted Reactor

V.S

Centrifugal Filter

	working range, µg L^{-1}	R	MDL, µg L^{-1}	spike recovery, %
AgNPs (pH = 6)	0.1 – 10	0.9998	0.006	83 – 111
Ag^+ (pH = 6)	0.1 – 10	0.9989	0.006	89 – 113
Ag^+ (pH = 10)	0.1 – 10	0.9995	0.234	88 – 107

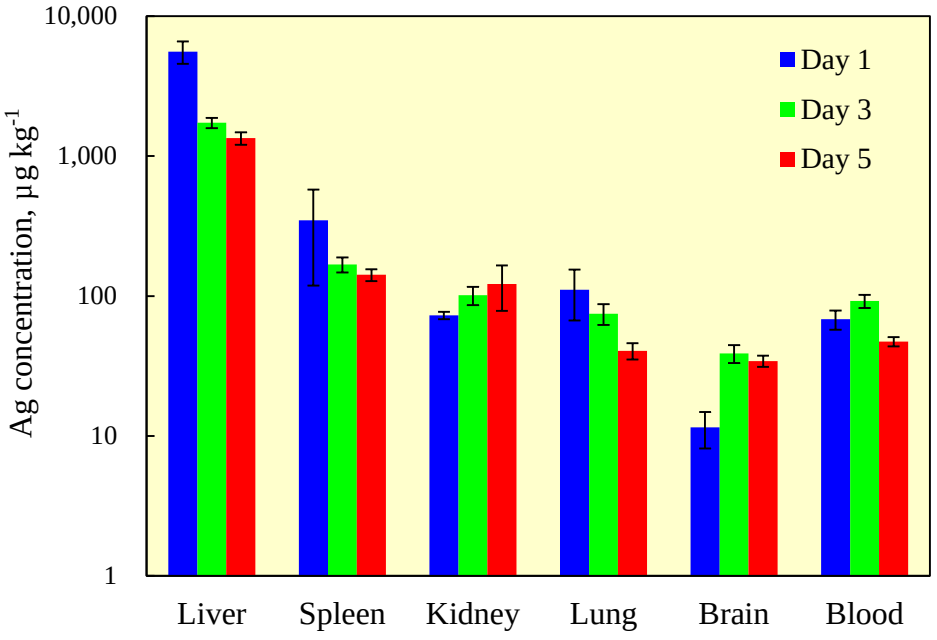
SOLVABLE™ is an aqueous based solubilizer that has an excellent capacity for the solubilization of wet tissue .



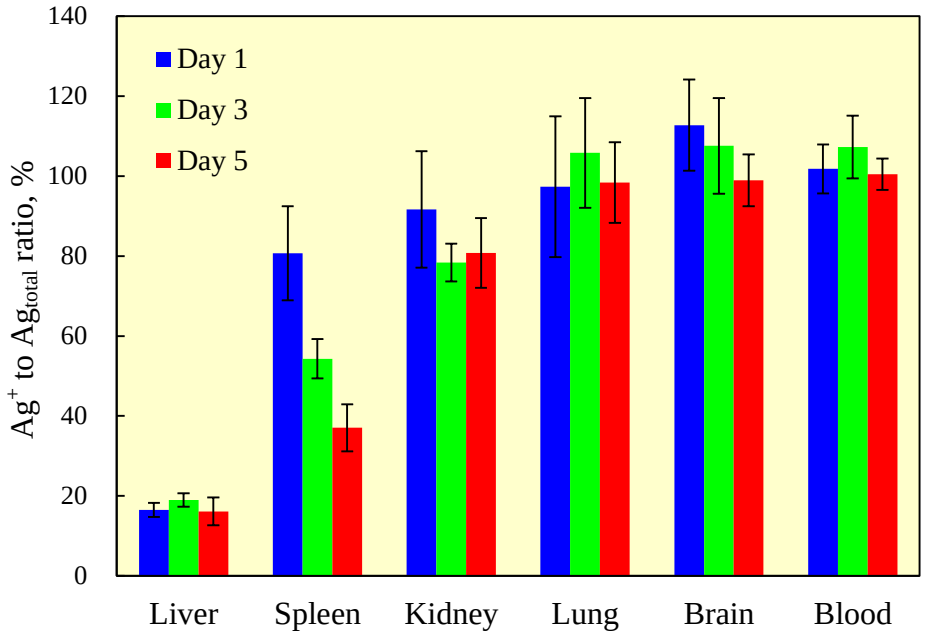
SOLVABLE™ is a basic mixture.

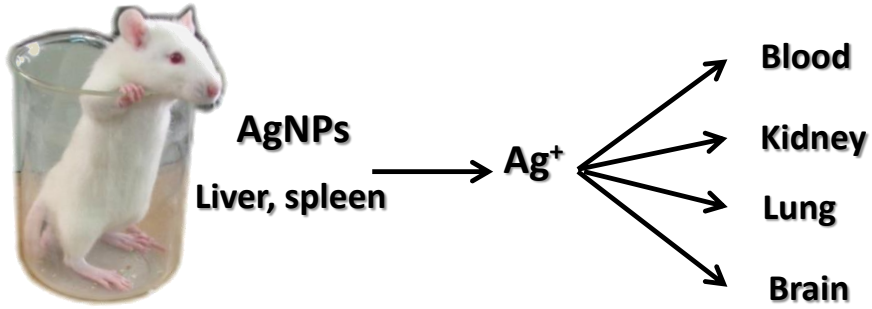
Biodistribution and Dissolution of AgNPs *in Vivo*

AgNP Biodistribution (500 µg kg^{-1})



Ag^+/Ag_{total} → AgNP Dissolution





analytical chemistry

dx.doi.org/10.1021/ac501691z | Anal. Chem. 2014, 86, 8267−8274 Article

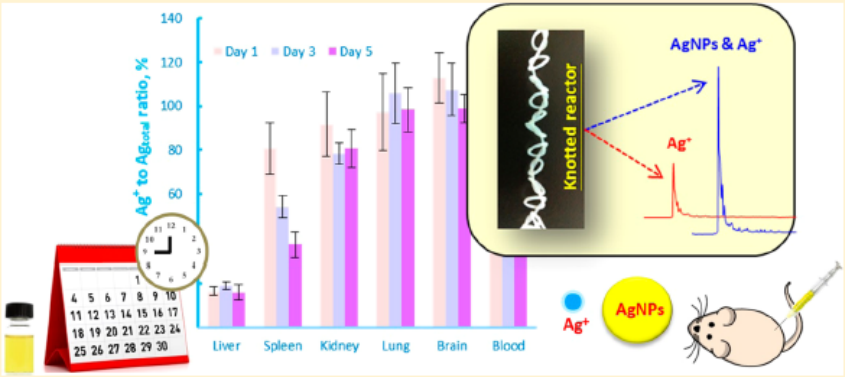
pubs.acs.org/ac

Quantitatively Profiling the Dissolution and Redistribution of Silver Nanoparticles in Living Rats Using a Knotted Reactor-Based Differentiation Scheme

Cheng-Kuan Su, Hsin-Tung Liu, Sheng-Chieh Hsia, and Yuh-Chang Sun*

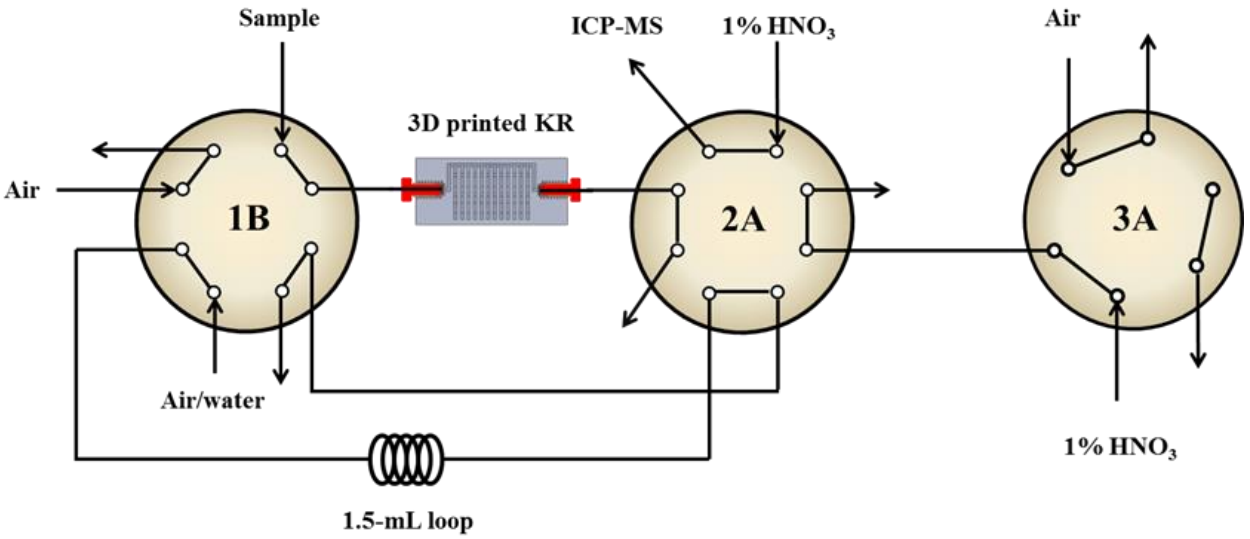
Department of Biomedical Engineering and Environmental Sciences, National Tsing-Hua University, Hsinchu, 30013, Taiwan

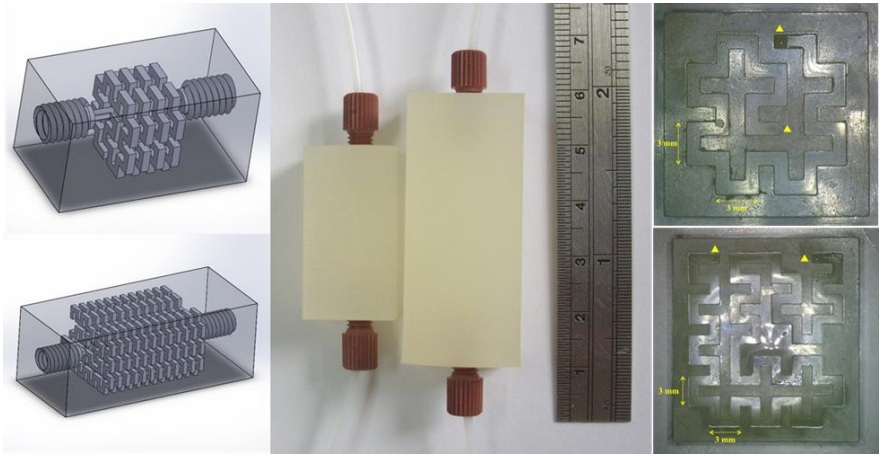
Supporting Information

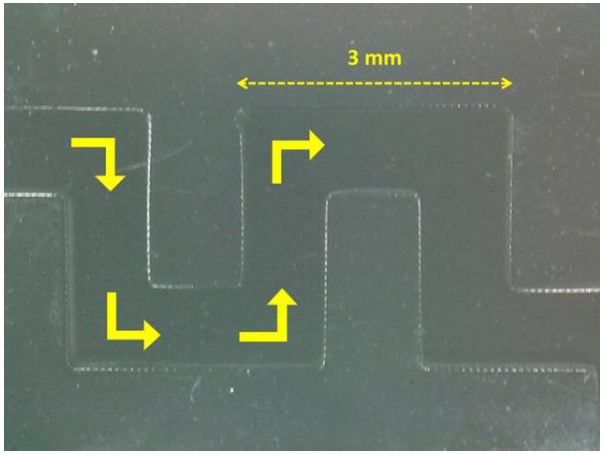


ABSTRACT: Whether silver nanoparticles (AgNPs) degrade and release silver ions (Ag^+) *in vivo* has remained an unresolved issue. To evaluate the biodistribution and dissolution behavior of intravenously administered AgNPs in living rats, we employed a knotted reactor (KR) device to construct a differentiation scheme for quantitative assessment of residual AgNPs and their released Ag^+ ions in complicated animal tissues; to do so, we adjusted the operating parameters of the KR, namely, the presence/absence of a rinse solution and the sample acidity. After optimization, our proposed differentiation system was confirmed to be tolerant to rat tissue and organ matrix and provide superior reliability of differentiating AgNPs/Ag^+ than the conventional centrifugal filtration method. We then applied this differentiation strategy to investigate the biodistribution and dissolution of AgNPs in rats 1, 3, and 5 days postadministration, and it was found that the administered AgNPs accumulated predominantly in the liver and spleen, then dissolved and released Ag^+ ions that were gradually excreted, resulting in almost all of the Ag^+ ions becoming deposited in the kidney, lung, and brain. Histopathological data also indicated that toxic responses were specifically located in the AgNP-rich liver, not in the Ag^+-dominated tissues and organs. Thus, the full-scale chemical fate of AgNPs *in vivo* should be integrated into future assessments of the environmental health effects and utilization of AgNP-containing products.

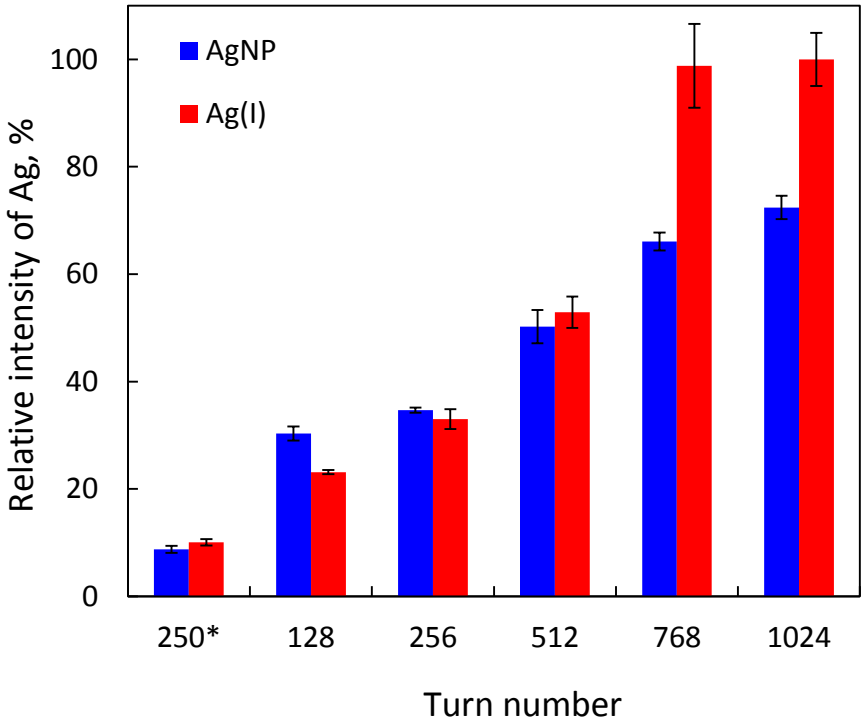
3D Printed Centrifugal Separation Technique

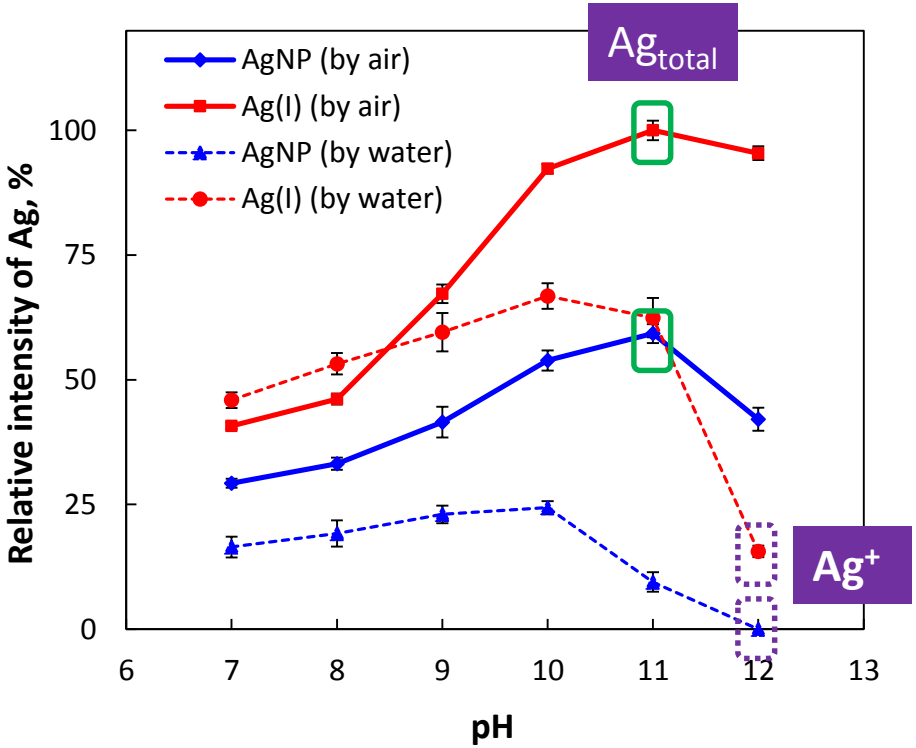






Differentiation of Ag^+/AgNPs





Analytical performance of the proposed differentiation scheme

	Working range, ng L^{-1}	*R*	Detection limit, ng L^{-1}	Spike recovery*, %
Ag^{+}	5–500	0.9947	0.86	96 ± 5
AgNPs	5–500	0.9978	0.51	89 ± 5

*: Performed in wastewater sampled from a WWTP influent (50 ng L^{-1})