Monday September 8th **Fate, Behavior, and Transformations/Physical and Chemical Properties of Nanoparticles Related to the Environment and Health**	
8:45-9:35	**Invited talk –Vicki Grassian.** *"Surface Chemistry of Environmentally and Biologically Relevant Molecules on Nanoparticle Surfaces."*
9:35-9:50	Armand Masion (FATE) France Integrated abiotic and mesocosm approach to assess the fate of nanomaterials: case of a CeO2 nanocomposite
9:50-10:05	George Metreveli (FATE) Germany Agglomeration reversibility of silver nanoparticles in natural river water
10:05-10:20	Robert Reed (FATE) USA Characterization of colloidal supplement drinks and assessment of their potential interactions after ingestion
10:20-10:35	Maryam Khaksar (FATE) Australia In-situ study of the chemical transformation of surface functionalized silver nanoparticles along the water-sediment continuum
10:35-11:00	COFFEE BREAK
11:00-11:15	Anke Hofacker (FATE) Switzerland Distribution and speciation of Ag, Ce, Ti in natural freshwaters
11:15-11:30	Alan Decho (INNOV) USA Particle Uptake in bacteria is an active and inducible process, and triggers a unique antibiotic response.
11:30-11:45	Amy Dale (FATE) USA Modeling the Transformation of Engineered Nanoparticles in the Environment
11:45-12:00	Melusi Thwala (FATE) South Africa The interactive influence of water chemistry and nanoparticle characteristics in determining the environmental fate of metal-based nanoparticles: a case of nAg and nZnO.
12:00-12:15	Khara Grieger (INNOV) USA Ensuring the sustainable development and use of nZVI for environmental remediation
12:15-12:30	Mohammed Baalousha (FATE) USA Aggregation and sulfidation of AgNPs

The interactive influence of water chemistry and nanoparticle characteristics in determining the environmental fate of metal-based nanoparticles: a case of nAg and nZnO

Melusi Thwala[1,2], Ntsiki Radebe[1,3], Yolanda Tancu[1], Ndeke Musee[1]

[1]Nanotechnology Sustainability Research Group, CSIR, Pretoria.
[2]Zoology Department, University of Johannesburg, Johannesburg.
[3]Chemistry Department, Tshwane University of Technology, Pretoria.

9th ICEENN, COLUMBIA, USA, 7-11 SEPTEMBER 2014

UNIVERSITY OF JOHANNESBURG

CSIR
our future through science

Nanotechnology trends

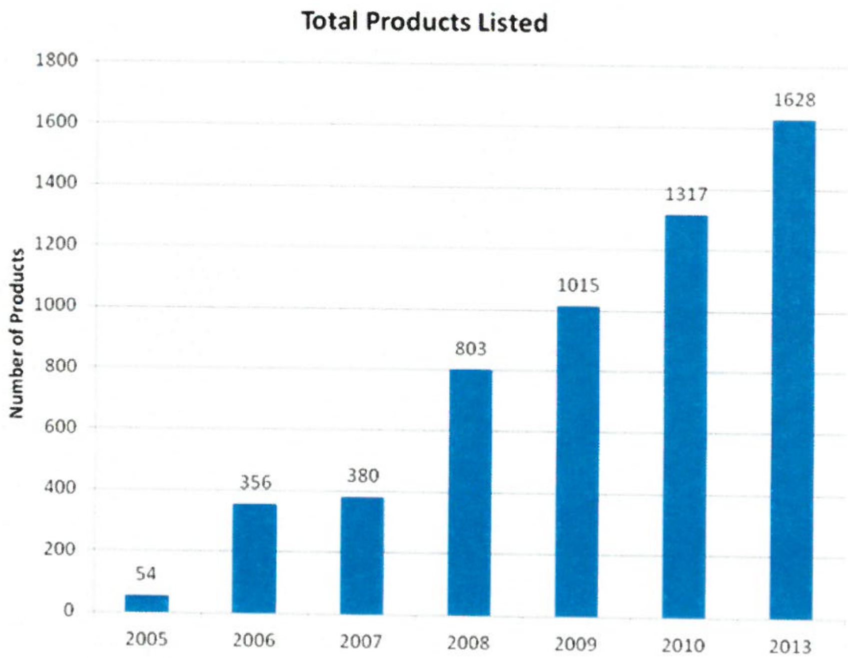
Technology	2011	2012	2017	CAGR%* 2012-2017
Nanomaterials	14,072.9	15,924.8	32,327.5	18.6
Nanotools	6,032.8	4,763.5	11,416.9	19.1
Nanodevices	39.5	45.3	176.2	31.2
Total	20,145.2	20,733.6	48,920.6	18.7

*CAGR; compound annual growth rate. Adopted from BCC Research 2012

The structure of nano-tecnology market for 2010-2015

Position	Market share, %
Nano-materials	30-35
Semi-conductors	18-25
Data storage devices	15-20
Bio-technologies	9-14
Polymers	8-12
Electro-chemistry	3-5
Optics	2-4

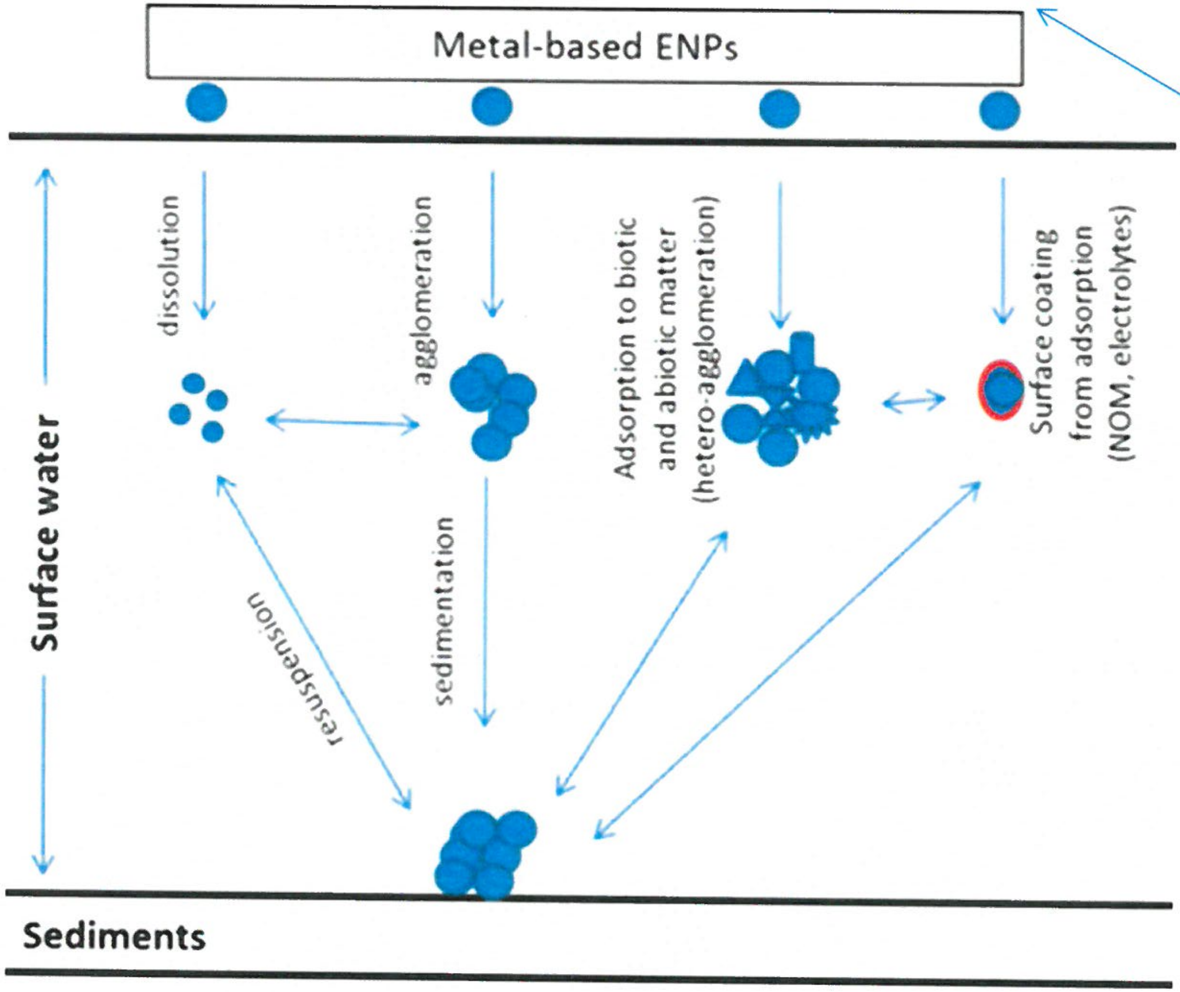
Adopted from Kovalev 2013



Adopted from Project on Emerging Technologies (WWICS)

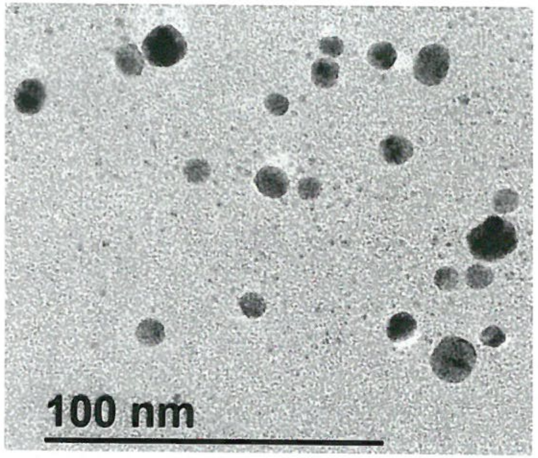
nZnO: PCPs, medical, optics, electronics
nTiO2: PCPs, paints, coatings,
nAg: medical, fabrics, PCPs
nCeO2: catalysts, plastics, optics
Production/fabrication
Usage/application
Waste/disposal
ENVIRONMENT

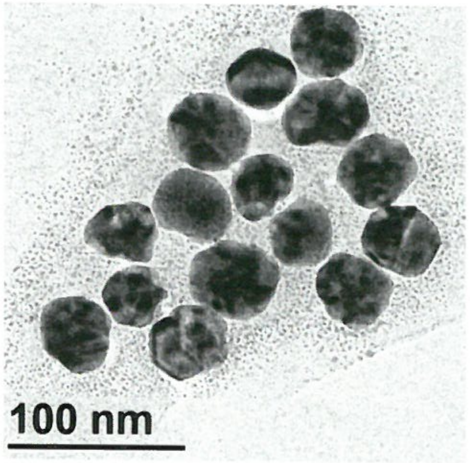
Objective: nAg and nZnO exposure dynamics towards pelagic biota

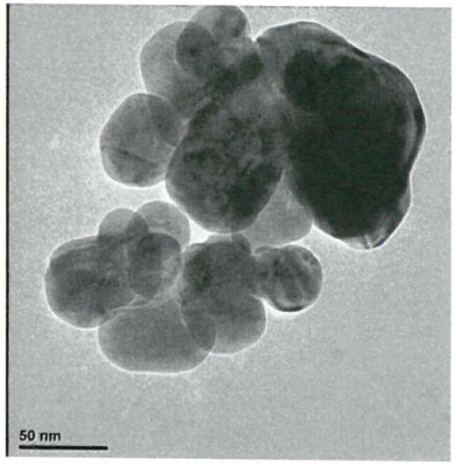


- Size
- Surface characteristics
- Water characteristics
- Multi-parametric analytical characterisation

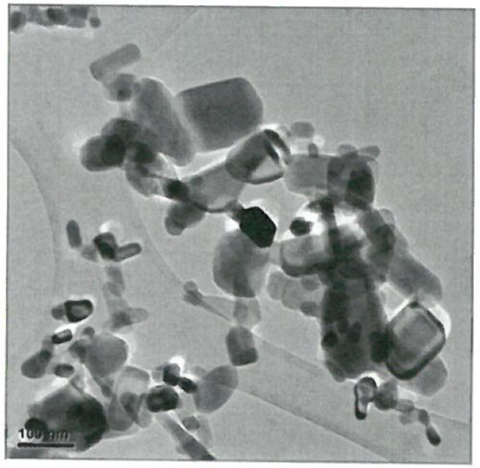
Materials







Form	cit-10 nm nAg	cit- 40 nm nAg	uncoated-nAg
Size	6.5 – 12.6 nm; average: 8.8 nm	35 .72 – 47.90 nm; average: 41.45 nm	40.32 – 153.5; average: 78.6 nm
Zeta	-17 mV	-24.3 mV	-29.3 mV
Coating	citrate	citrate	uncoated



uncoated-nZnO
10 – 130 nm; average: 85.5 nm
24.6 mV
uncoated

Exposure water	HM50	HM100
Ca (mg/L)	74	157
Mg (mg/L)	20.25	42.5
$CaCO_3$ (mg/L)	550.25	268.5
pH	6	6

Exposure and characterisation

- 100 µg/L
- shaken 100 RPM
- 23°C
- 0, 2, 24, 48, 72, 96 hrs
- Hoagland's medium
    - ½ = 50HM
    - 1 = 100HM

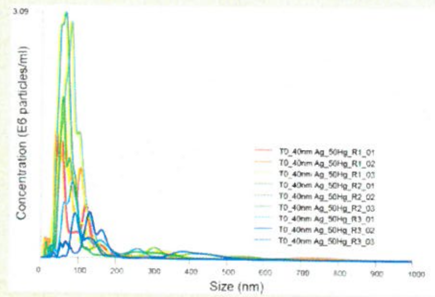
Dissolution

Ultracentifugation

HNO_3 preservation
ICP-MS

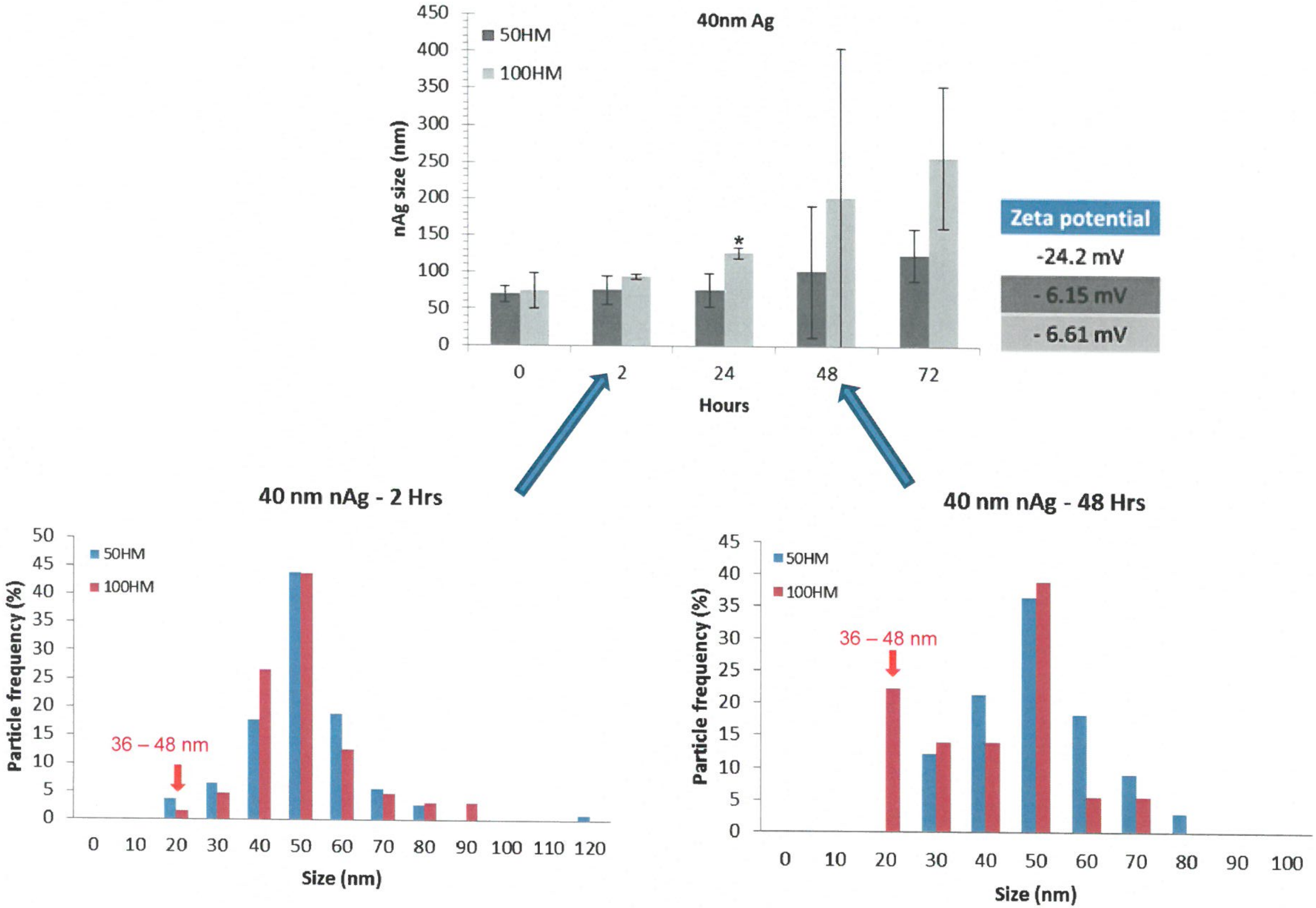
Agglomeration

Concentration (particles/mL)

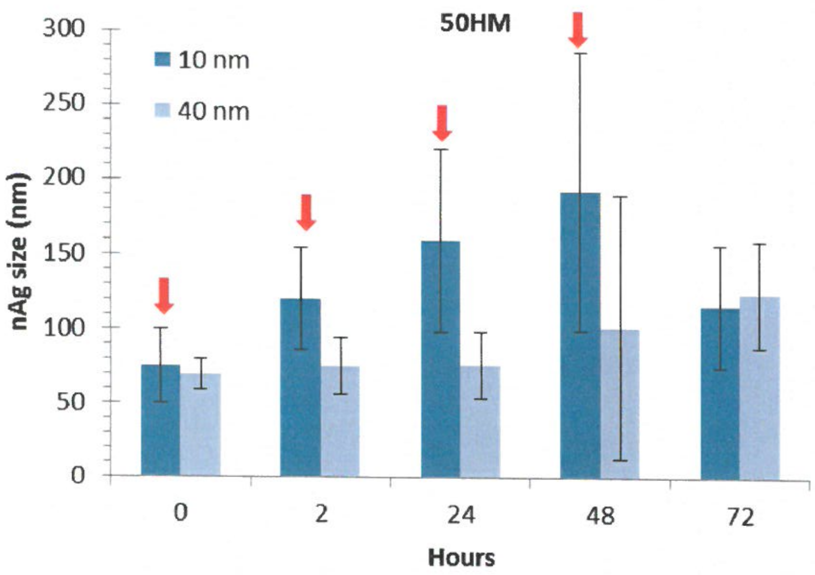


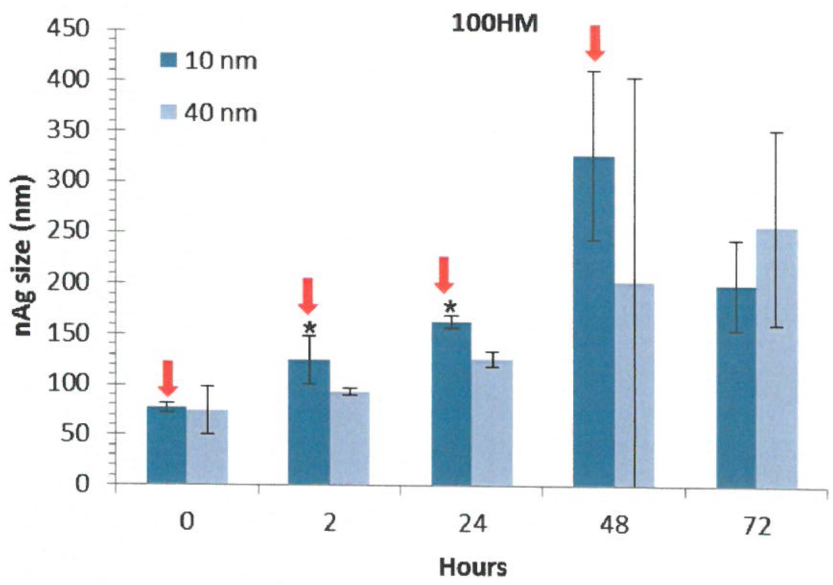
Surface charge potential

Agglomeration – size and media influence

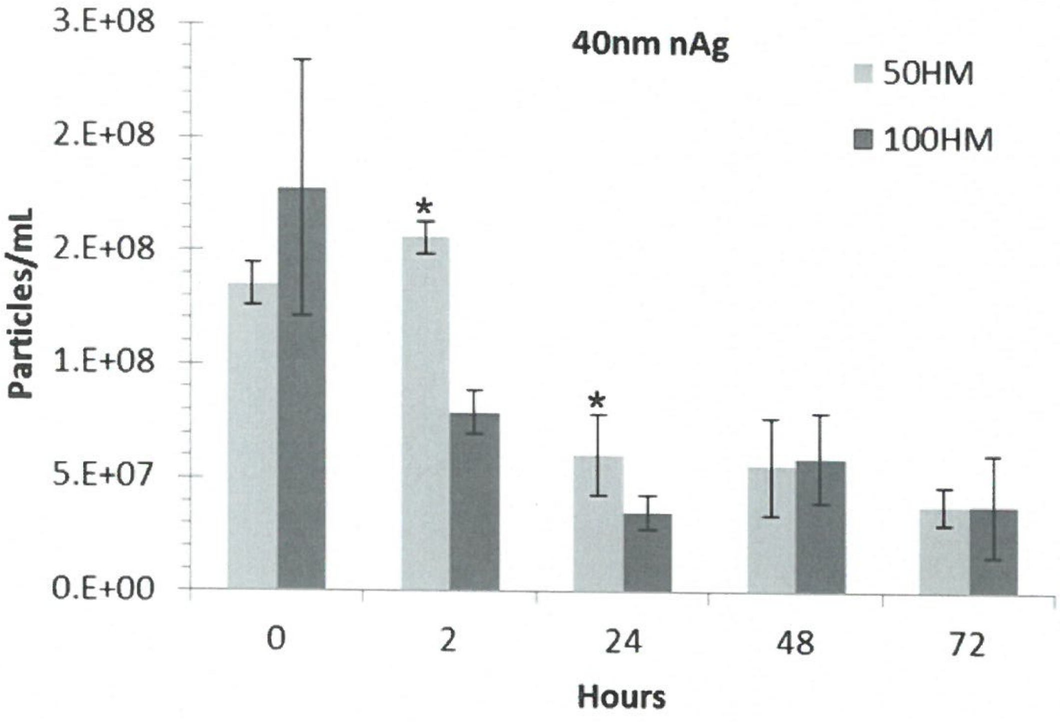


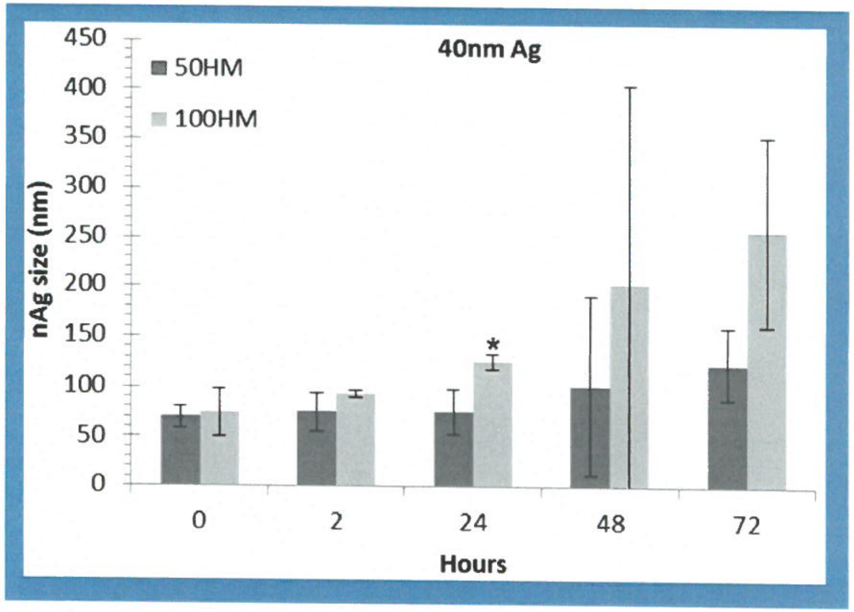
Agglomeration – size comparison



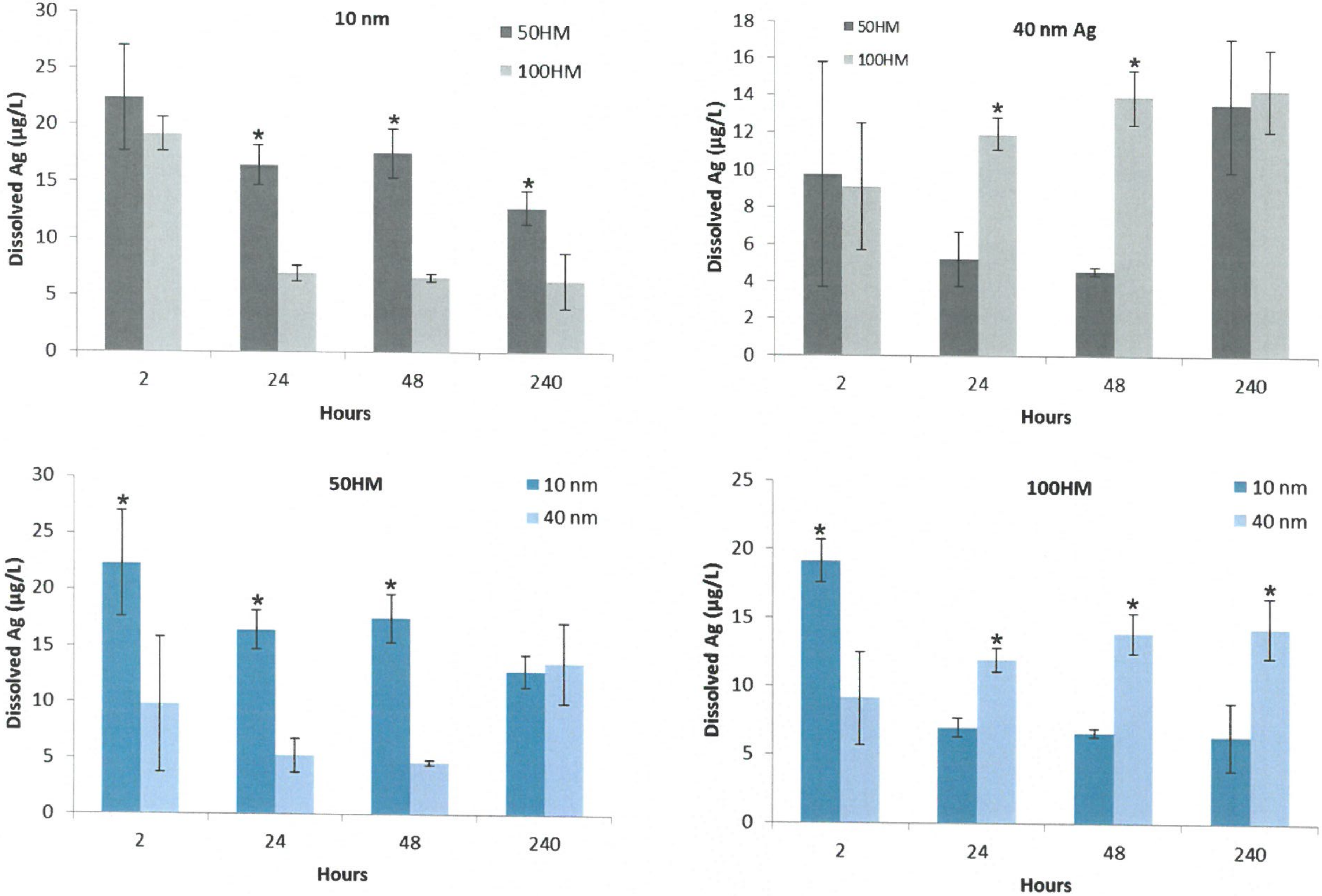


Exposure concentration – media influence

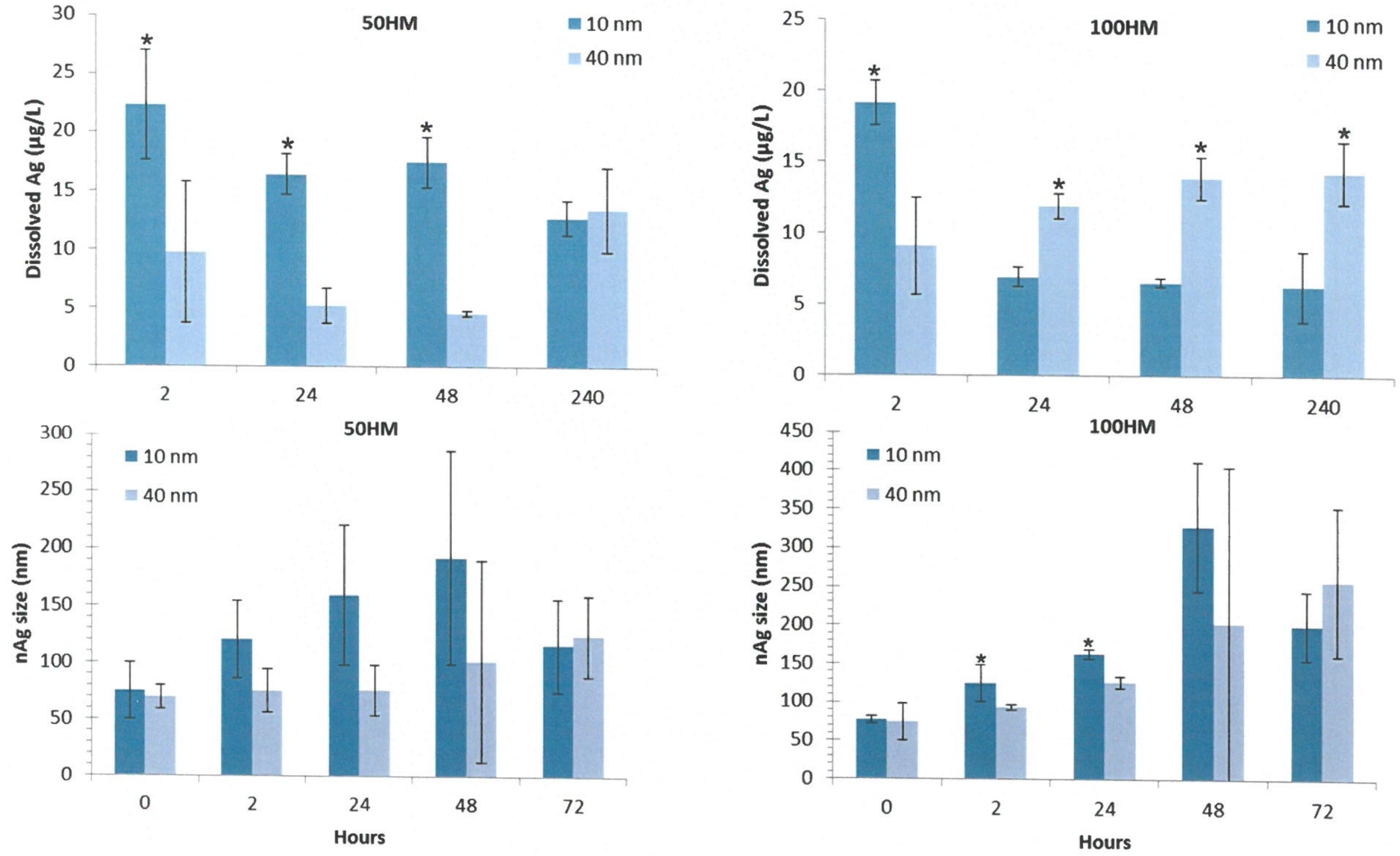




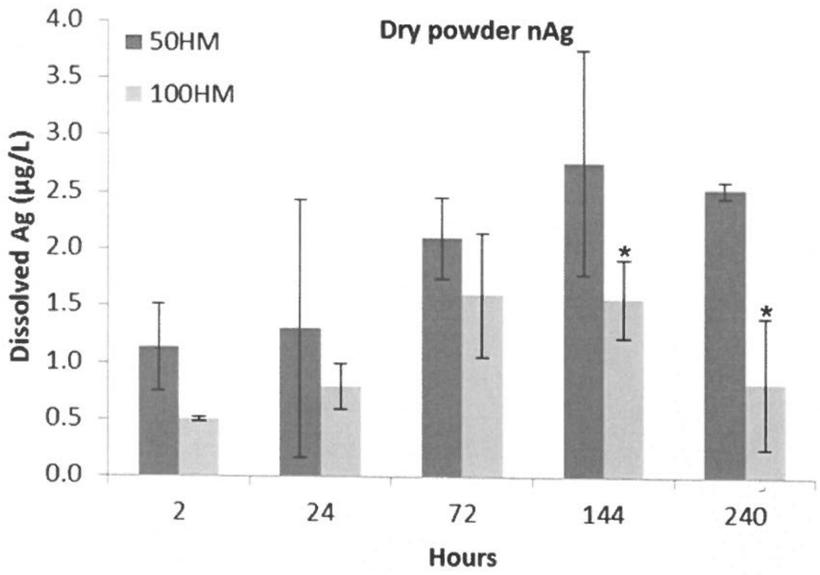
Dissolution: size and media on cit-nAg

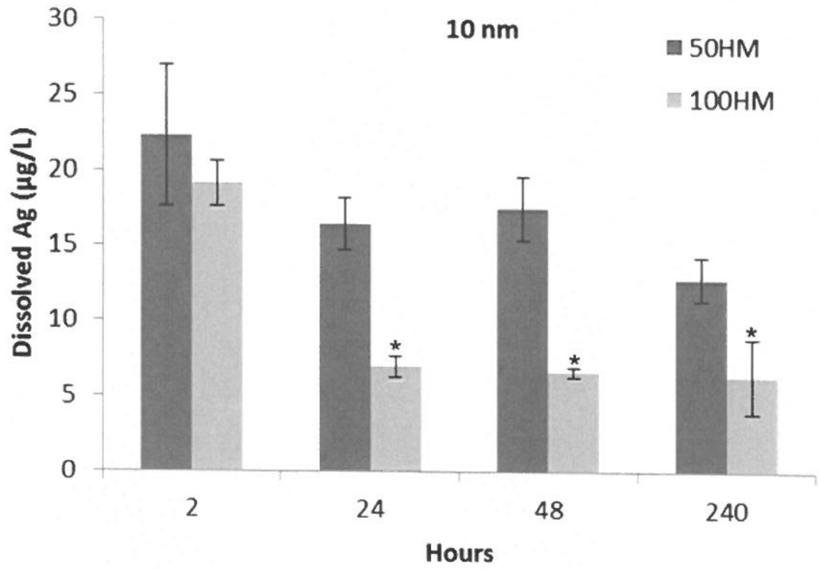


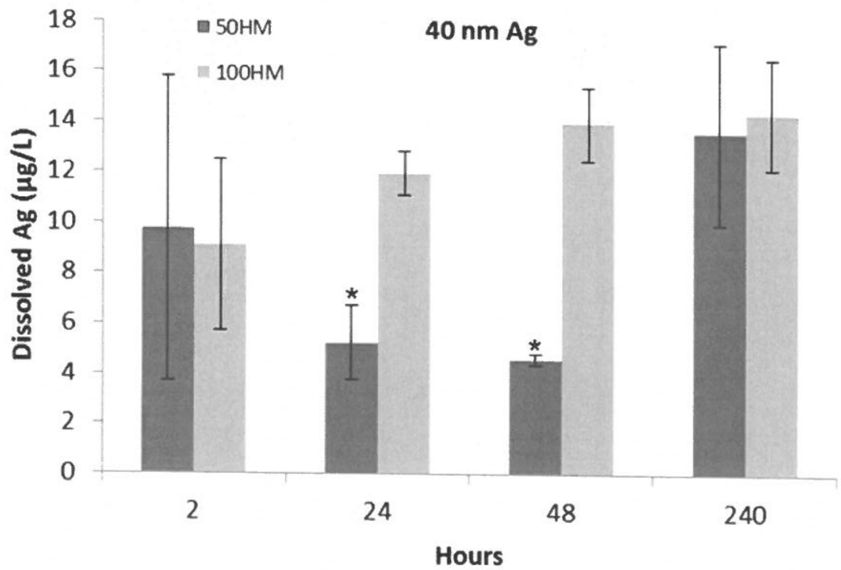
Dissolution: size and media on cit-nAg



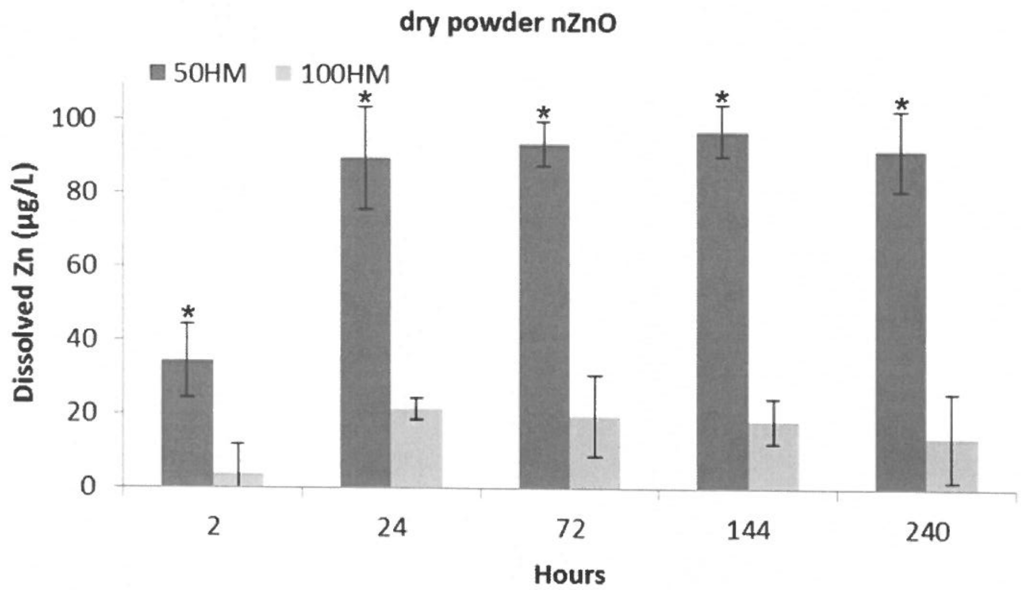
Dissolution: dry and cit-nAg:

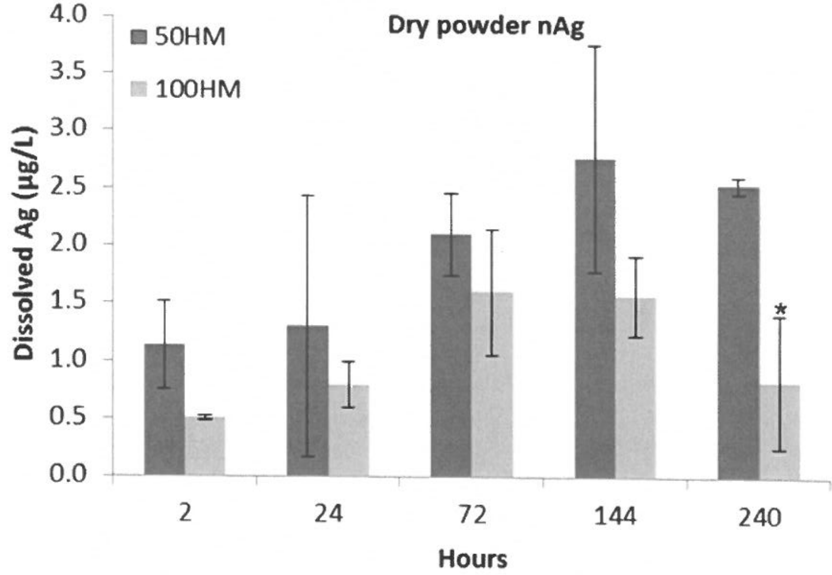






Dissolution: dry nAg and nZnO





Concluding remarks

- Environmental water quality transforms metal-based ENPs:
  - environmental fate bioavailability and potential effects.
  - high IS reduces exposure concentration_ “what is seen” by biota.
  - suggests that environmental regulation of nano-pollutants may require site specific risk assessment
- Interestingly larger agglomerates resulted from smaller ENPs:
  - indicates size induced reactivity difference.
  - small ENP size alone not a key determinant for internalisation/toxicity.
- Findings support an integrated approach → gain better insights.
- Detection and characterisation remains a challenge → collaborations.
- Complex and unpredictable environmental transformation → closer and closer to environmental realism > highly standardised and simple models.

Funding

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UNESCO

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Educational, Scientific and
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