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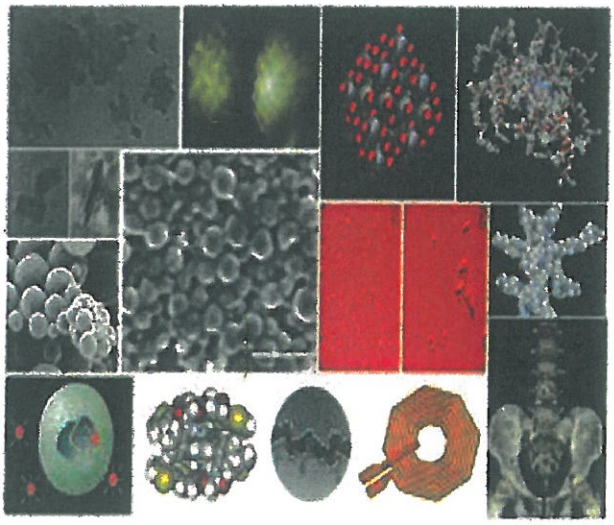
Research & Higher Degrees

NanoAfrica 2014

5th International Conference on Nanoscience & Nanotechnology

Vaal University of Technology, Department of Chemistry
Quest Conference Estate—Curie Boulevard—Vanderbijlpark
30 March—02 April 2014

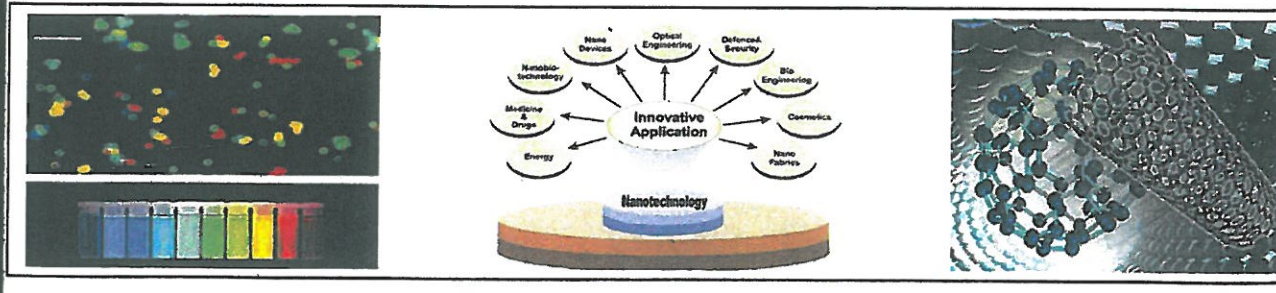


5TH INTERNATIONAL CONFERENCE ON NANOSCIENCE AND NANOTECHNOLOGY

30 MARCH – 2 APRIL 2014

HOSTED BY THE DEPARTMENT OF CHEMISTRY, VAAL UNIVERSITY OF TECHNOLOGY (VUT), VANDERBIJLPARK, SOUTH AFRICA AT THE QUEST CONFERENCE ESTATES

NANOAFRICA 2014 CONFERENCE



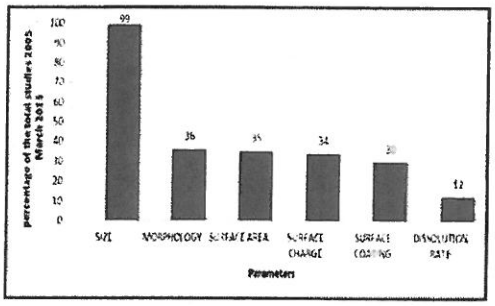
References
[1] F.V. Adams, E.N. Nxumalo, R.W.M. Krause, E.M.V. Hoek, B.B. Mamba. Journal of Membrane Science **405– 406** (2012) 291– 299
[2] E-S. Kim, G. Hwang, M.G. El-Din, Y. Liu. Journal of Membrane Science **394– 395** (2012) 37– 48

18. Ms. Ntombikayise Mahaye

An analysis of engineered nanomaterial characteristics reported in aquatic nanotoxicity studies: 2004-2013

Melusi Thwala[1], Ntombikayise Mahaye[1], Lisa Schaefer[2], Ndeke Musee[1,3]
[1]Nanotechnology Environmental Impacts Research Group, CSIR, Pretoria, South Africa
[2]Water Ecosystems and Human Health Research Group, CSIR, Pretoria, South Africa
[3]Department of Chemical and Metallurgical Engineering, Tshwane University of Technology, Pretoria, South Africa

In this study, we employed bibliometric techniques to analyse engineered nanomaterials (ENMs) characterization data published in peer-reviewed aquatic nanoecotoxicity hosted in the International Council on Nanotechnology (ICON) and Web of Science databases. Findings reported herein are based on 192 peer reviewed studies from January 2004 to March 2013. From the studies we examined: (1) the extent of reported characterisation properties of ENMs and testing media characteristics in the study data, and (2) the utilisation or application of ENMs characterisation data within a specific study to account for the observed toxicity response on biota.



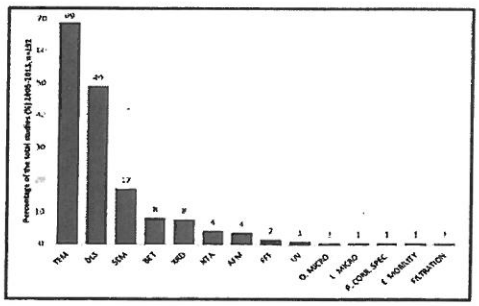


Fig. 1: Percentage studies reporting on ENM characterization, n=192 Fig. 2: Percentage usage of size characterization techniques, n=192

The most reported ENM characteristic was size by 99% of the studies, and surface coating was the least at 30% (Fig. 1). The low reporting of surface area and surface charge by 35% and 34%, respectively, suggests poor understanding on their influence towards reported toxicity. Large percentage of the particle size analysis was undertaken in testing media, rather than relying on data supplied by manufacturers, and suggests a high proportion of the data being credible and scenario relevant. The TEM was the most used technique for size characterisation at 69% (Fig. 2) possibly because it also generates morphology and surface composition characteristics data. Use of more than one size analysis techniques was observed, and hence contributed towards generation of high quality data. The testing media characteristics were poorly reported in the studies as pH, ionic strength, and natural organic matter were reported by 59%, 17%, and 12%, respectively, and need to be improved. Our analysis indicated the effort by the researchers to utilise ENMs characterisation data to a certain degree to account

for the observed toxicological responses. Overall, our findings indicates that for future nanoecotoxicity studies, both inherent ENMs characteristics and media chemistry properties should be reported to improve our collective understanding and importance on the influence of ENP characteristics to account for the potential toxicological effects; and also to account for their environmental fate and behaviour.

19. Mr. Siphesihle Nxele

Synthesis of Silver Nanoparticles and their use as Immobilization Matrix for Glucose Oxidase towards the Construction of a Glucose Sensor

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Immobilisation of biomolecules on nanostructures has been a technique applied in the optimisation of analyses in the food industry as well as medical and environmental fields. The implementation of such modifications may be attributed to the need for increased stability and sensitivity of the biomolecule specific to an analyte of interest. A vast range of nanostructures have been incorporated into biosensor construction for the aforementioned purposes. In the work presented, silver nanoparticles were synthesised and characterised for their use as an immobilization matrix for glucose oxidase (Gox) to ultimately construct a glucose electrochemical sensor which detects hydrogen peroxide generated by equation 1. The electrode surface was characterised using cyclic voltammetry, scanning electrochemical microscopy, Fig. 2 and x-ray photoelectron spectroscopy. The silver nanoparticles proved to have good electrocatalytic ability towards H_2O_2 and glucose.

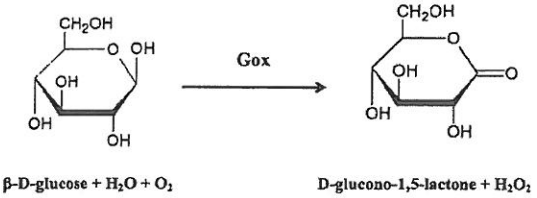

Fig. 1: Catalytic reaction between glucose and Gox

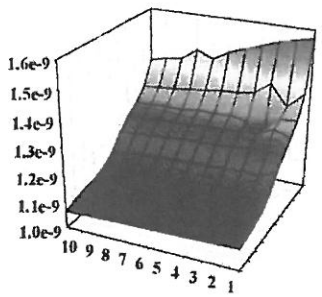

Fig.2. Scanning electrochemical microscopy area plots for the AgNPs-GC plate

20. Mr. Osikoya Adeniyi

Synthesis and Characterization of Nitrogen–Doped Carbon Nanotubes Using Cobalt And Silver Catalysts

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[2]Department of Civil and Chemical Engineering, College of Science, Engineering and Technology University of South Africa, P/Bag X6, Florida 1710, Johannesburg, South Africa

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Nitrogen doped carbon nanotubes were synthesized in a horizontal CVD using acetylene gas as carbon source and a bimetallic catalyst of cobalt and silver supported on magnesium oxide.

An analysis of engineered nanomaterial characteristics reported in aquatic nanotoxicity studies: 2004-2013

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[3]Department of Chemical and Metallurgical Engineering, Tshwane University of Technology, Pretoria, South Africa

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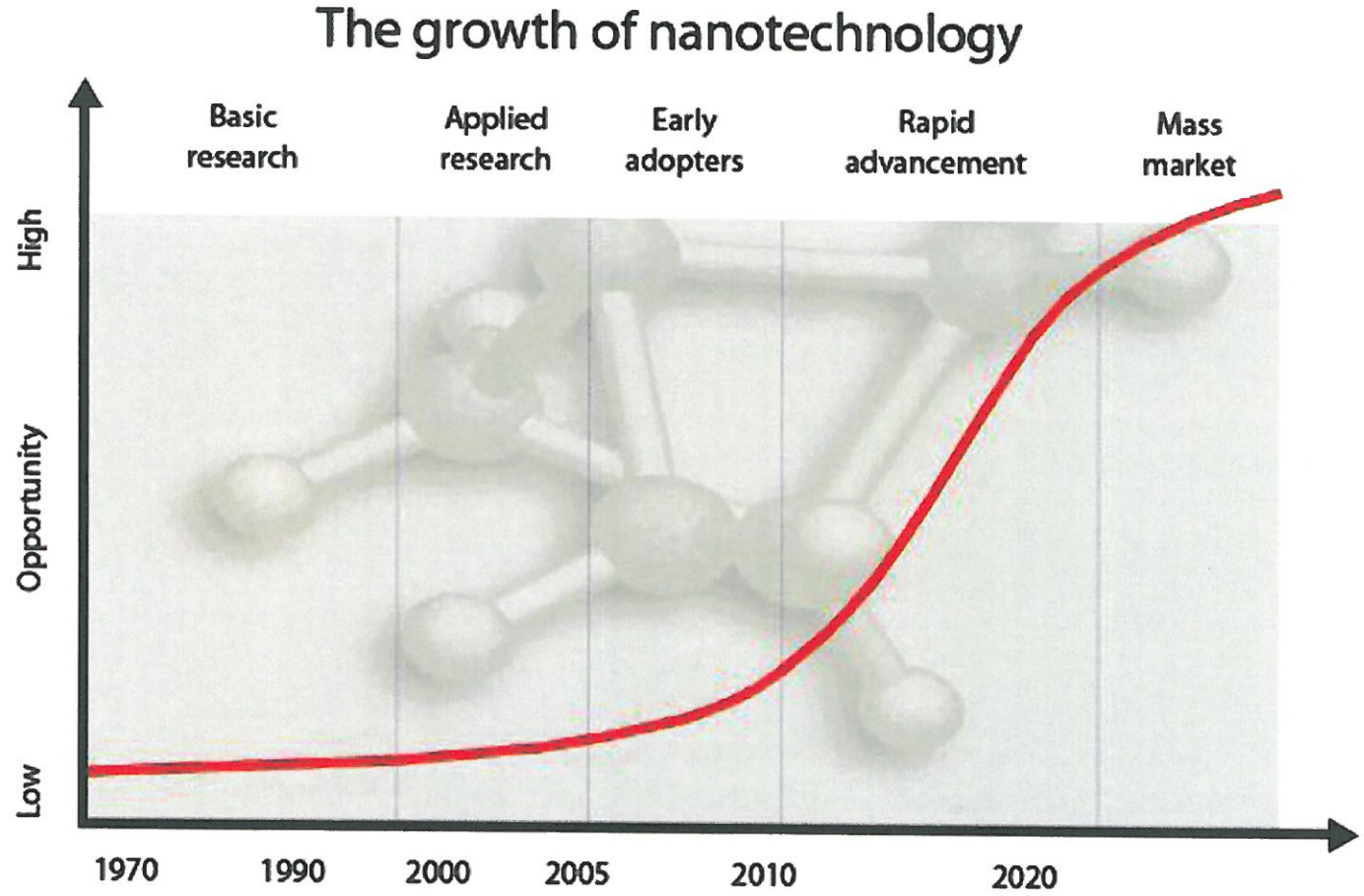

http://www.futuretimeline.net/subject/nanotechnology.htm

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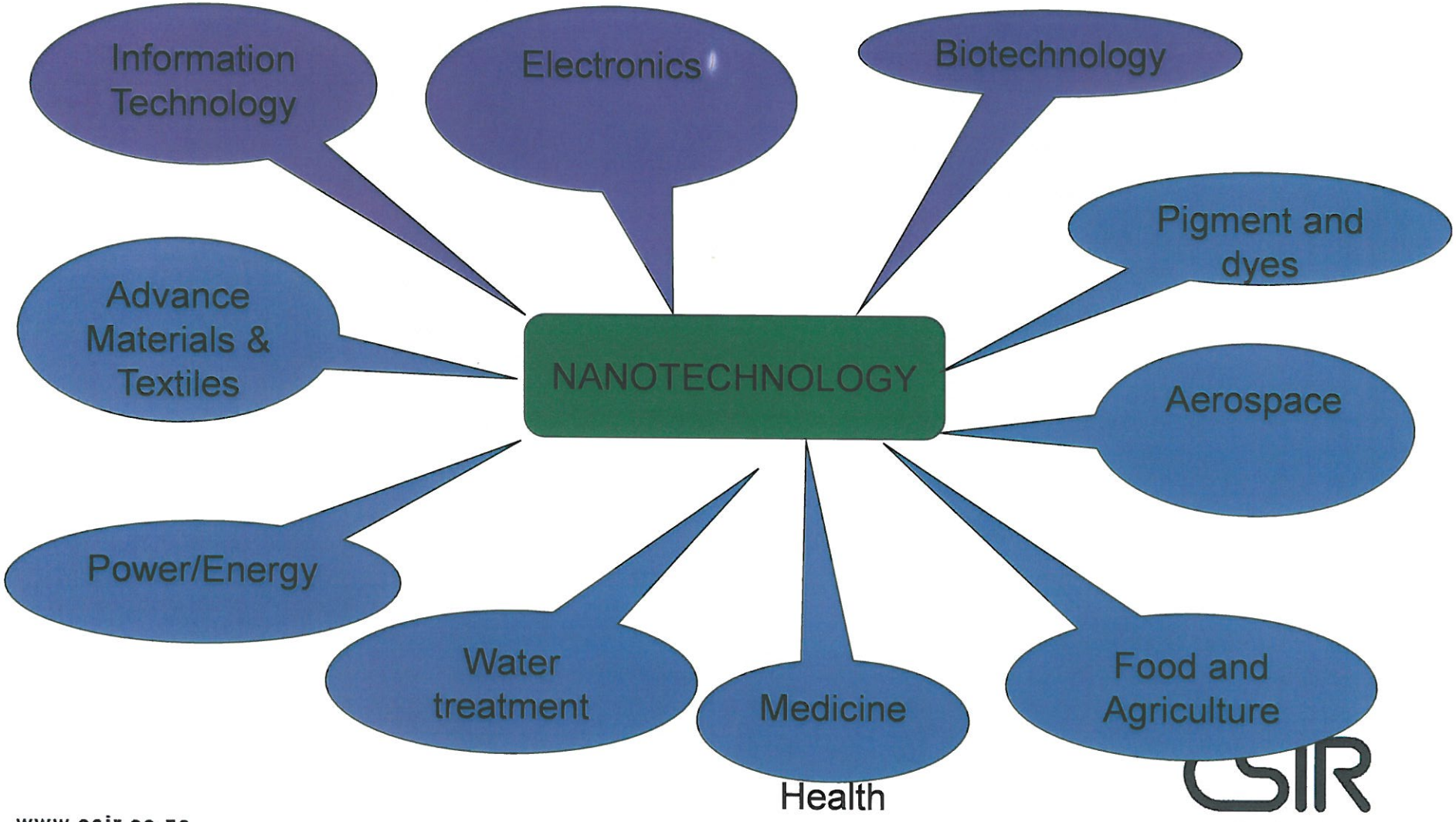
APPLICATIONS



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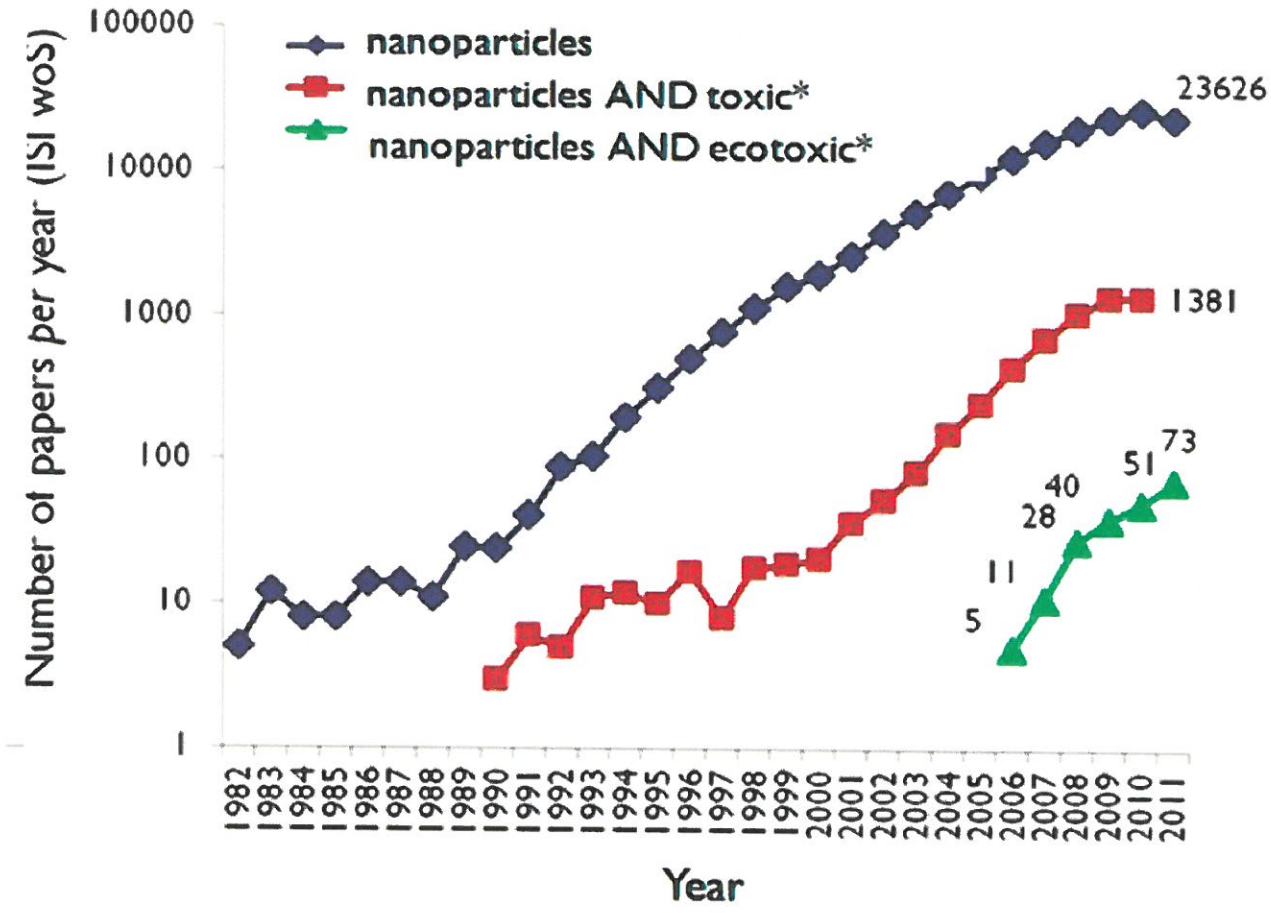
PRODUCTS OF NANOTECHNOLOGY

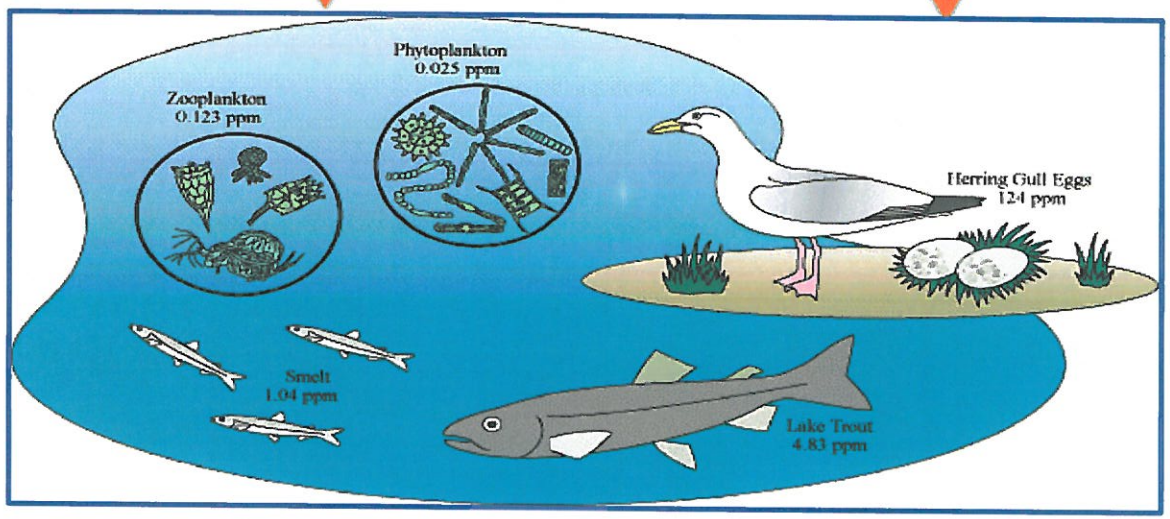
INTRODUCTION



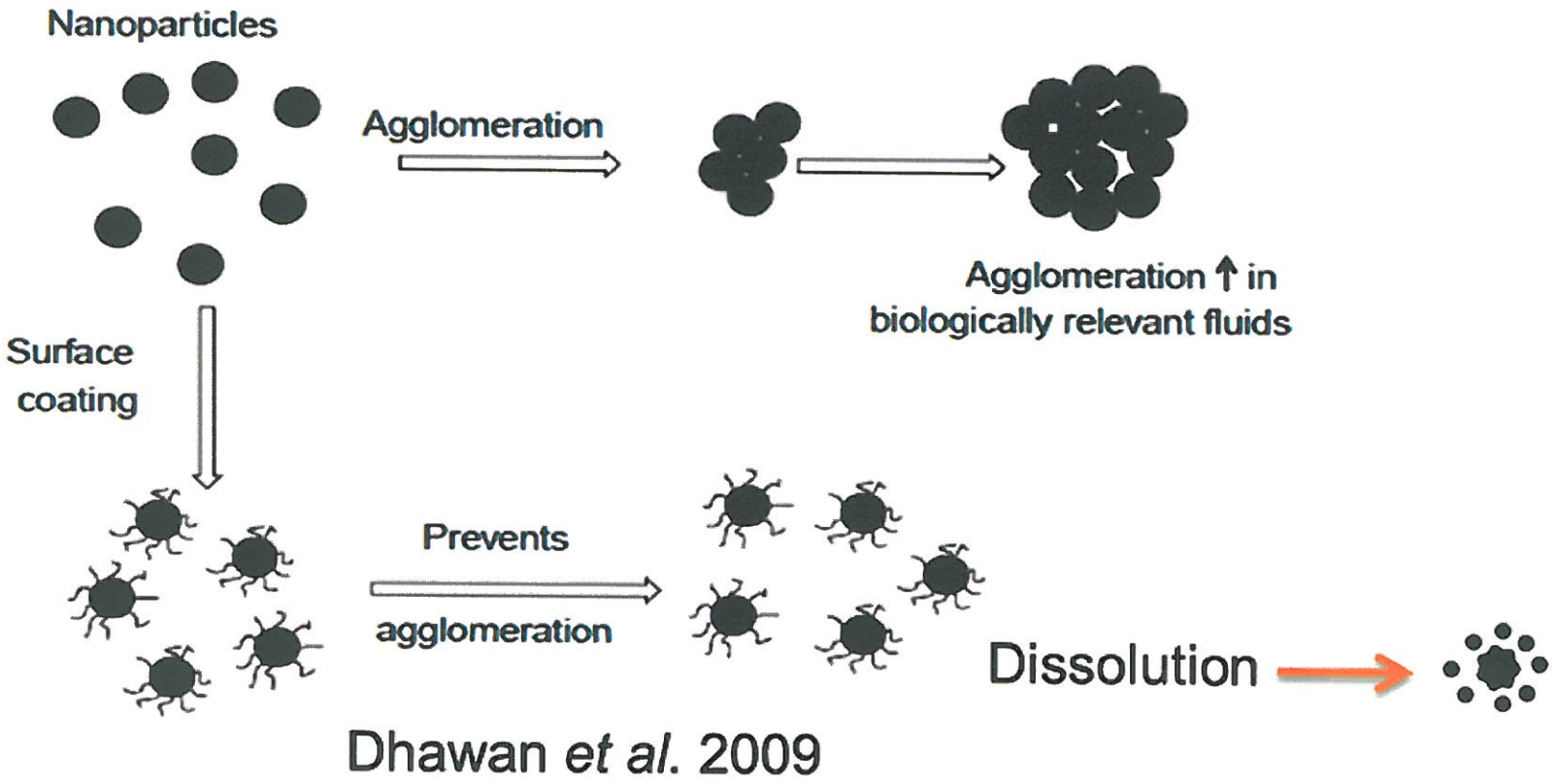
"for every 1000 nanoparticle papers about 10 included information on their toxicological effects and 1 on ecotoxicological properties"

Kahru and Ivask 2013. Acc. Chem. Res. 46(3): 823-833

POTENTIAL PATHWAYS OF ENMs INTO WATER RESOURCES

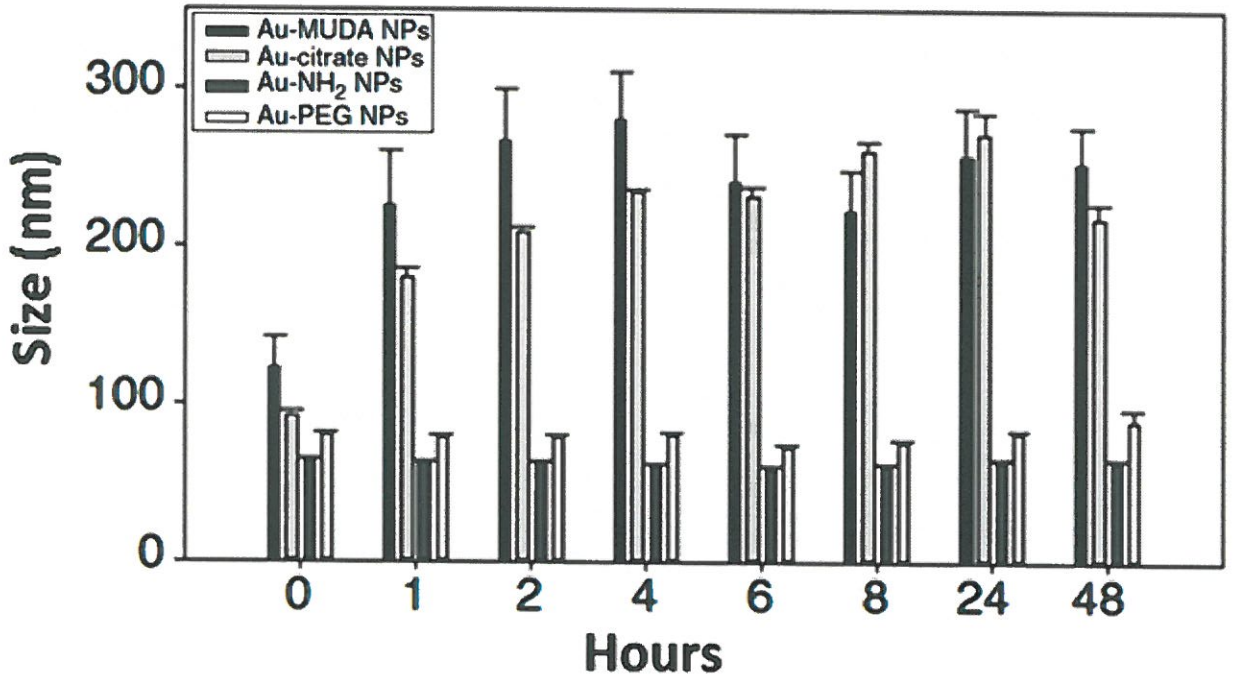


AQUEOUS MEDIA



Dhawan *et al.* 2009

EFFECT OF SURFACE COATING ON AGGREGATION



Park et al. 2014. *Nanotoxicology* 8(5): 583-592.

Aggregation was observed within 1 – 6 hrs

Au-MUDA – significant aggregation

Au-citrate – increased aggregation

Au-NH2 – no significant increase

Au-PEG – no significant difference

AIMS

- To examine how the published characterization data has been used to link ENMs physicochemical properties and the observed biological response.

- To discuss the usefulness of reported data in accounting for the observed ENMs toxicity.

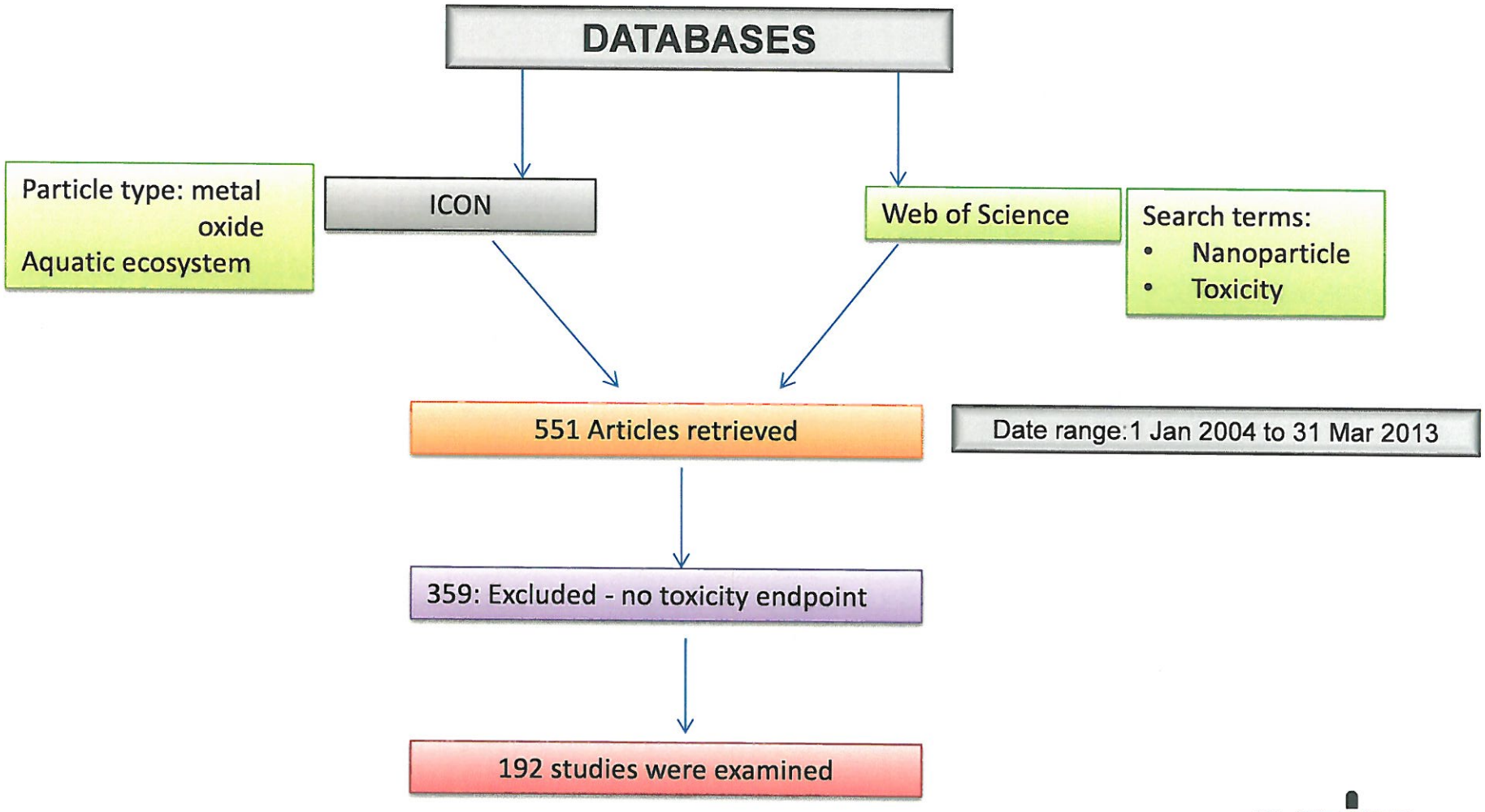
Aspects Examined

- The inherent characteristics of ENMs.

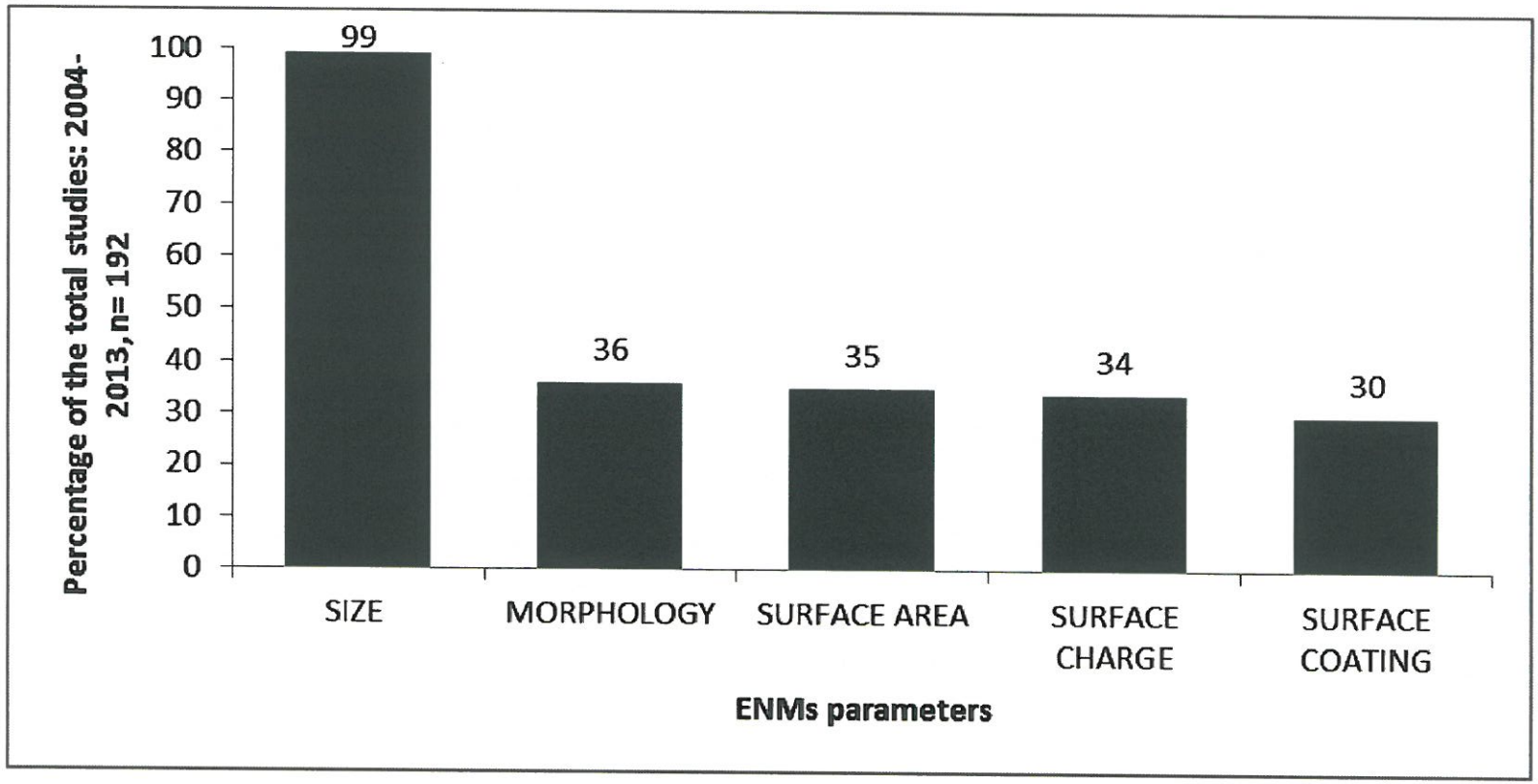
- Testing media chemistry parameters.

- Utilisation and/or application of reported ENMs characterisation.

STUDY APPROACH

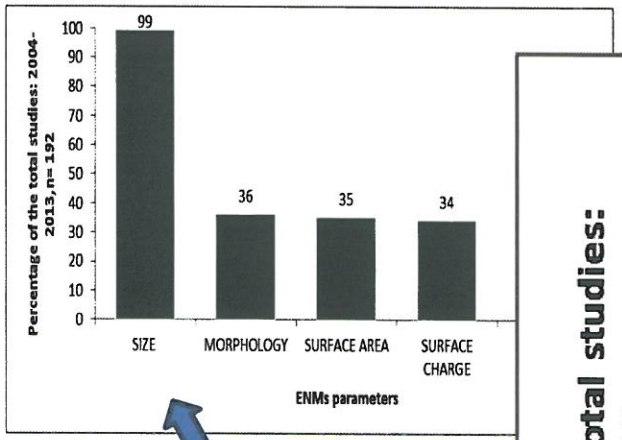


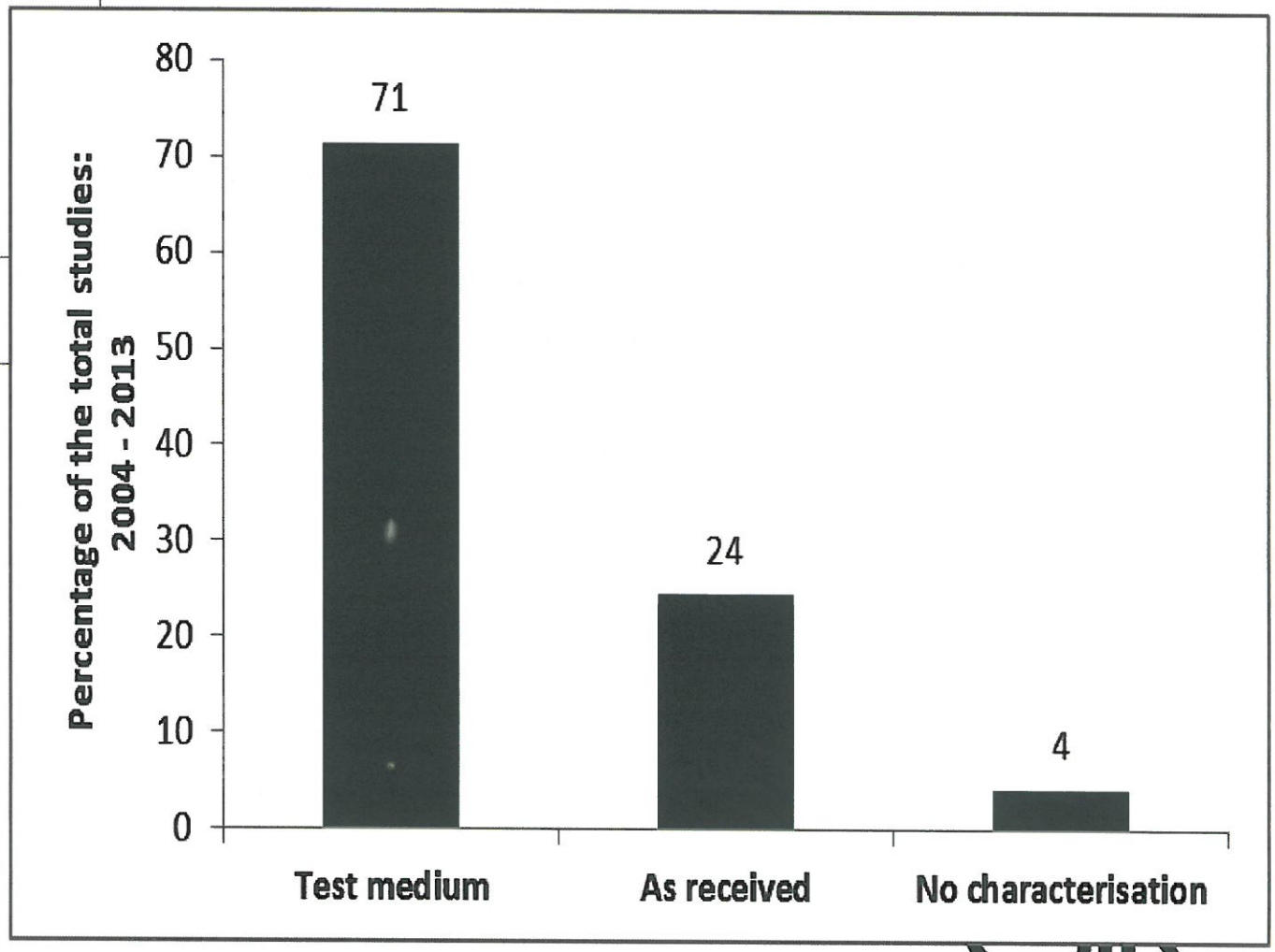
RESULTS



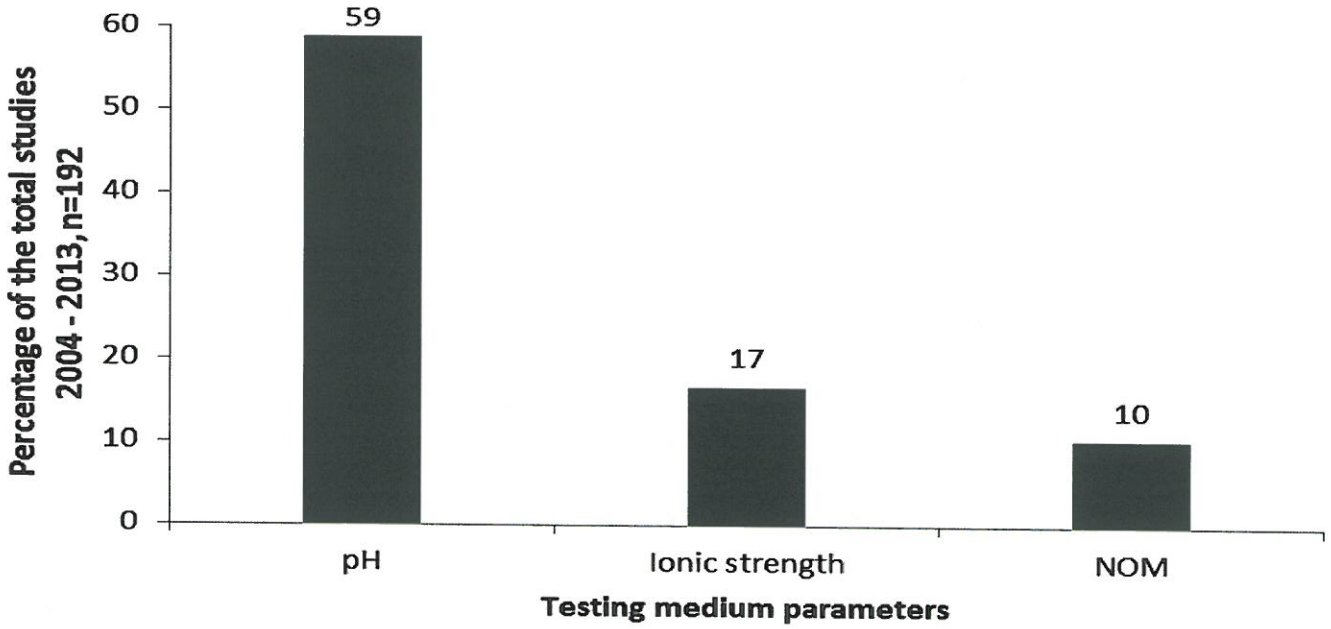
Most significantly reported inherent characteristics of ENMs (n =192)

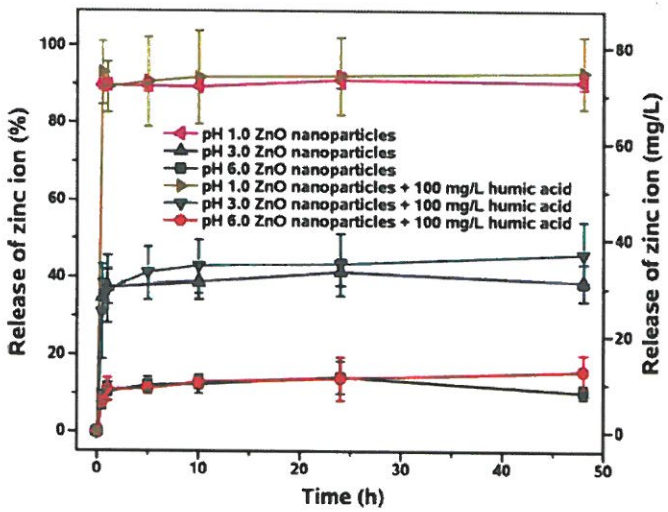
RESULTS


Percentage of the total studies: 2004-2013, n= 192
100
90
80
70
60
50
40
30
20
10
0
99
36
35
34
SIZE
MORPHOLOGY
SURFACE AREA
SURFACE CHARGE
ENMs parameters

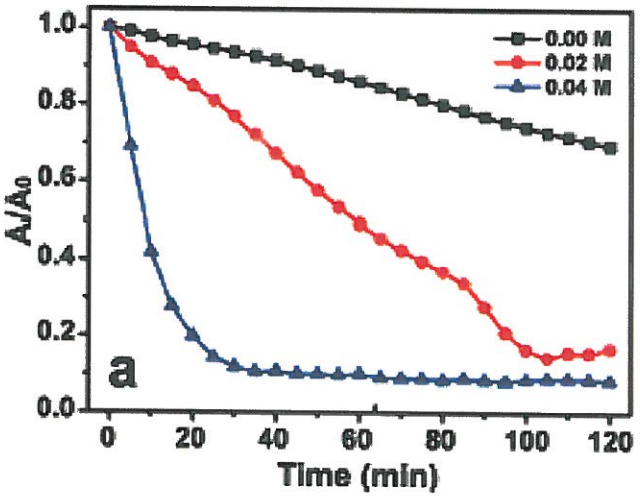

Percentage of the total studies: 2004 - 2013
80
70
60
50
40
30
20
10
0
71
24
4
Test medium
As received
No characterisation

MEDIA PARAMETERS





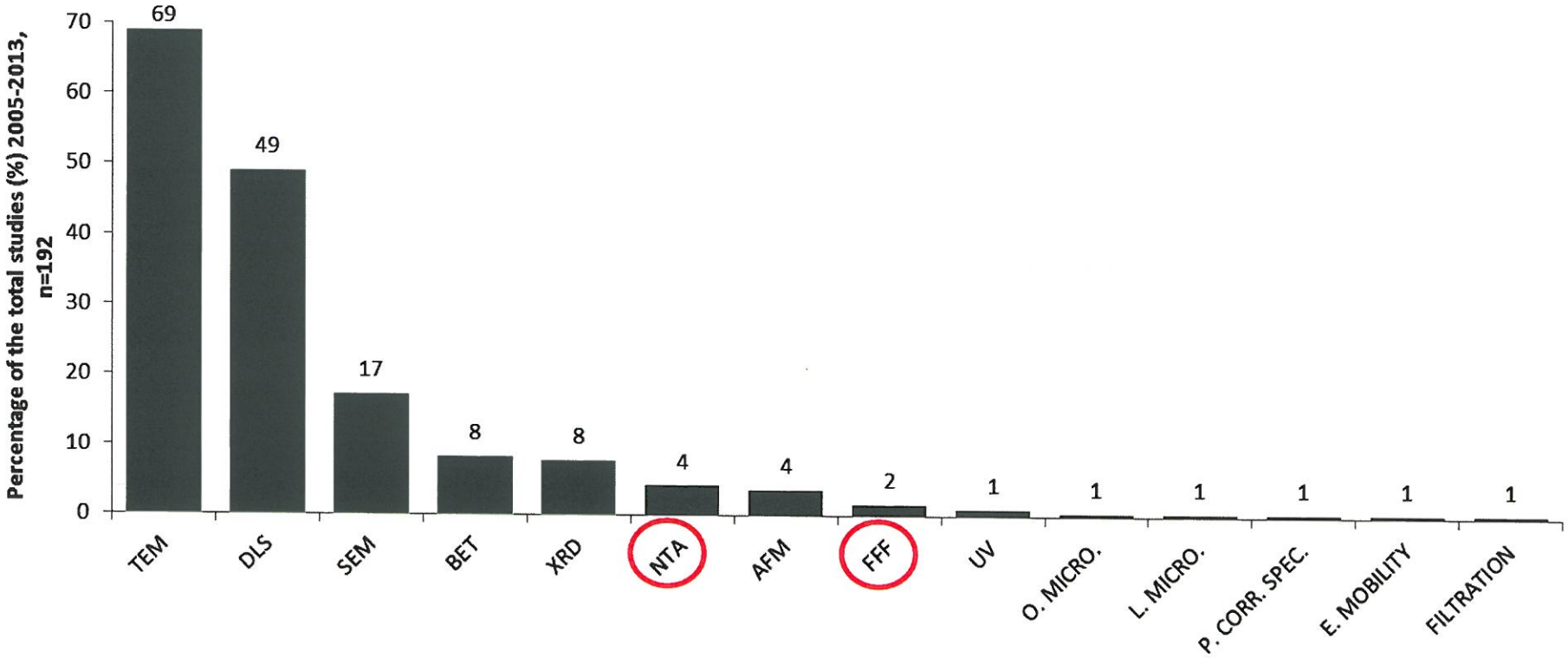
Dissolution of ZnO NPs

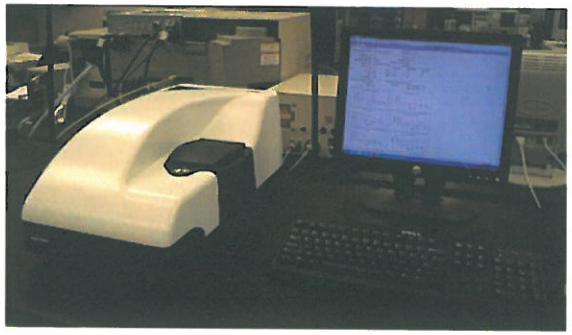


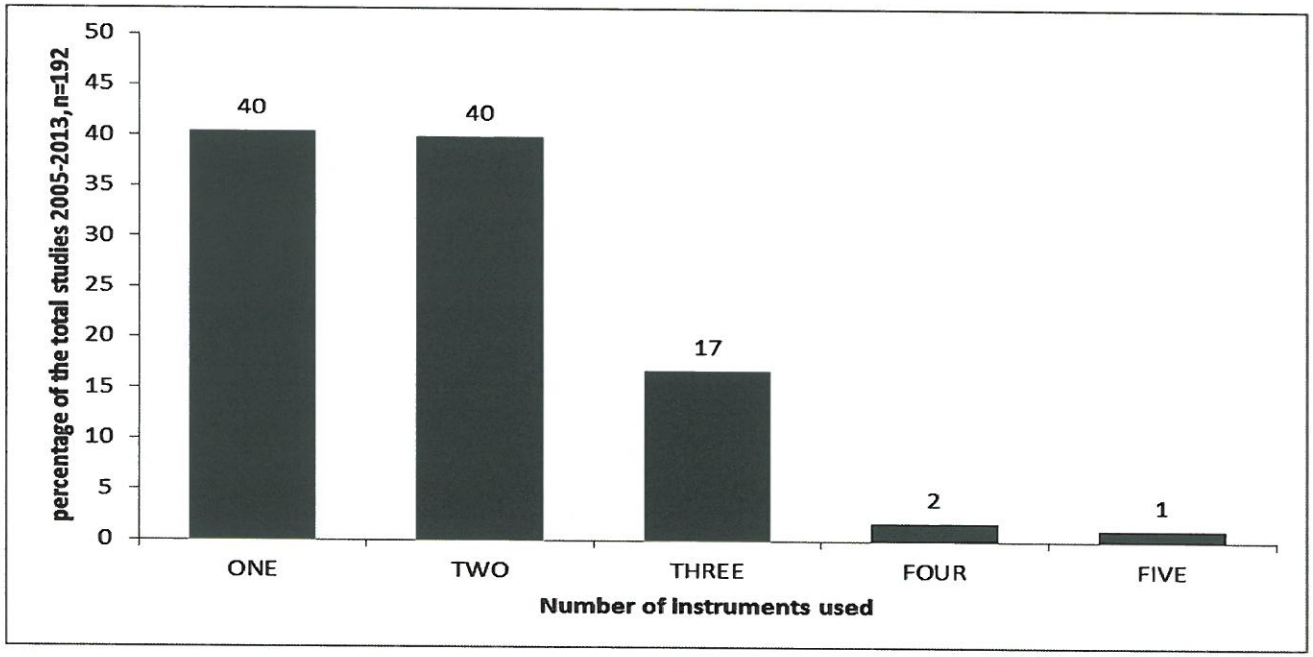
Sedimentation plot for ZnO NPs as a function of IS

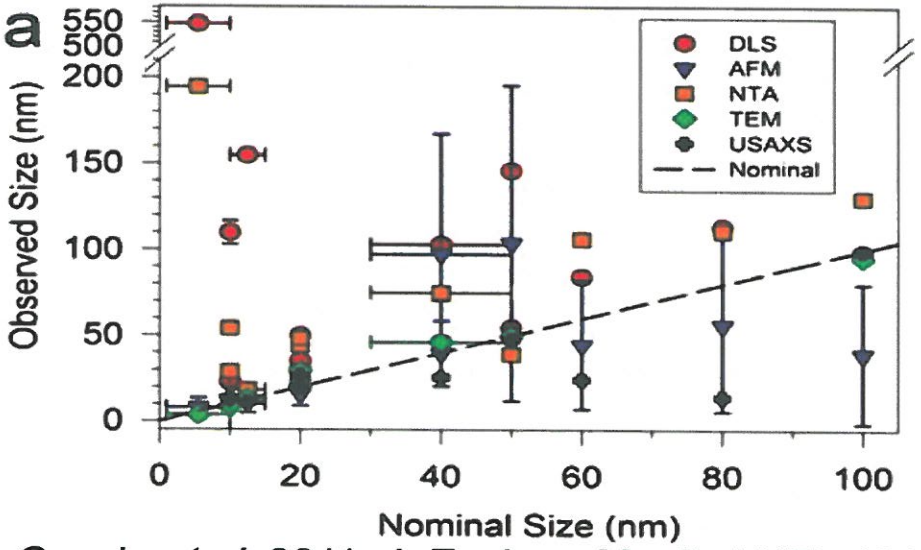
Bian *et al.* 2011. Langmuir 27: 6059-6068

Use of analytical techniques for ENMs size measurement in nanoecotoxicity studies (n = 192).









MacCuspie *et al*. 2011. J. Environ. Monit. 13(5): 1212-26

SUMMARY & CONCLUSION

- 71% of the studies provided size data as measured in the testing media.
- There is limited appreciation of pH effect on the fate and behaviour of ENMs in aqueous media.
- Most commonly used techniques: TEM (69%), DLS (49%), and SEM (17%).
- Nanoecotoxicity investigations play an important role in screening the potential environmental risks of ENMs.
- Our analysis indicated the effort by the researchers to utilise ENMs characterisation data to a certain degree to account for the observed toxicological responses.

FUTURE CONSIDERATIONS

- More effort on the influence of media parameters on the observed toxicity.
- Improved analysis and reporting of media characteristics in nanoecotoxicity investigations.
- Improve ENMs characterisation in the testing media than relying on the ENMs data as supplied by the manufactures.

THANK YOU

Colleagues - Nanotechnology Sustainability Research Group