

## Safety research for a responsible use of nanomaterials



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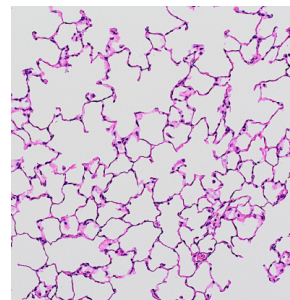
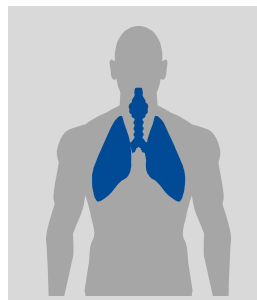
## Safety concerns with nanomaterials



### Nanoparticles raise questions:

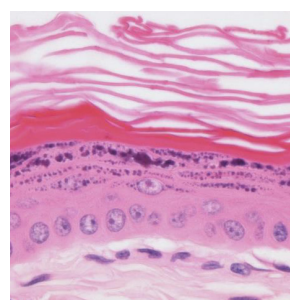
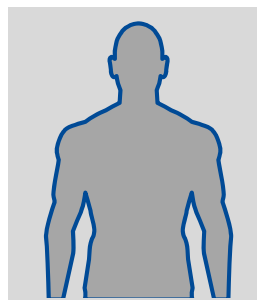
- Large surface → higher reactivity?
- Small size → defeat barriers?
- Life-cycle-dependent nanostructure?
- Unique properties?

Savolainen, Kai, et al. "Nanosafety in Europe 2015–2025: towards safe and sustainable nanomaterials and nanotechnology innovations.", Helsinki (2013). ISBN 978-952-261-310-3  
[www.veronananomedicine.it/wordpress/wp-content/uploads/2013/06/nanosafety\\_2015-2025.pdf](http://www.veronananomedicine.it/wordpress/wp-content/uploads/2013/06/nanosafety_2015-2025.pdf)



### BASF:

- Nano safety research since 2004
- More than 150 studies on nanomaterial toxicity
- More than 25 co-operations and research projects
- More than 50 scientific publications



# Cooperations

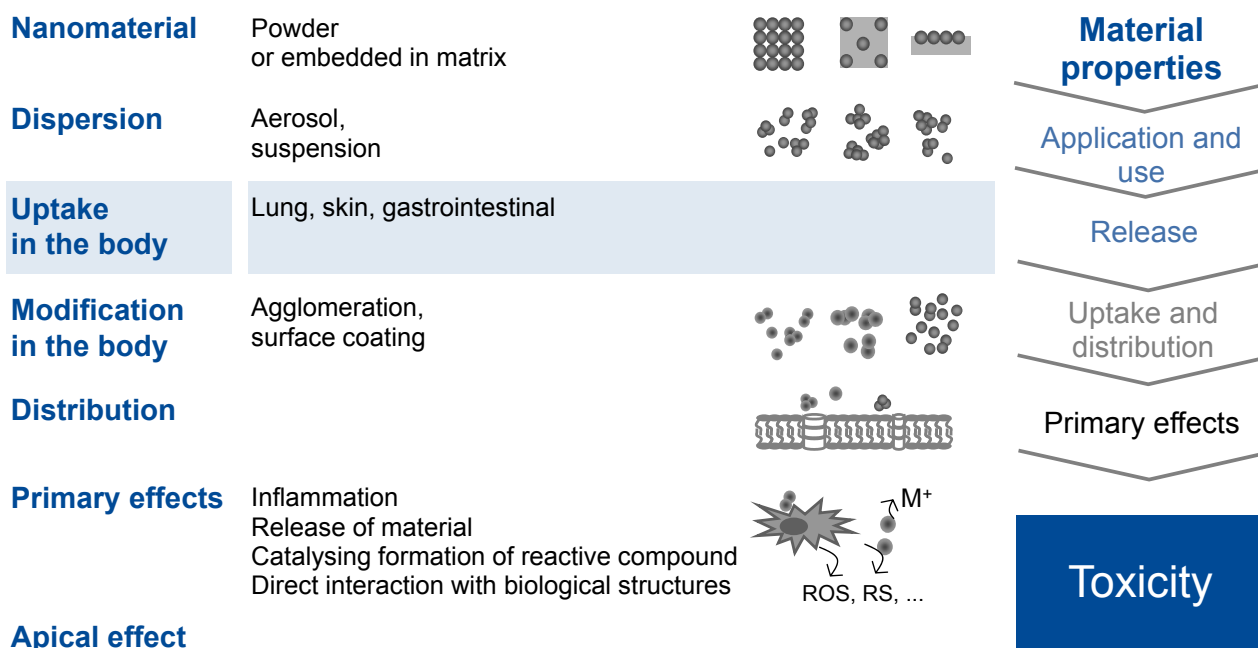
## Partners (*inter alia*)

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit	JRC European Commission	Harvard University	IUTA Institut für Energie- und Umwelttechnik
Bundesanstalt für Arbeitsschutz und Arbeitsmedizin	Bundesinstitut für Risikobewertung	Umwelt Bundesamt für Mensch und Umwelt	ENEA Italian National Agency for New Technology
RIVM Rijksinstituut voor Volksgezondheid en Milieu	Finnish Institute of Occupational Health	Health Canada Santé Canada	Danmarks Tekniske Universitet
RIKILT Wageningen UR	Uniwersytet Gdański	Université Paris Diderot	IOM Institute of Occupational Medicine
Universität des Saarlandes	Westfälische Wilhelms-Universität Münster	Bayer MaterialScience	ILSI Risk Science Innovation and Application
Universität Leipzig	US Environmental Protection Agency	Swiss Empa Materials Science & Technology	...

## Projects



# Life-cycle and biological pathway of nanomaterials



# Use of nanomaterials



in cosmetic emulsions



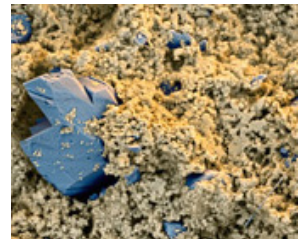
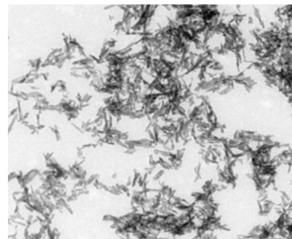
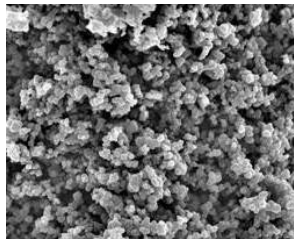
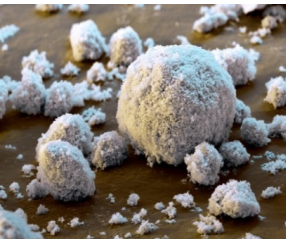
in rubber tires



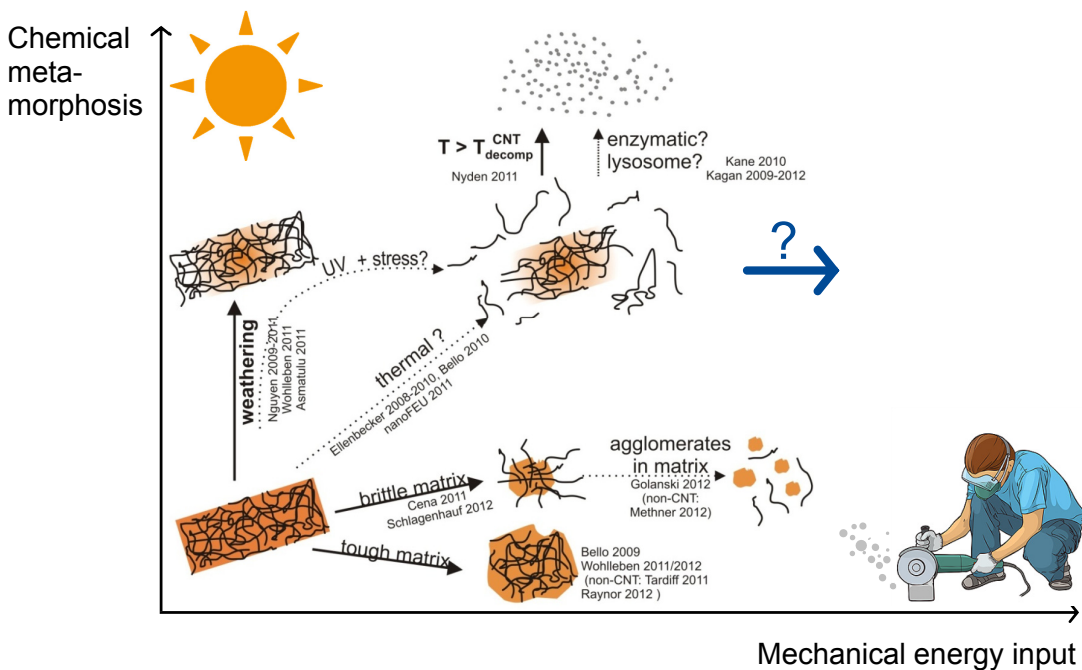
in car coatings



in concrete

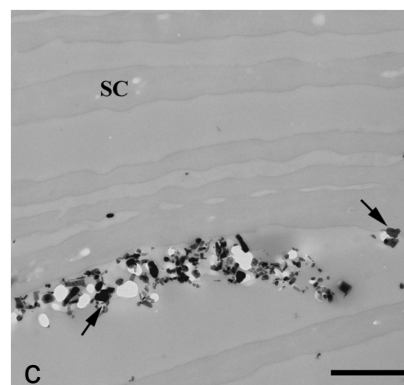
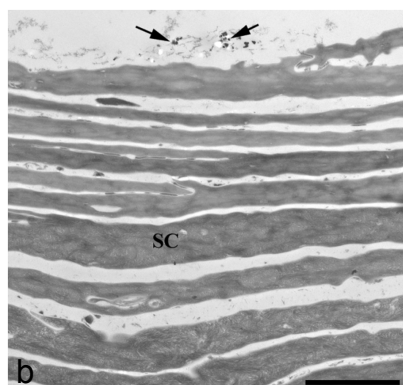
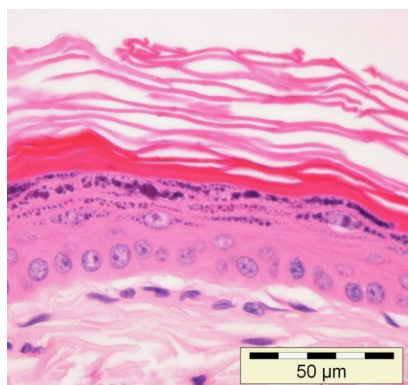


# Release of nanomaterials



# Uptake of nanomaterials

## Dermal absorption of nano ZnO



Monteiro-Riviere, Nancy A., et al. Toxicological Sciences 123.1 (2011): 264 – 280.

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# Effects of nanomaterials

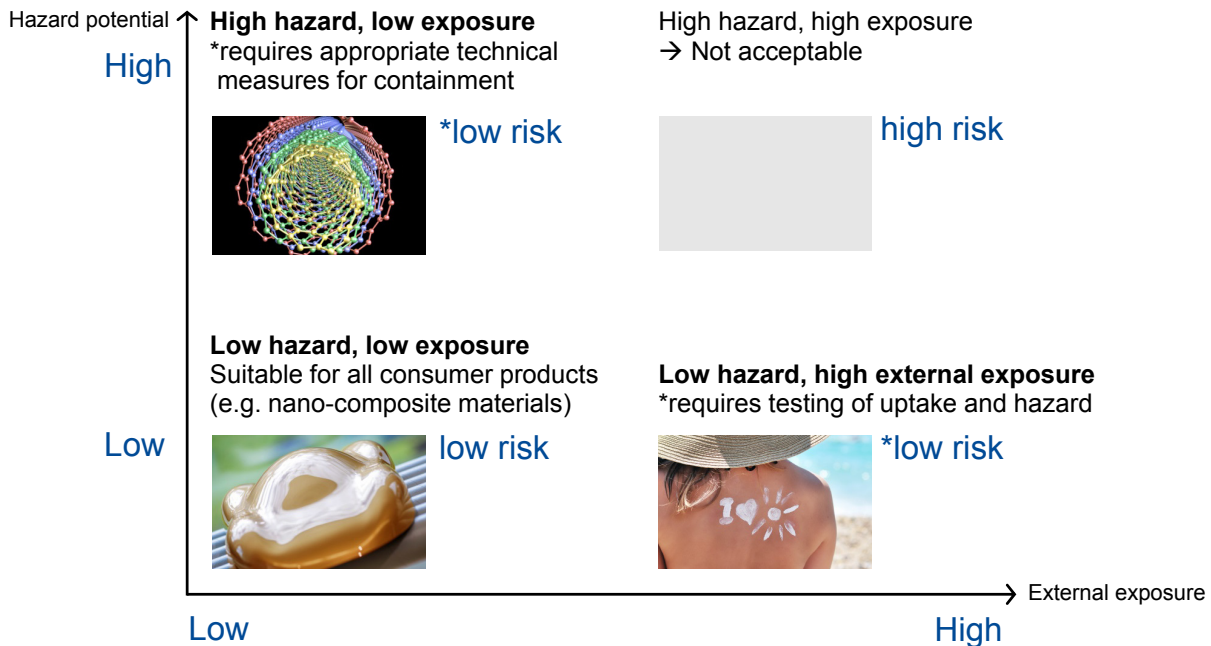
## Inhalation exposure

Material	Conc. [mg/m <sup>3</sup> ]	NOAEC [mg/m <sup>3</sup> ]	Effects	Reversible?
TiO <sub>2</sub>	2; 10; 50	2	Lung: histiocytosis	Yes, incomplete
ZnO	0.5; 2.5; 12.5	< 0.5	Lung: inflammation, necrosis Nose: necrosis	Yes
SiO <sub>2</sub>	0.5; 2.5; 10	10	none	-
SiO <sub>2</sub> coated	0.5; 2.5; 10	10	none	-
CeO <sub>2</sub>	0.5; 0.5; 10	< 0.5	Lung: histiocytosis, inflammation	Yes, incomplete
MWCNT	0.1; 2.5; 2.5	≤ 0.1	Lung: inflammation	No
BaSO <sub>4</sub>	2; 10; 50	50	none	-

Landsiedel, Robert, et al. Particle and Fibre Toxicity (2014): 16  
 Ma-Hock, Lan, et al. Particle and fibre toxicology 10.1 (2013): 23  
 Klein, Christoph L., et al. Archives of toxicology 86.7 (2012): 1137-1151

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# Knowing hazard and exposure enables the safe use of nanomaterials



Bräu et al. 86 Arch Toxicol (2012) 077 – 1087  
Landsiedel, Robert, et al. Advanced Materials 22.24 (2010): 2601 – 2627  
Ma-Hock, Lan, et al. 112.2 (2009): 468-481

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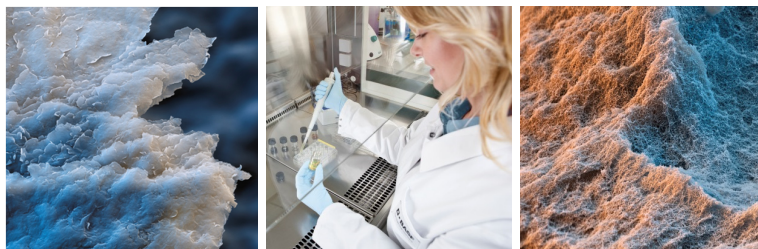
## Summary

- Well-known mechanisms of toxicity, no nano-specific toxicity observed
- Existing testing methods of the OECD test guidelines are generally suitable for nanomaterials
- Safety assessment should consider the lifecycle of the material (use, release) as well as the biological pathway (uptake, biopersistence and biological effect)
- Nanomaterials can be grouped for safety assessment
- Long-term effects still under investigation

BASF Research Press Conference  
on May 27, 2014

# Nanotechnology

Small dimensions – great opportunities



 **BASF**  
The Chemical Company