Willkommen
Welcome
Bienvenue

EMPA
Materials Science & Technology

Aging and Transformations of Nanoparticles Relevant to Product Use

Dr. Denise M. Mitrano

Project Goals

- **Nanomaterials safer by design**

  - Correlate specific ENP properties to their aging, transformation, and behavior
  - Classify nanomaterials according to their impacts

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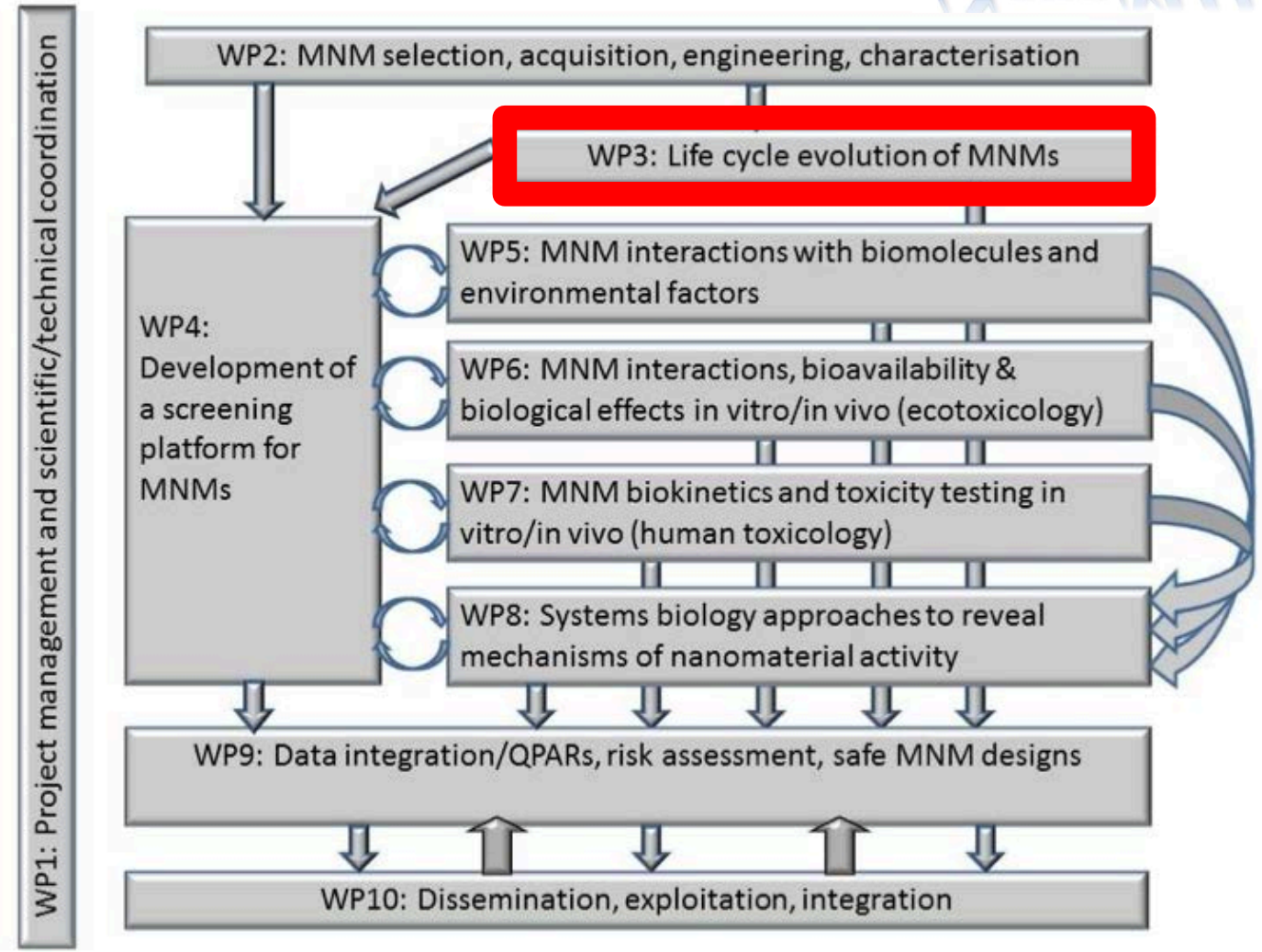
- **Expected Impacts**
  - Protocols for ENP synthesis, characterization, and safety assessment
  - Relate specific characteristics to impacts
  - Predictive ENP risk assessment according to biological and environmental impacts
  - Provide guidance for future safer design

Project Goals

Nanomaterials safer by design



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- **Work Package: Life Cycle Evolution of ENP**
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  - Provide aged particles to other consortium members to compare toxicological effects to pristine materials

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  - Aging nanomaterials in air (Ag, CeO)

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- **CEA (Commissariat a l'Energie Atomique), France**
  - Aging nanomaterials in air (Ag, CeO)
- **University of Birmingham, UK**
  - Develop specialized particles for aging tests
  - Aging nanomaterials in water (ZnO, CeO)

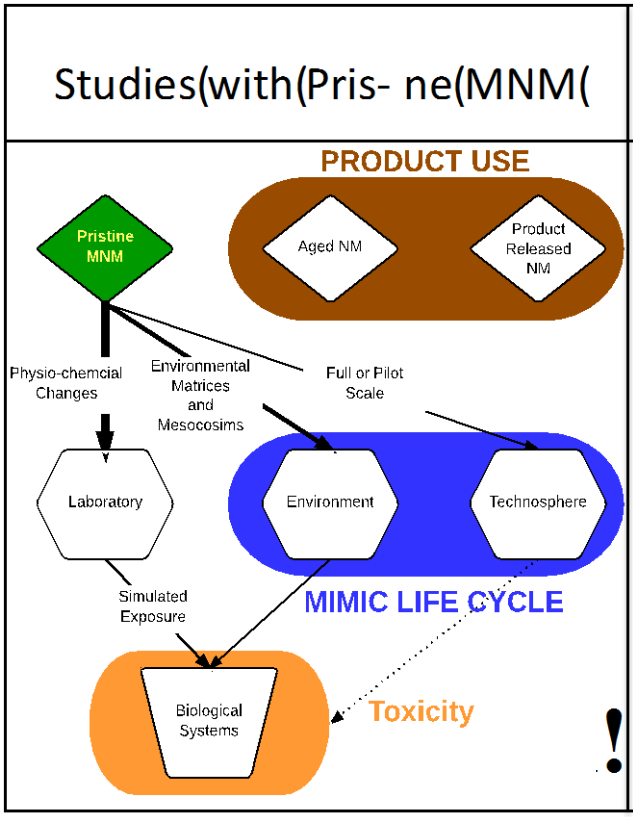
UNIVERSITY OF BIRMINGHAM

Project Goals

- **Work at Empa:**
  - Aging nanomaterials in water; study transformation(s) relevant to product use

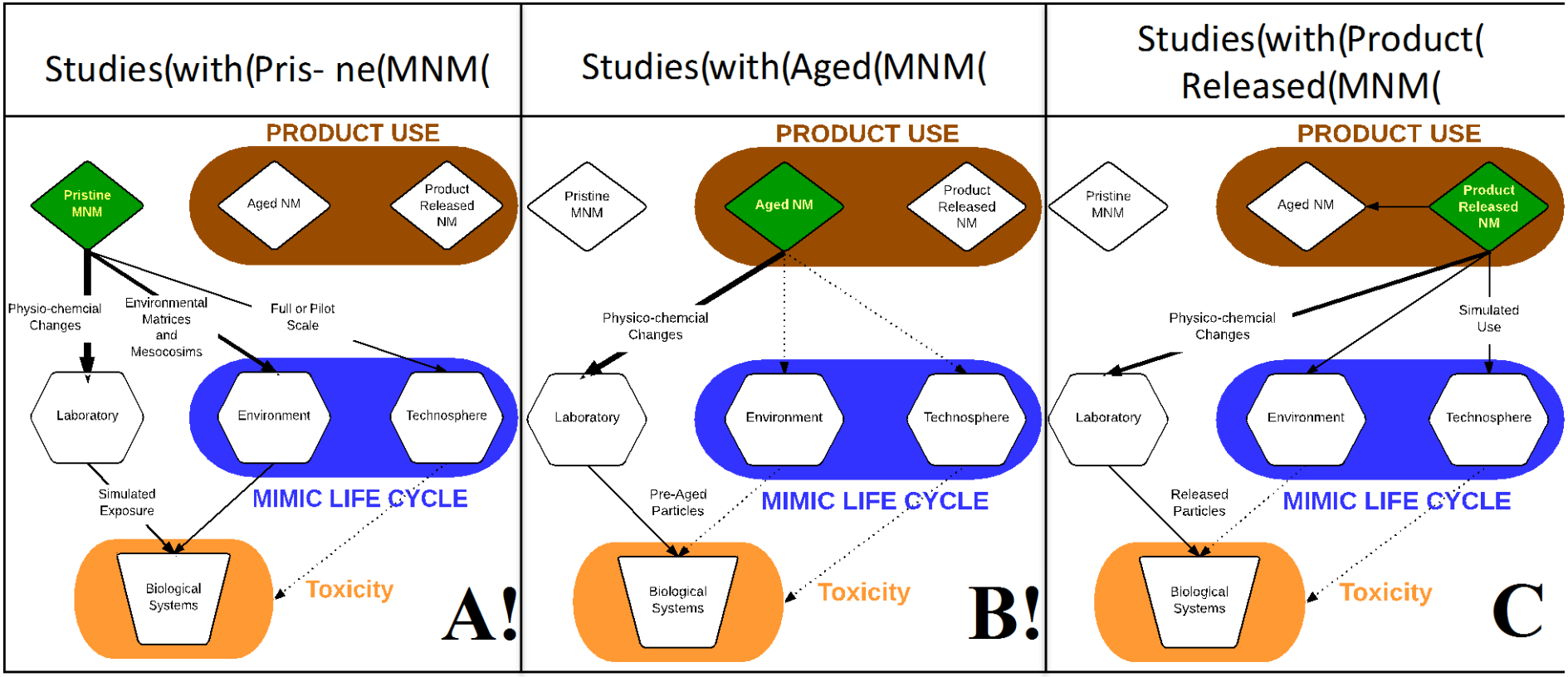
1. Provide literature review of ENP aging: determine relevant particle transformation(s) and where gaps in knowledge exist
2. Conduct experiments of ENP aging processes
3. Determine which properties make particles more similar or more varied after aging
4. Age consortium particles to determine varied toxicity compared to pristine counterparts

Present Aging/Transformation Studies



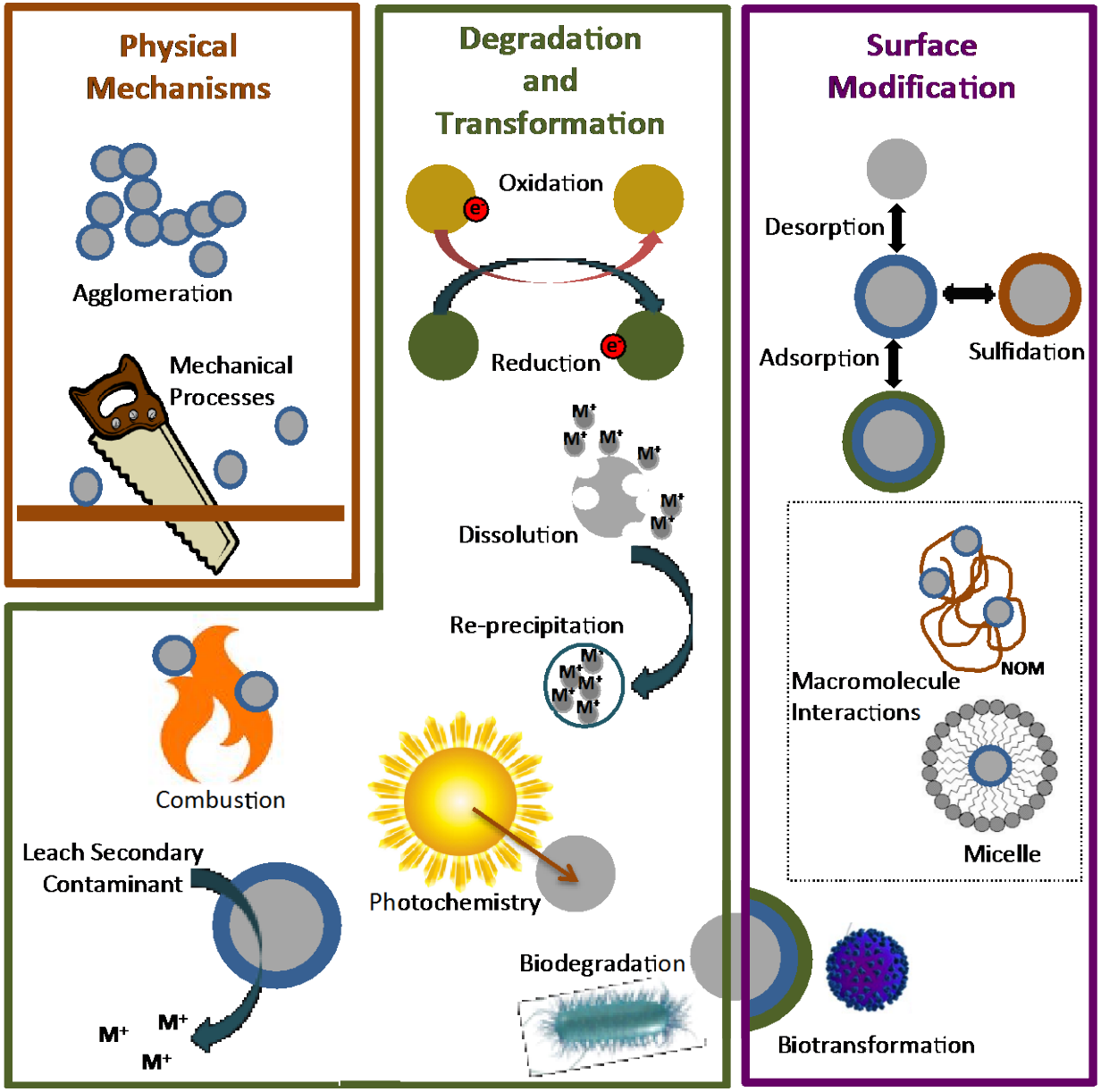
D. Mitrano

Present Aging/Transformation Studies



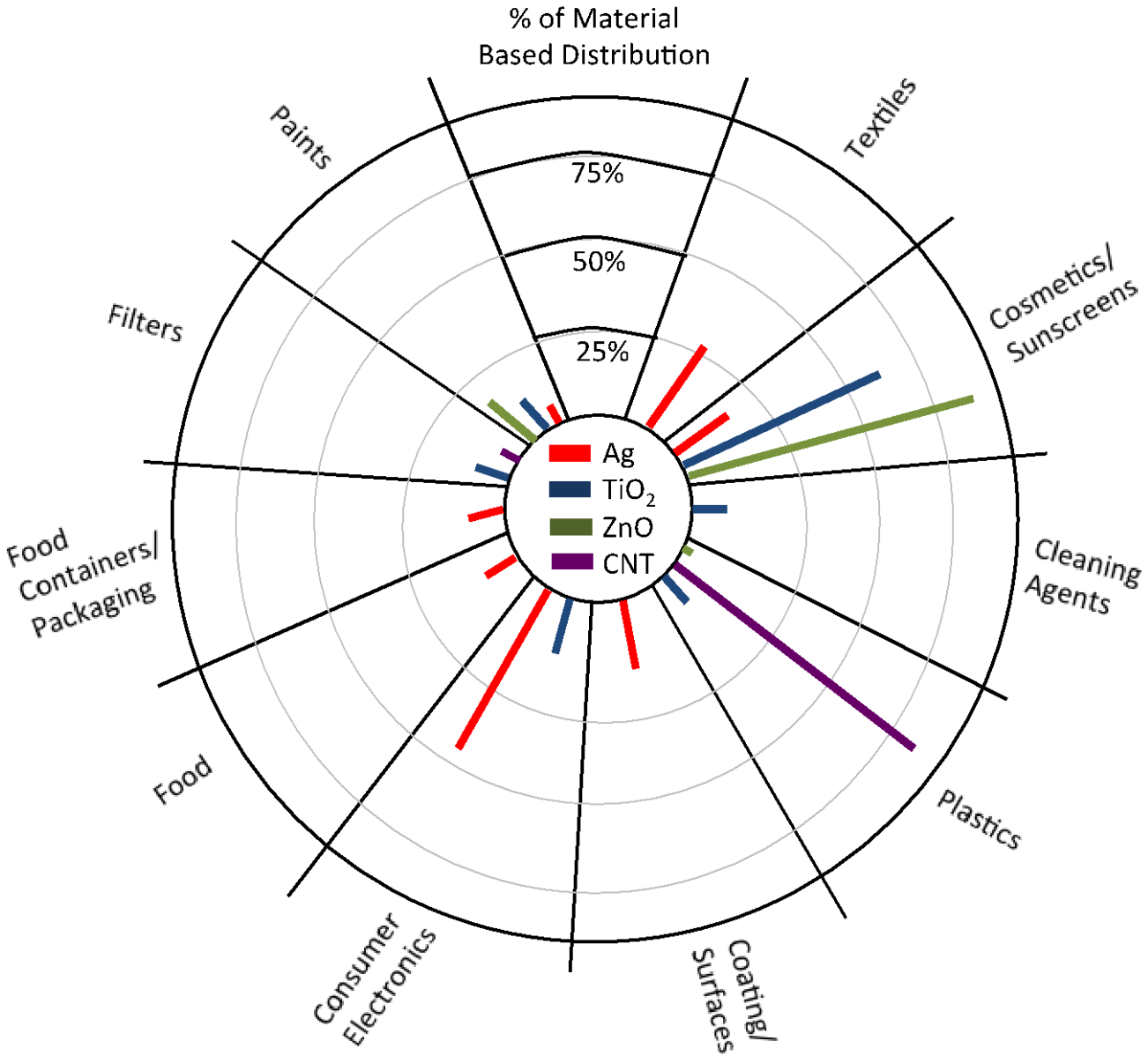
D. Mitrano

Particle Aging/Transformations



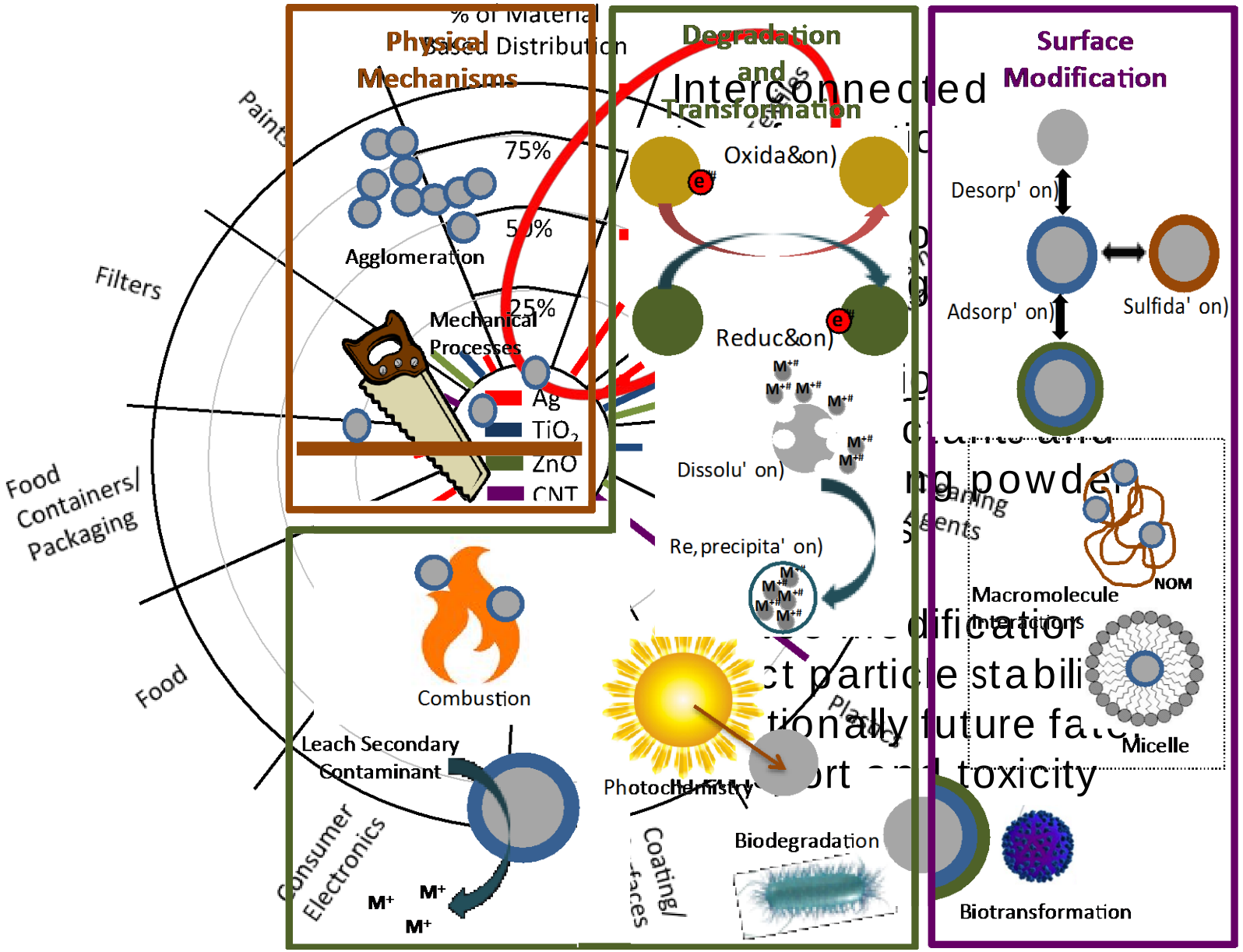
D. Mitrano

Nanomaterial Distribution in Products



D. Mitrano, based on Sun et al 2014

Nanomaterial Distribution in Products



Interconnected

ng powder

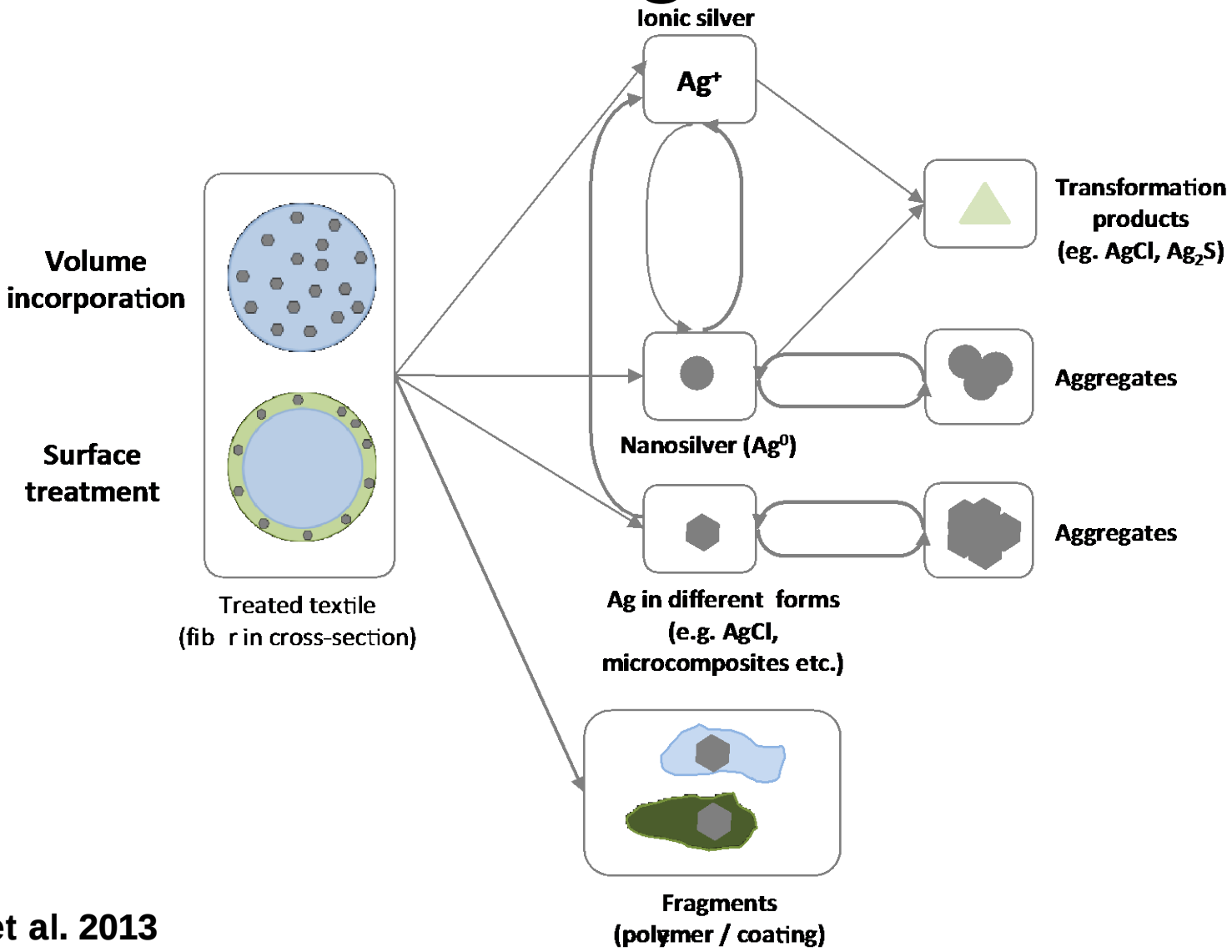
dification

ct particle stabili

tionally future fate

ort and toxicity

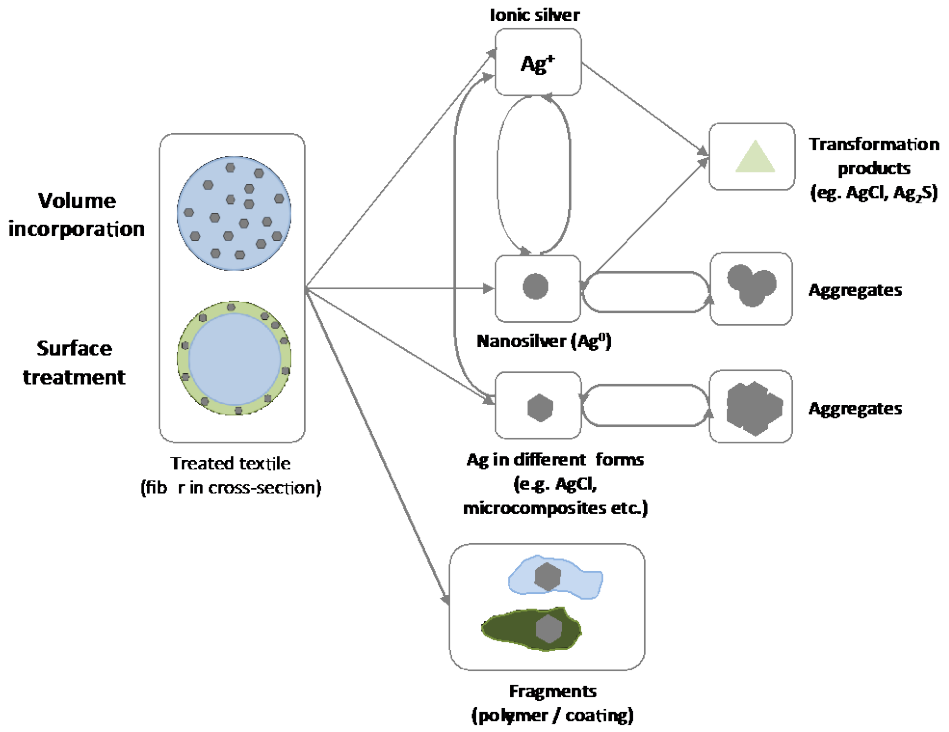
Ag Release and Transformation after Laundering Fabrics



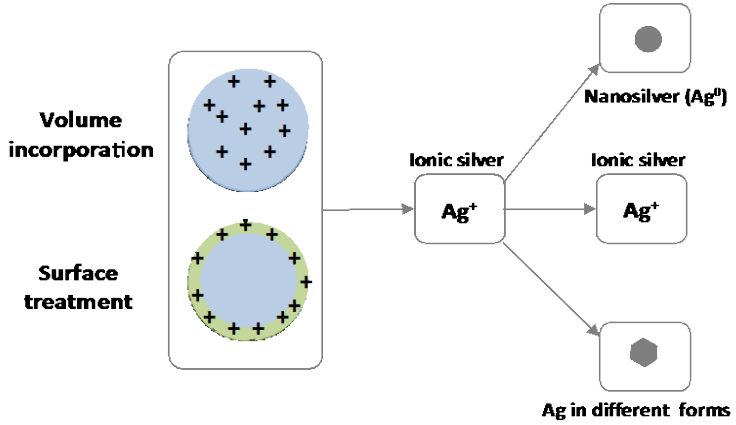
Nowack et al. 2013

Comparison of NP and Traditional Ag after Release

NP Incorporation



Traditional Ag Additives



Ag salts: AgCl, AgCl on TiO_2 carrier
Ag ion exchange: AgZeolite
Metallic Ag: Ag threads

Comparison of NP and Traditional Ag after Release

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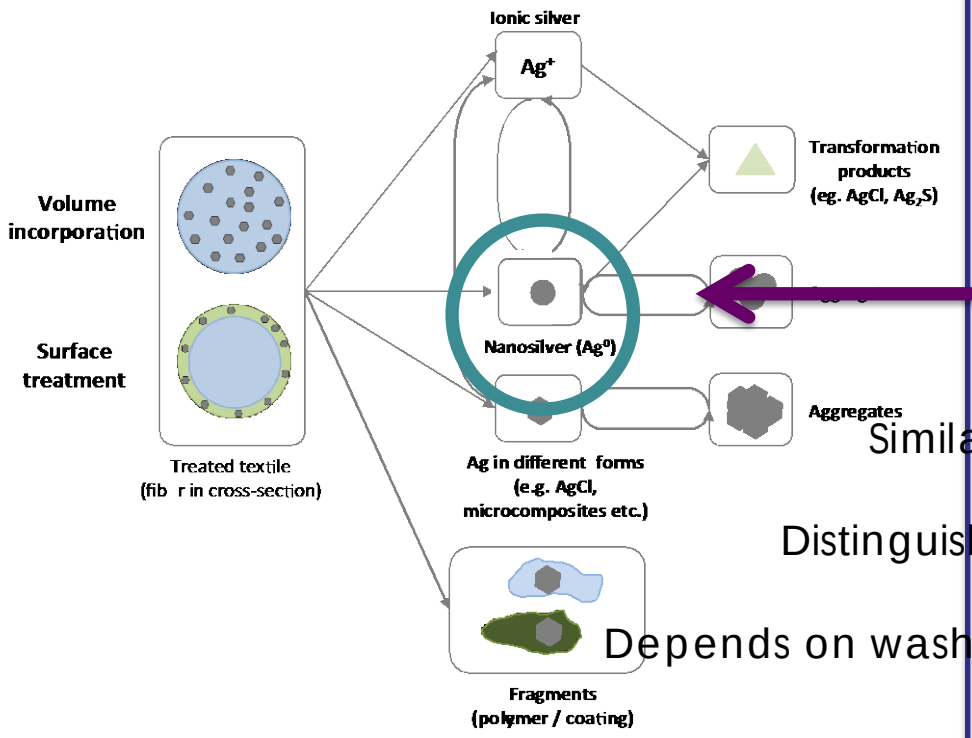

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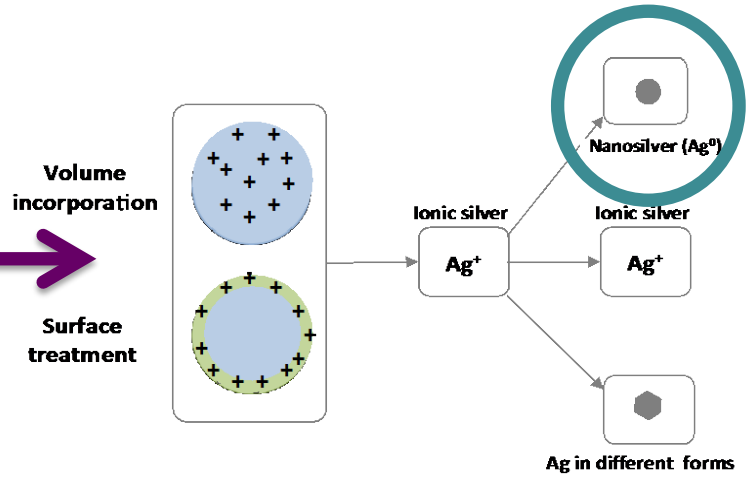


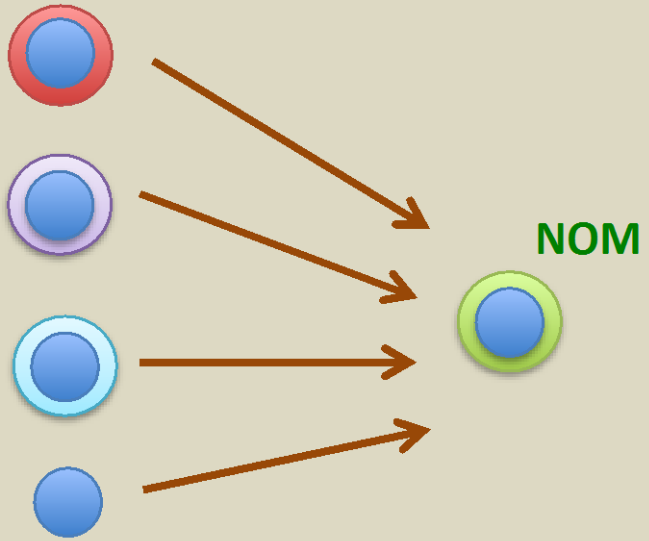
Similar?

Distinguishable?

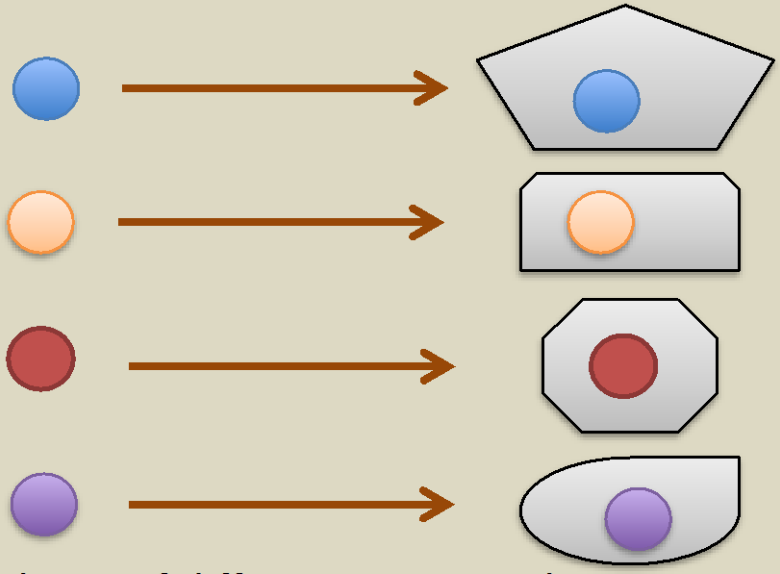
Depends on washing conditions?

Ag salts: AgCl, AgCl on TiO_2 carrier
Ag ion exchange: AgZeolite
Metallic Ag: Ag threads

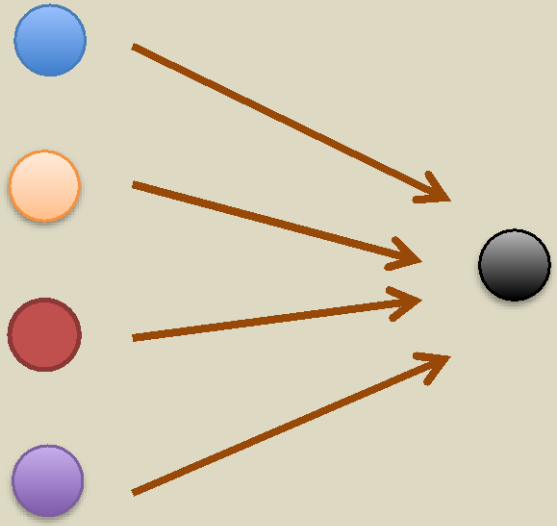
Transformation Increases Similarity



Transformation of coating

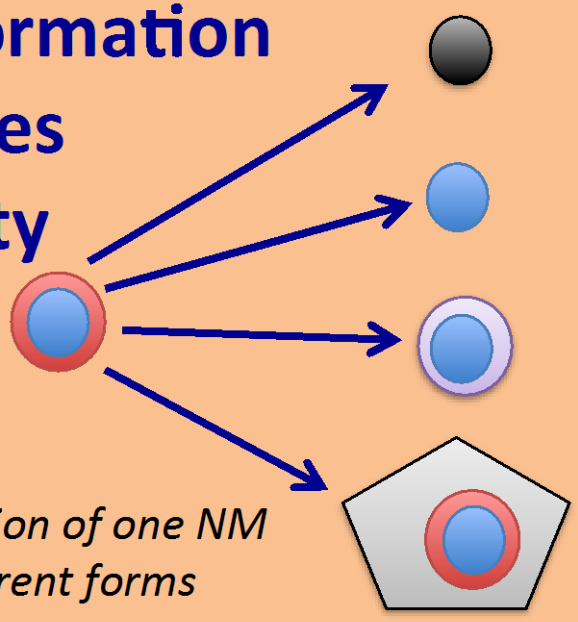


Release of different MNM in the same matrix



Transformation of different NM into the same material

Transformation Increases Diversity



Transformation of one NM into different forms

Conclusions

- Aged and/or product released NP will have different qualities than pristine ENP
- Product use dictates relevant aging/transformation
- Multiple, subsequent transformation possible and likely
- "Traditional" additives to textiles, etc. may also release nano-sized materials

QUESTIONS?