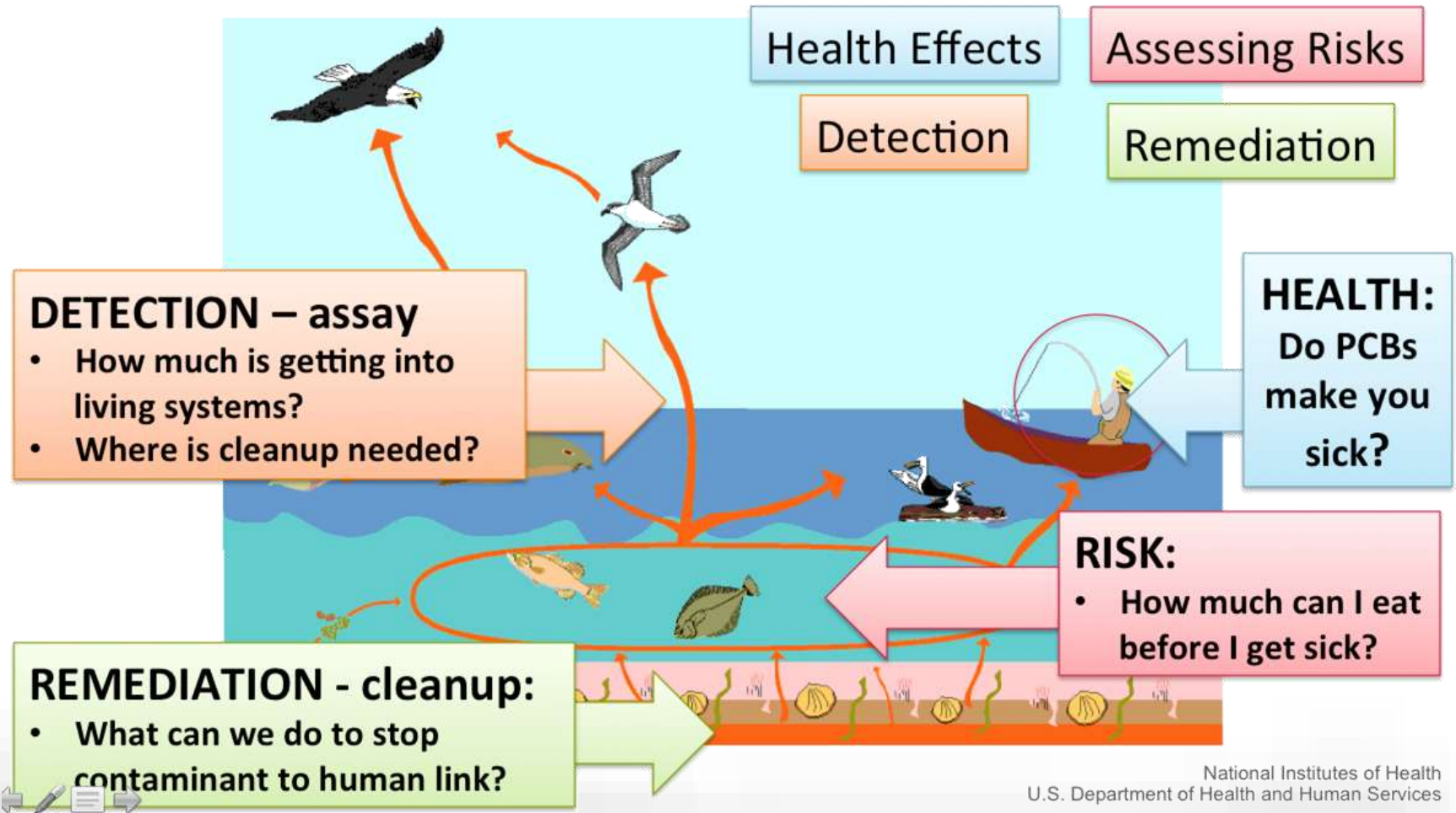


Intersection of Green Chemistry and Materials Engineering: Employing Green Chemistry Principles to Advance Environmental Remediation Technologies

Brad Newsome
University of Kentucky
Superfund Research Center
bradley.newsome@uky.edu

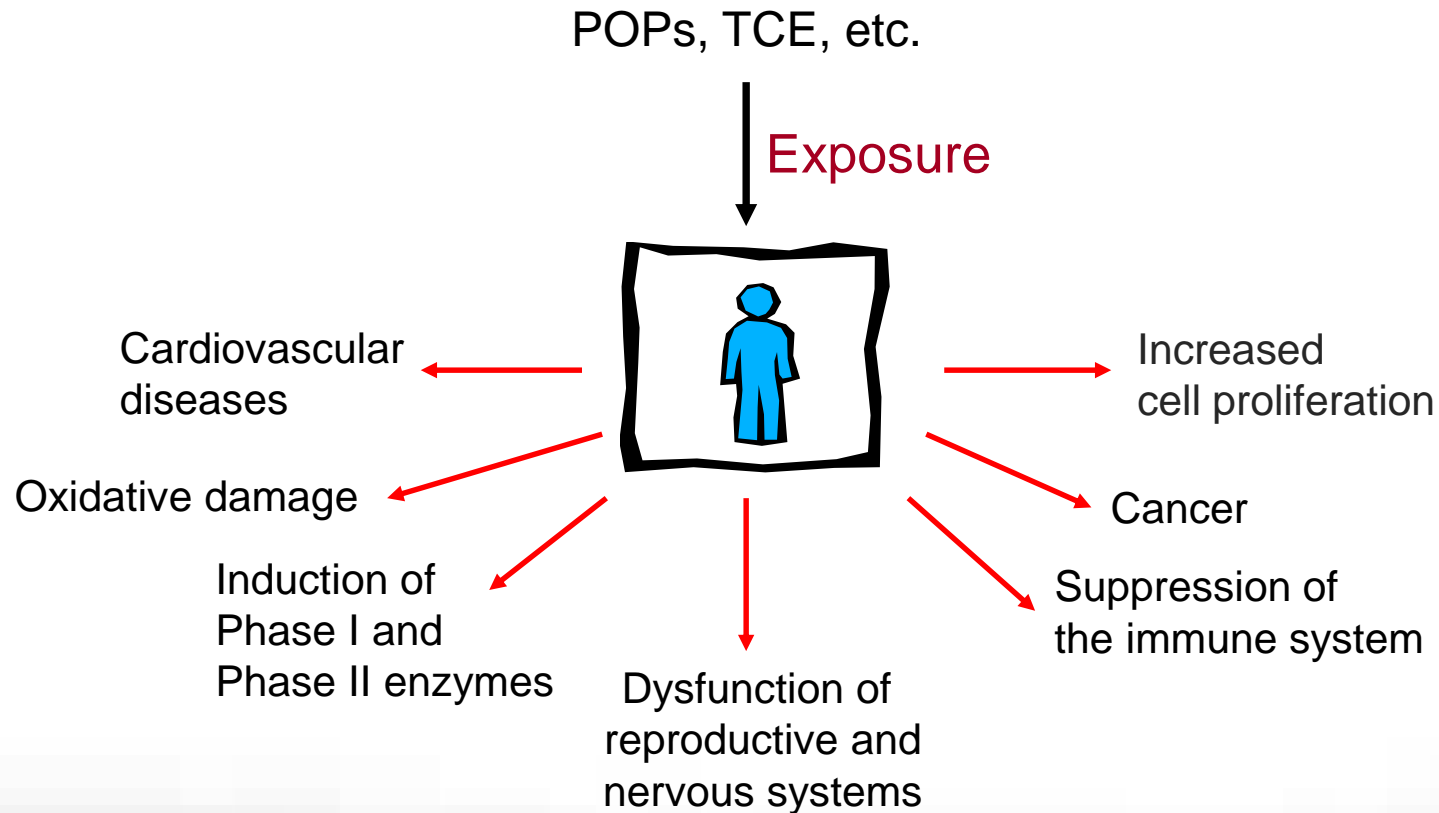
Superfund Research Program: Environmental Health Science with Broad Scope



National Institutes of Health
U.S. Department of Health and Human Services

Slide From: Heather Henry, NIEHS

Chlorinated Organic Risk Reduction using Nutrition Directly and Indirectly



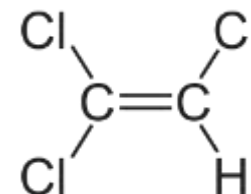
<http://ohioline.osu.edu/cd-fact/0201.html>

Using Nature and Nutrition as a guide

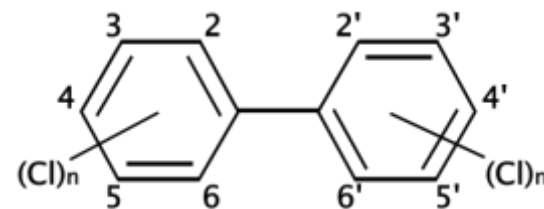


- **Polyphenols** (found in fruits and vegetables): antioxidant and anti-inflammatory properties.
- Nutrients may be of value for inhibiting the toxic effects of PCBs and other AhR ligands.
- **Plant-derived polyphenols** (e.g., green tea extract (GTE), quercetin) also can reduce body burden of POPs.
- **Benign alternatives** for toxic reducing agents

Groundwater Remediation: Chlorinated Organic Compounds



Trichloroethylene (TCE)



Polychlorinated biphenyls (PCBs)

Remediation Technologies

Physical Treatment

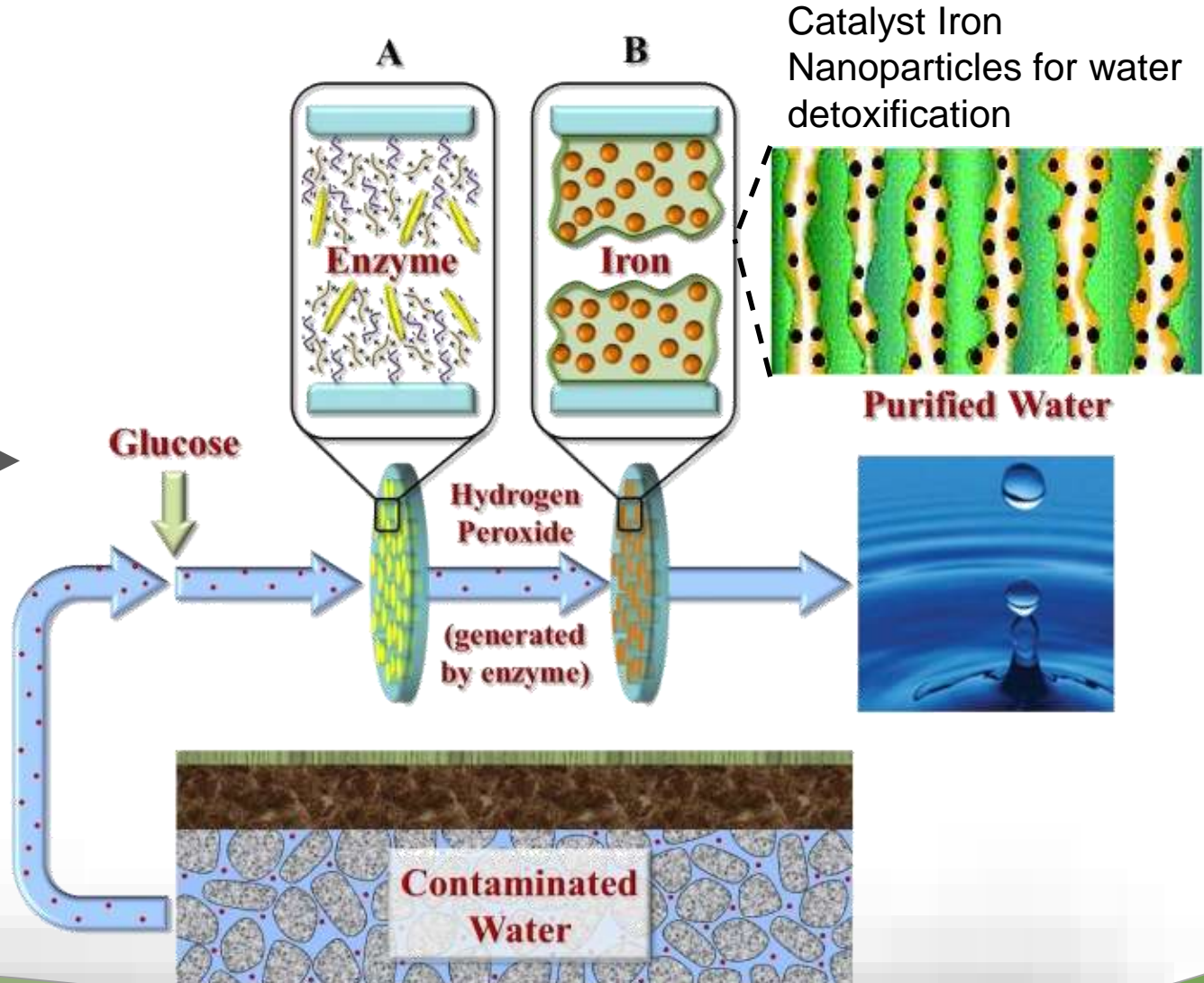
Surface
Subsurface
Filtration

Biological Treatment

Aerobic
Anaerobic

Chemical Treatment

Reduction
Oxidation
(free radicals,
oxidants)



Green Synthesis of Reactive Iron Nanoparticles in High Throughput Membranes



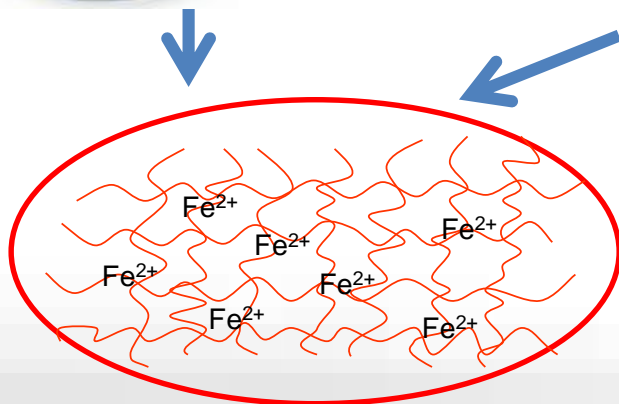
Citrate
or
Green Tea
Extract



Ferrous Sulfate

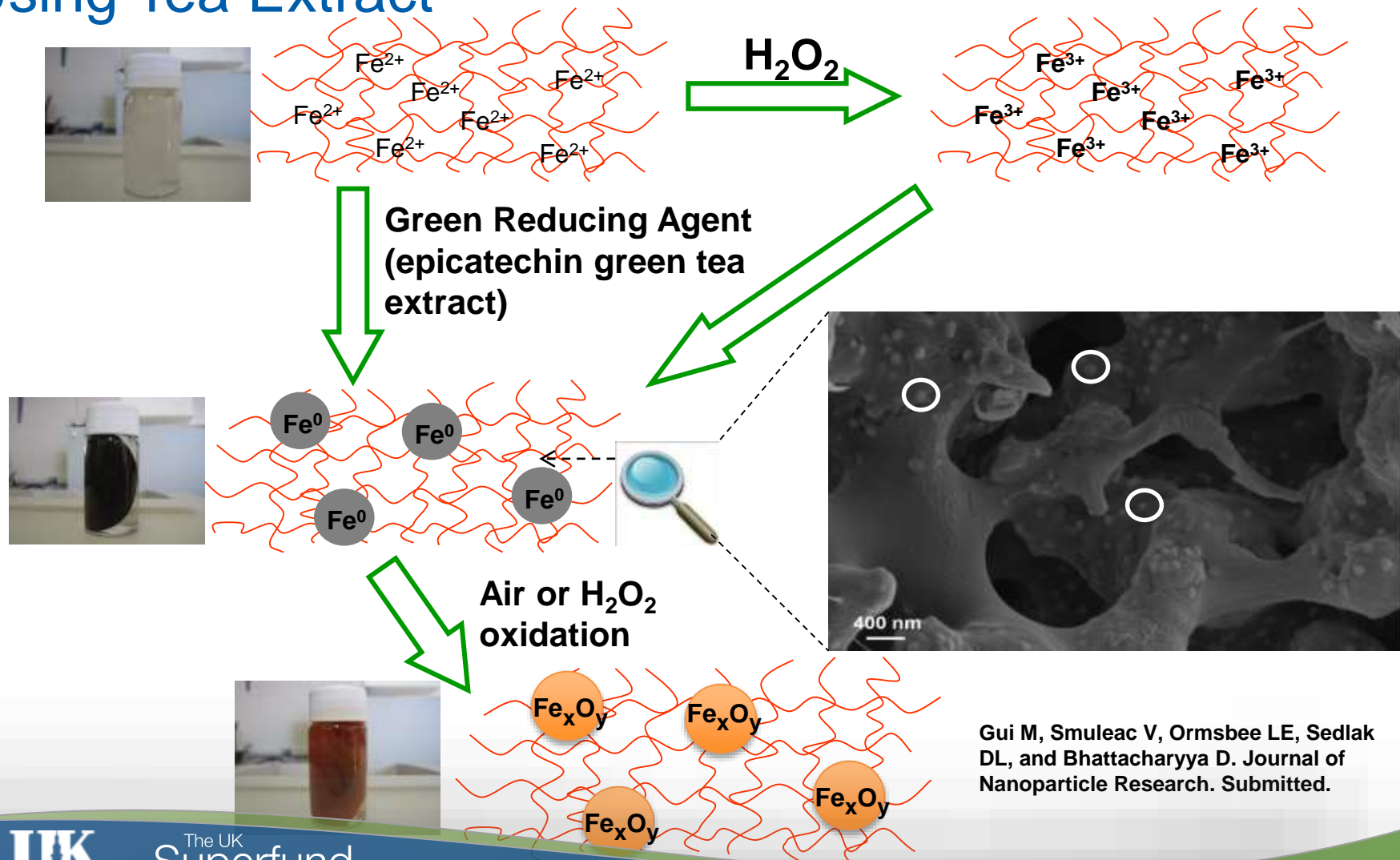


Hydrogen
Peroxide



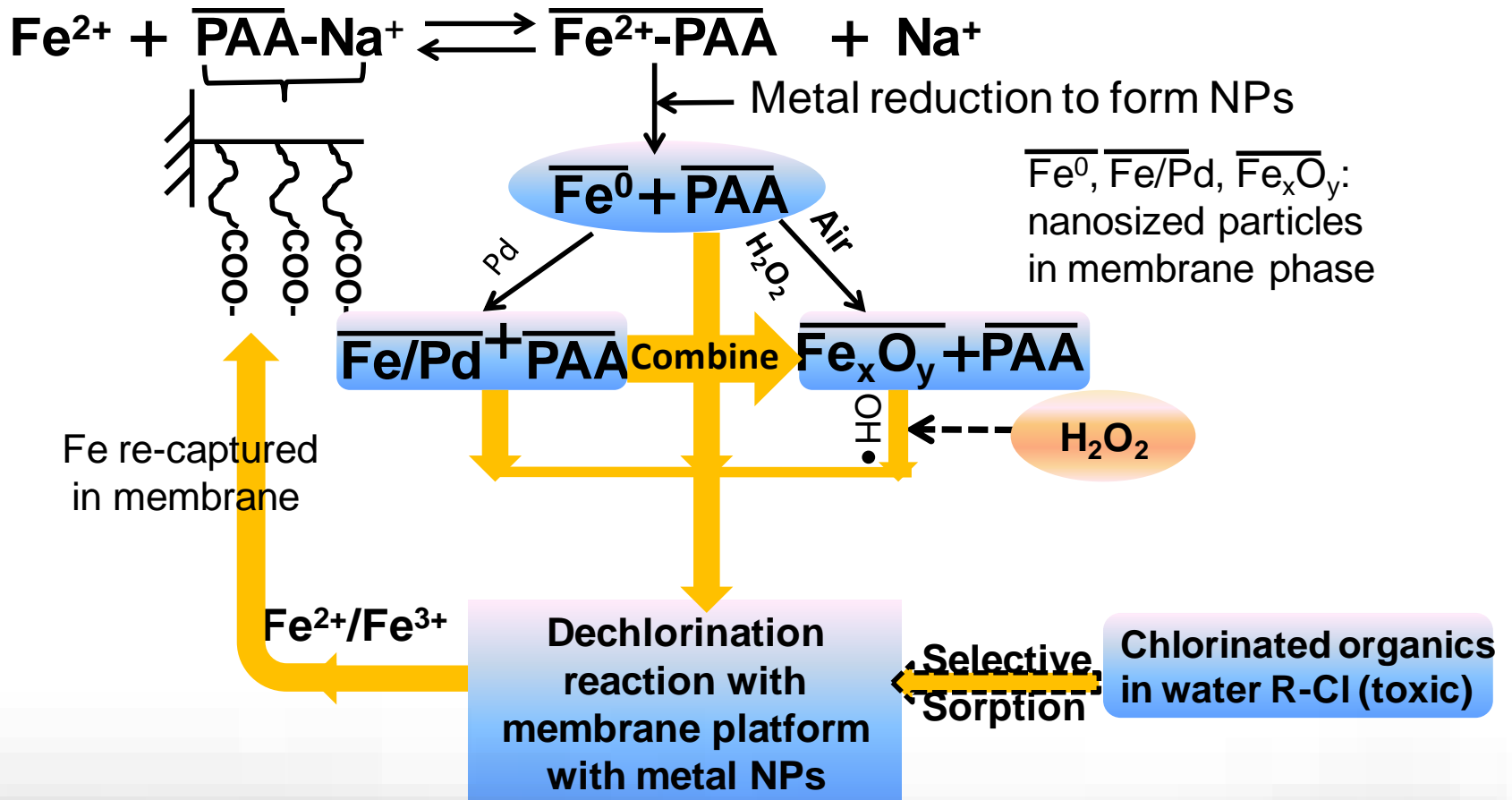
Can We Use the Membrane ?
to immobilize the iron

Green Synthesis of Nanoparticles in Membranes Using Tea Extract



Gui M, Smuleac V, Ormsbee LE, Sedlak DL, and Bhattacharyya D. Journal of Nanoparticle Research. Submitted.

Iron-functionalized Membrane Remediation Technologies



Iron-Based Nanoparticles

Reduction

TCE, TCP...

With 2nd metal
such as Pd

PCBs

Oxidation

Combined
Pathway

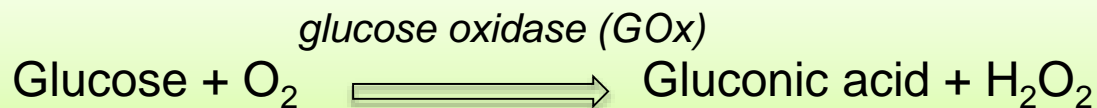
Convert iron to
iron oxide NPs

Green synthesis

e.g. Glucose oxidation

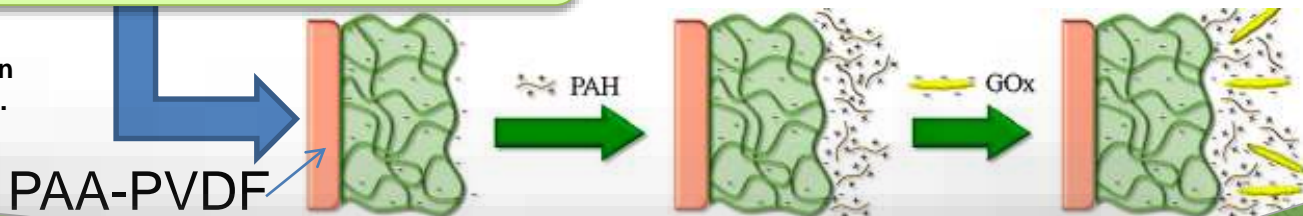
Add H₂O₂

No need to
add 2nd metal



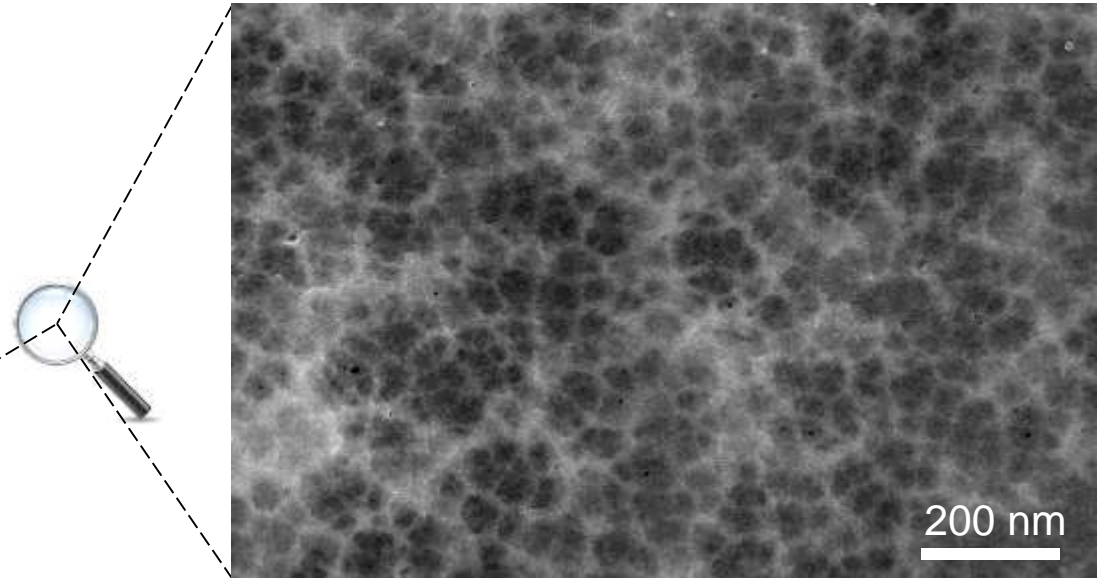
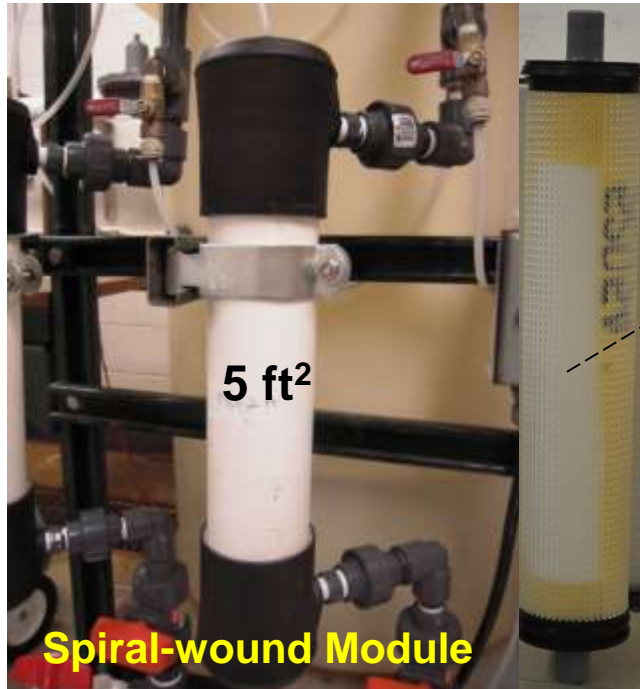
Duke FR et al.. Journal of the American
Chemical Society, 1969, 91: 3904-3909.

PAA-PVDF



S. Lewis et al. PNAS. 2011, 108(21), 8577,

Full-scale Functionalized Membrane Development (joint work with Nanostone/Sepro Inc.)



PAA functionalized membrane



Iron functionalized membrane



Iron oxide functionalized membrane

Chlorinated Organic Risk Reduction using Nutrition and Green Chemistry

