

Team Microfluidics/Arsenic in water: Primary Discussion Points

- Assumptions:
 - Mechanism is colorimetric with optical detection (shift from red to blue at 0.01 mg/L)
 - We will assume no need for microscope (free App – e.g., maglight, App that comes with the kit)
 - Correct App available (assumption)
 - Vision of deployment has to be more clear
 - Sold as a kit with the device, reagents, etc.
 - Sold to Well-owners, EPA, developing countries?
 - Could be good outreach for developing countries? IF they have the infrastructure and raw materials to run it...
 - science has been worked out already
 - 100 mL 50 nm is \$900 0.01% (\$0.18 per sample)
- The Joe Stetter Process:
 - First is customer vision
 - Second is Master Design Review Document
 - Engineering document of how to meet vision
 - Build and Test parameters, implementation
 - Evaluation of data to see how close you are
 - Revise MDRD

Team Microfluidics/Arsenic in water: Primary Discussion Points

- Factors impacting the reproducibility of the manufacturing method and final product
 - Need to worry about fouling (bio/chemical)
 - Single use, front end filtration
 - Determines cost
 - Injection molding/stamping would help fix the reproducibility issues
 - Include larger imaging area
- Factors to consider when choosing materials (e.g., cost, purity, source)
 - Material selection is good (EHS): Gold and silica
 - Cost of materials? (gold np) Is this the driver in cost?
 - 100 mL 50 nm is \$900 0.01% (\$0.18 per sample)
- The plan for testing, including field/test conditions, regulatory requirements, scope, etc.
 - What is the sensitivity? What other water chemicals can give false positives?
 - Need to test the stamped/molded material to ensure similar activity
 - Need to test the shape of the viewing port/collector to test fidelity
 - Can you see the difference between 10 ppb and 9? 10 and 1? Need to fully characterize fully (+/- acceptable range)
 - What is the error caused by variability in AuNP solution
 - Evaluation across large variety of well waters

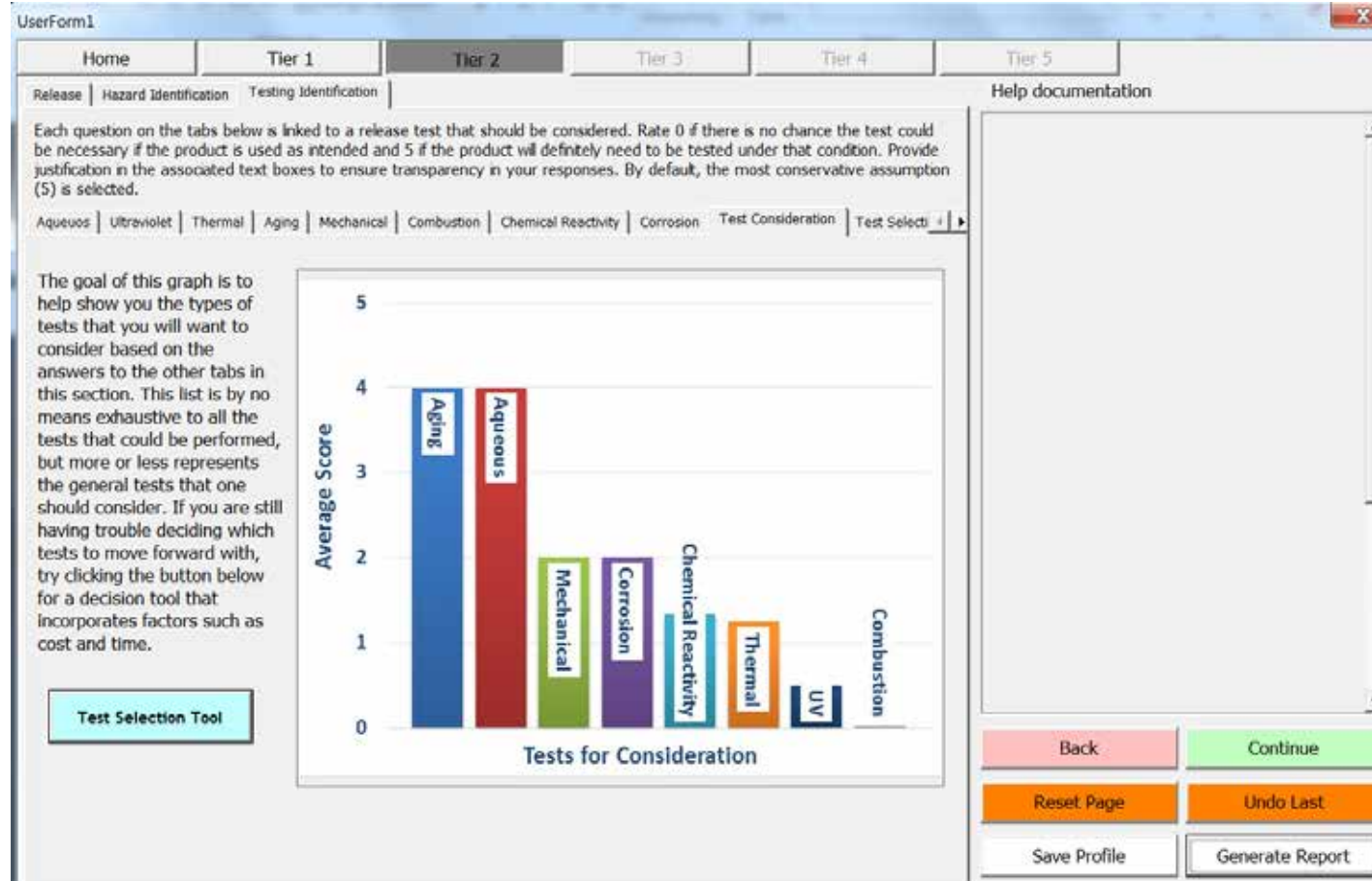
Team Microfluidics/Arsenic in water: Other Considerations (1 of 2)

- Factors impacting the scalability of the manufacturing method
 - 3D printing is less expensive for R&D, but may be too expensive for manufacturing
 - Probably cheaper to be stamped or injection-molded
 - That would fix tolerance issues.
- Limitations in terms of raw materials and processing technologies
 - Requirement of treating the flow channel surfaces
- Manufacturing cost drivers for this technology
 - Cost of gold (\$0.18 per sample)
- Remaining technical issues hindering commercialization of this technology
 - Level of education for users? Homeowner in rural area?

Team Microfluidics/Arsenic in water : Other Considerations (1 of 2)

- Factors that will influence the decision to manufacture in-house vs. contracting out
 - Cost
 - Reproducibility
- Life cycle considerations (e.g., device or effluent disposal)
 - Very small volumes
- Major safety concerns for manufacturing the sensor
 - See NanoGRID report
- Other (please specify)

Test selection for durability



MCDCA combinational testing output

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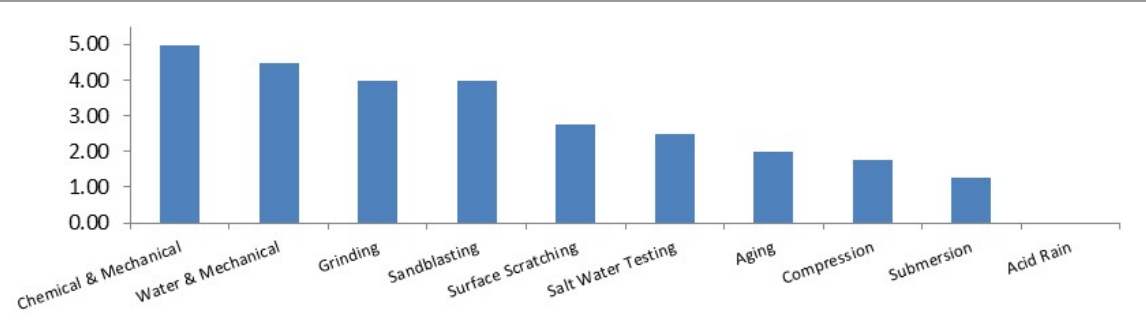
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Release Hazard Identification Testing Identification

Help documentation

Each question on the tabs below is linked to a release test that should be considered. Rate 0 if there is no chance the test could be necessary if the product is used as intended and 5 if the product will definitely need to be tested under that condition. Provide justification in the associated text boxes to ensure transparency in your responses. By default, the most conservative assumption (5) is selected.

Thermal Aging Mechanical Combustion Chemical Reactivity Corrosion Test Consideration Test Selection and Results



Test Method	Rating
Chemical & Mechanical	5.00
Water & Mechanical	4.50
Grinding	4.00
Sandblasting	4.00
Surface Scratching	2.80
Salt Water Testing	2.50
Aging	2.00
Compression	1.80
Submersion	1.20
Acid Rain	1.00

Test 1 Test 2 Test 3 Test 4

You may perform either a simple test, or a combinational test. Use the first row of inputs below to report the results of a single test, or multiple rows for each stage in the case of a combinational test. Click 'Browse' after selecting a test method to view its specification online. Please record whether you observed the release of the nanomaterial by selecting 'Yes' or 'No'. You may also describe the release or provide justification for choosing this test.

Test: Test method: Released? Describe the release:

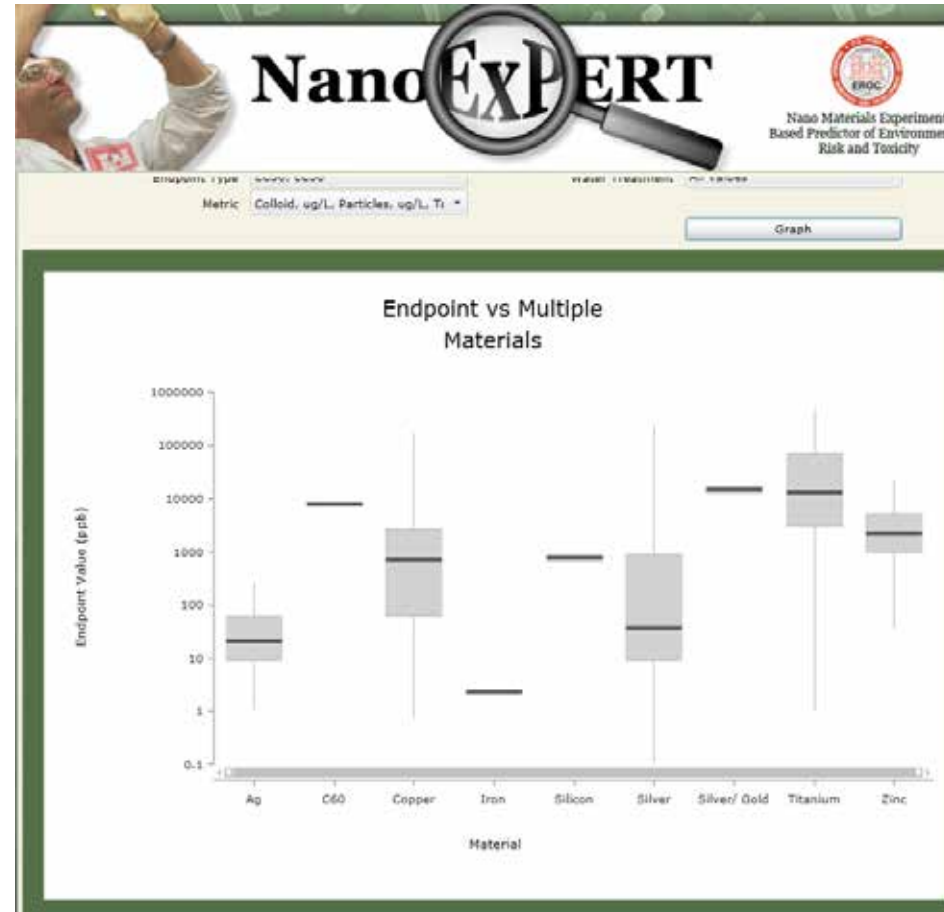
Submersion		Browse	<input type="radio"/> Yes <input type="radio"/> No	
		Browse	<input type="radio"/> Yes <input type="radio"/> No	
		Browse	<input type="radio"/> Yes <input type="radio"/> No	
		Browse	<input type="radio"/> Yes <input type="radio"/> No	

Submersion
Rain Event
Acid Rain
Humidity Changes
Washing
Sunlight Exposure
Light Cycling

ational):

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Tiers 2/4: environmental hazard screening: low; exposure may not be of concern; manufacturing occupation safety concern for silica before suspended



Gold sensor for As

Use of nano-enabled technology structure category cannot be excluded from regulatory testing

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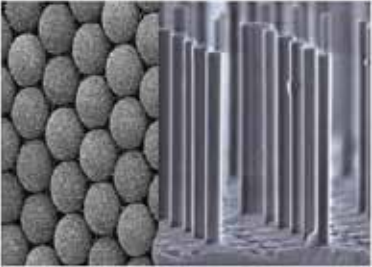
Basic Information Technology Category Nanomaterial Definition Special Properties Help documentation

Instructions
Please read the description of each of the nano-enabled technology categories by clicking on each of the tabs below. Then use the dropdown menu at the bottom to select the most applicable technology category to your product. You may only select one technology category. If multiple technology categories apply, please start a separate profile of NanoGRID for that technology category and run that technology category through the process separately.

Bulk			Surface Bound			Particles			
1A	1B		2A	2B	2C	3A	3B	3C	3D

Category 3A: Surface bound Nano-object (particles, rods, diamonds etc.) 2 Dimensional Structure (Multi Type)

This category consists of a surface bound nano-objects. The nanoscale object dimensions range from roughly 1 to 100 nanometers and extend in two spatial dimensions. This category is made up of multiple types of material.



Category 3A: Surface bound Nano-object (particles, rods, diamonds etc.) 2 Dimensional Structure (Multi Type)

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Use of nanoparticle cannot be excluded from regulatory testing

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Basic Information Technology Category Nanomaterial Definition Special Properties Help documentation

Instructions
Please select all of the following that apply. If you are unsure of an answer, you may use a precautionary ("conservative") approach by checking the box next to the question(s).

Solid at 25 °C and 1 atmosphere and at least 1% of the total particles (A) by mass (US EPA TSCA Section 8) or (B) by particle number (EU 2011) has a primary particle size that is less than or equal to 100 nm in at least one dimension.

The material is a nanomaterial, as defined above, and the average aggregate size is less than 1000 nm in at least one dimension

There is strong evidence that there is aggregation or sintering (irreversible size increase) such that the average aggregate size is greater than 1000 nm

If there is aggregation or sintering there may be an argument that the materials are no longer nano-sized. However, you must have a very strong rationale in the text box below. If you have strong rationale and this is the only check box, you may wish to determine if further nano-specific regulatory scrutiny or testing is required.

The average volume specific surface area of the material is greater than $60 \text{ m}^2 / \text{cm}^3$ (Kreyling et al 2010)

The nanomaterial displays size-dependent unique/novel properties that are a result of its size in at least one of the following categories:

- Strength
- Magnetism
- Chemical reactivity
- Electrical conductance
- Heat conductivity
- Light reflection
- Color
- Melting point
- Fluorescence

For more information on these nano-enabled technology categories to inform your selection, please see the following resources:

Kreyling WG, Semmler-Behnke M, Chaudhry Q. 2010. A complementary definition of nanomaterial. *Nano Today* 5:165-168. <http://www.sciencedirect.com/science/article/pii/S1748013210000460>

European Commission. Commission recommendation of 18 October 2011 on the definition of nanomaterial. 2011. Official Journal of the European Union. 2011/696/EU. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:275:0038:0040:EN:PDF>

Surface Area Analysis Using the Brunauer-Emmett-Teller (BET) Method (2016). Brame, J.A., Griggs, C.S. (No. ERDC/EL SR-16-3) <https://erdc-library.erdc.dren.mil/xmlui/handle/11681/20339>

US EPA TSCA Section 8a <https://www.federalregister.gov/documents/2017/01/12/2017-00052/chemical-substances-when-manufactured-or-processed-as-nanoscale-materials-tsc-reporting-and>

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Perform tests: Low release potential?

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Release Hazard Identification Testing Identification Help documentation

Product Classification and Use

Is the product a freely dispersed particle (product class 3B or 3D)?

Conservative Release Scenario

Does your material have a known Predicted No Effect Concentration?

Would you like to first generate hazard data / screening values (skip to Tier 4) or would you prefer to proceed without it and generate release data (continue/complete Tier 2)?

Testing Identification

Perform release testing per results of Testing Identification tab in order to quantify the potential release under a realistic use scenario.

Release Data Generation & Analysis

After characterizing released material per Martin et al., were nanomaterials released either in a free form or a matrix-bound form that still meets the definition of 'nano'?

This may suggest low risk/concern. It is recommended that you stop here (click 'Generate Report' to save your findings). Keep in mind, however, that the toxicity of matrix-bound material may be different from that of the pristine nano-scale ingredient. If you would like to continue characterizing the EHS implications of your product, you may proceed to Tier 3 by clicking 'Continue'.

Hazard values entered for demonstration purposes: requires more thorough literature review

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Release Hazard Identification Testing Identification

Help documentation

This page is designed to help screen your material for potential hazard level. Here we will use Simple Box for Nano to compute a Predicted Environmental Concentration (PEC) and compare it to a Probable No Effect Concentration (PNEC).

Environmental Hazard Screening Human Health

Were relevant hazard values found for the nanomaterial? (Note: This answer will not influence any decision making and is only used for recording) Yes No

Predicted No-Effect Concentration

How many species were tested? 3 species

Enter acute endpoints (up to four). Recommended endpoints: LC50 or EC50.

Species 1 endpoint (ppb): 13000

Species 2 endpoint (ppb): 13500

Species 3 endpoint (ppb): 14000

Enter chronic endpoints (up to four). Recommended endpoints to enter: EC50 or NOEC.

Species 1 endpoint (ppb):

Species 2 endpoint (ppb):

Species 3 endpoint (ppb):

Predicted Environmental Concentration

Select a model below and use it to compute the Predicted Environmental Concentration and then enter the value below. Be sure the units entered for PEC and PNEC are in parts per billion (ppb)!

SimpleBox for Nano Download the model PEC value (ppb): 0.1

Results

Compute Results Based on 3 acute endpoint(s), the safety factor of 1000 was selected. PNEC = 13.49, which is larger than PEC. Go back to the 'Release' page and choose 'Yes'

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