

Suggested Criteria and Ranking Procedure of Nanoproducts

Volume II „Bioni Nature“

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Ranking of Nanoproducts

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Introduction

In order to analyze and evaluate nanoproducts we propose a combination-method consisting of product description according to selected criteria and additional ranking in numbers between 1 and 3
[1 (poor degree of fulfillment), 2 (medium), 3 (high)].

Main topics, index

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Ranking of Nanoproducts

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0 Classification, basic information

Country	Prod.-No.	Product-Name	Manufacturer / Contact-Person
Germany	2	Bioni Nature®	Address Bioni CS GmbH, Lessingstr. 21, 46149 Oberhausen, Mr. Sven Knoll Phone 0049 (0)208 621 7553 Mail info@bioni.de

Short description of product-type and basic features

Dispersion paint for **interior use** with antimicrobial additional functionality based on nano-silver.

Durable protection against algae, moss and fungus.

Excellent moisture regulating properties, water repellent, permeable to water vapour.

Superior heat reflection properties „Cool Paint“.

UV-stability, colour retention.

Superior adhesion, crack-bridging abilities.

Sustainable, reduces frequency of repaints and maintenance.

Free of conventional biocides, solvents, softeners, environmental friendly.

Main difference to Bioni Perform® is a nano-suspension content of 5 %.



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1 Is it a real nano-product?

1.1 Criterion: Particle size data of basic material available, diameter below 100 nm

Primary particle size of basic material was analyzed by X-Ray Diffraction and is around 10 nm. In addition particle size distribution of nano suspension was analyzed by PCS (Photon Correlation Spectroscopy). The result shows a narrow distribution with a maximum at 12.1 [nm]. The results of both methods show a good correlation.

Evaluation: 3

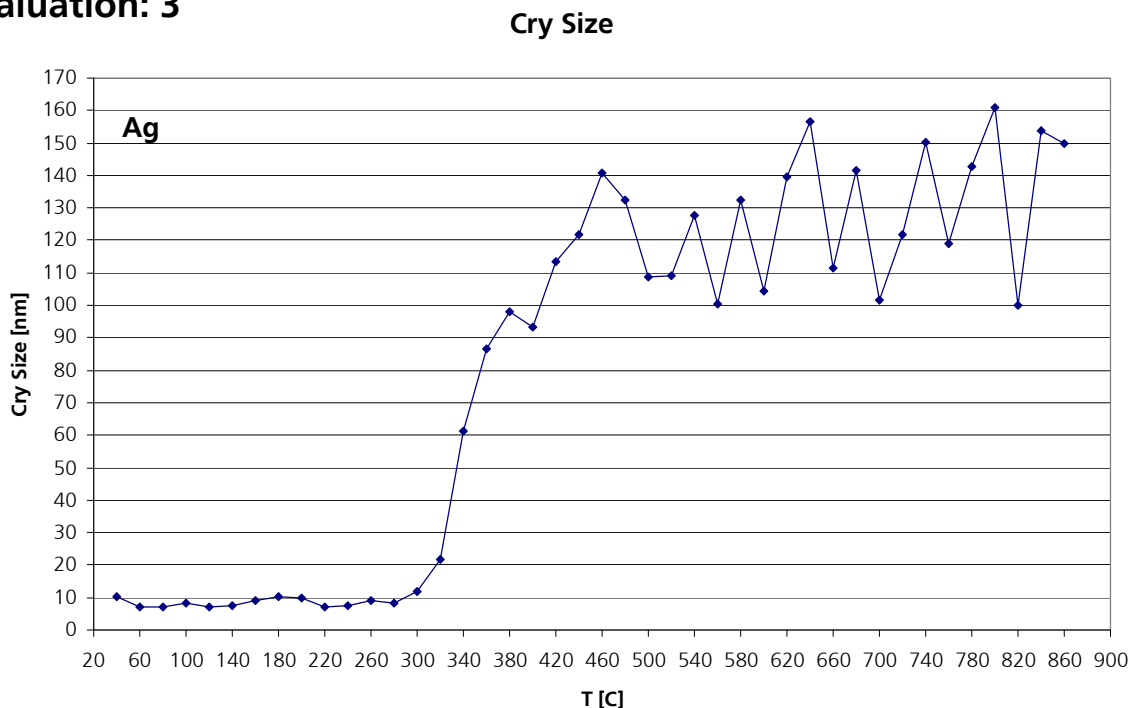


Figure 4.1: By means of **temperature-resolved** X-Ray Diffraction evaluated primary crystallite dimension of Nano-Ag as a function of temperature. Grain growth starting from 300 °C.

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1.2 Criterion: Effect dominated by particle size

Particle size domination can be concluded from mass-specific antimicrobial efficiency.

Evaluation: 3

1.3 Criterion: Stabilization concept applied

Calculation of surface potential u according Poisson-Boltzmann-Equation (1) leads to an effective selection of chemical stabilizers.

Evaluation: 3

$$\nabla^2 U(\eta, \theta) = \frac{(\cosh \eta - \cos \theta)^2}{B^2} \cdot \frac{\partial^2 U}{\partial \eta^2} + \frac{(\cosh \eta - \cos \theta)^2}{B^2} \cdot \frac{\partial^2 U}{\partial \theta^2} - \frac{\sinh \eta \cdot (\cos \eta - \cos \theta)}{B^2} \cdot \frac{\partial U}{\partial \eta} + \left(\frac{(\cosh \eta - \cos \theta)^2}{\tan \theta} - (\cosh \eta - \cos \theta) \cdot \sin \theta \right) \cdot \frac{1}{B^2} \cdot \frac{\partial U}{\partial \theta} = \sinh(U(\eta, \theta)) \quad (1)$$

U: Reduced Electrostatic Potential, B: Constant in Bispheric System of Coordinates

1.4 Criterion: Nano system integration solved and analytically proved

Homogeneity and stability obtained and proved by SEM / X-Ray Fluorescence.

Evaluation: 3

1.5 Criterion: Consistency of product philosophy

The recipe is based on non-human-toxic substances. Conventional biocides can be completely replaced.

Evaluation: 3

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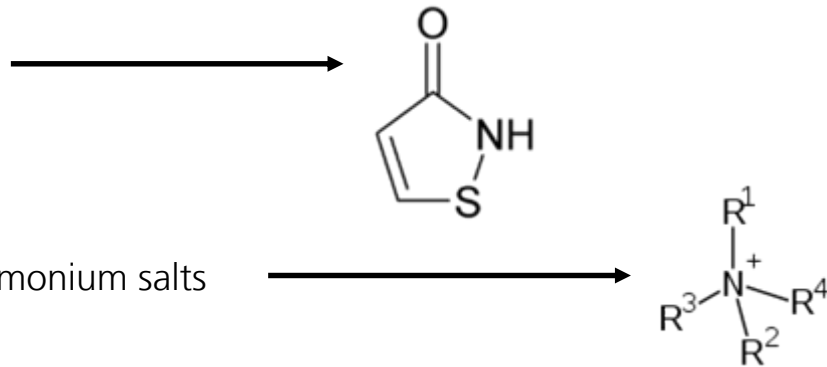
2 Product benefits

2.1 Criterion: Invention step compared to state of the art

High invention step compared to conventional biocides related to effectiveness, sustainability and replacement of toxic components.

State of the art is the use of predominantly 6 types of biocides:

- Carbamates
- Isothiazolinones
- Triazines
- Phenylureas
- Metalorganics
- Quartary alkyl-ammonium salts



These components are of organic nature with lower chemical stability. Furthermore human-toxicity is problematic.

Nano-silver as an inorganic element is stable and not human-toxic considering dose and working principle in the sense of a surface interaction.

Evaluation: 3

2.2 Criterion: Patent protection

Patent protection obtained (PCT/EP2006/065581, DE10 2005 041 006.5-43 and PCT/EP for AE, CA, US, RU).

Evaluation: 3

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2.3 Criterion: Efficiency of effect related to mass ratio

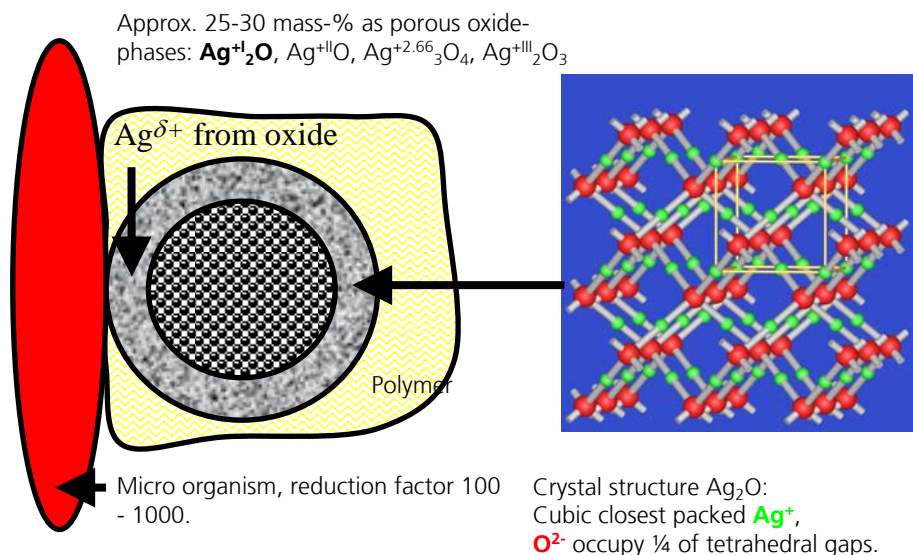
High antimicrobial efficiency because of synergetic effects where the nano-silver mass ratio could be reduced to the order of 10 ppm.

Evaluation: 3

2.4 Criterion: Sustainability of effect

Working principle of antimicrobial effect via surface reaction in the sense of catalysis; no drug-release.

Evaluation: 3



2.5 Criterion: Limitations / possible negative side effects

Under adverse conditions surface reactions could be impeded by secondary pollution effects.

Evaluation: 2

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3 Market potential

3.1 Criterion: Cost-benefit ratio

Excellent cost-benefit ratio specifically considering sustainability and reduction of repaint frequency.

Evaluation: 3

3.2 Criterion: Nice to have – or problem- solver

Problem solver.

Evaluation: 3

3.3 Criterion: Range of applications

Interior application.

Evaluation: 2

3.4 Criterion: Market volume compared to market saturation

Large market volume compared to saturation.

Evaluation: 3

3.5 Criterion: Competitive situation

Indirect competitive situation with paints containing conventional biocides; risk of product piracy.

Evaluation: 2

3.6 Criterion: Import / export restrictions

No restrictions so far, but to be expected in future in some foreign countries, e.g. US.

Evaluation: 2

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3.7 Criterion: Existence and quality of distribution network

Sophisticated national and international distribution network.

Evaluation: 3

3.8 Criterion:

Information / consulting according product complexity

Product consulting available.

Evaluation: 3

3.9 Criterion: Warranty, service

Mandatory warrenty and sophisticated service worldwide.

Evaluation: 3

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4 Product safety

4.1 Definition and risk assessment of nanomaterials in the REACH context (max. 3 products)

(assignment to work package 4.2.1)

4.1.1 Criterion: Specific toxicological analysis of the nanomaterial(s) used in the product according to safety data sheet

No toxicological impacts indicated (and to be indicated) in product data sheet. Nano-silver is a trace constituent in a order of magnitude of 10 ppm. Nano-silver is combined with a polymer binder phase and anchored via dipole interactions.

Evaluation: 3

4.1.2 Criterion: Estimation of REACH compliance

Reach conformity ensured by component suppliers.

Evaluation: 3

4.1.3 Criterion: Estimation of basic health hazards

Provided the ordinary use of the product, health hazards are very unlikely. Potential risks during product life-cycle are indicated in 4.2 ff.

Evaluation: 3

4.1.4 Criterion: Estimation of basic environmental hazards

Provided the ordinary use of the product, environmental hazards are very unlikely.

Potential risks during product life-cycle are indicated in 4.2 ff.

Evaluation: 3

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4 Product safety

4.2 Elaboration of specific exposure scenarios (max. 3 nanomaterials) (assignment to work package 4.2.2)

4.2.1 Criterion: Exposure scenarios related to people according product application

During ordinary product application the release of single nano-silver particles is impossible because of chemisorption (dipole interaction) with polymer binder phase. Furthermore surface energy prohibits ablation.

The theoretical case of the direct interaction of nano-silver powder with skin can be answered by results of EU-project „NANODERM“ (IC: QLK4-CT-2002-02678). Skin penetration is very unlikely for - not only size - but surface charge matters.

Evaluation: 3

4.2.2 Criterion: Exposure scenarios related to the environment

Estimation of basic toxicity of silver and further references are given in: Daunerer, Handbuch der Umweltgifte, 6/2006, 1 ff. Release of nano-silver out of products is matter of several studies (see table in chapter 6.3).

To investigate exposure scenarios product samples were mechanically stressed. As a result of trace analysis with ICP-MS (iCAP 6300 Thermo Electron Cooperation) no emission of single nano-silver particles was detected.

In addition leaching of facades was investigated. The detected concentration is close to the determination limit of the analytical device, where nano particle release by sample preparation (centrifugation) is under discussion. For additional comments see 4.3.

Evaluation: 3

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4 Product safety

4.3 Additional detailed criteria

4.3.1 Criterion: Estimation of human toxicity of the nano drugs under consideration of dose, particle properties (size, surface charge) and chemistry

Estimation of dose-depending basic toxicity of silver with additional numerous references are given in „Report of the Task Group on Reference Man“, Pergamon Press 1974, 407 f. FDA classification of silver is GRAS (generally recognized as safe). Daily intake per person by water and food is 30 µg (Hamilton).

Risk potential of nano-silver powder considering the boundary conditions is limited. Contrary to popular belief alveoli are not reached because of surface affinity. In case of inhalation elimination from the upper part of the lung is possible (BASF).

This is not valid for nano fiber structures.

Evaluation: 2

4.3.2 Criterion: Safety concept of nano system, to avoid uncontrolled release of single nano particles; integration by physisorption / chemisorption

As mentioned in 4.1.1 nano-silver is combined with a polymer binder phase and anchored via dipole interactions.

Evaluation: 3

4.3.3 Criterion: As a consequence of 4.1, 4.2: Product safety for the user

As already discussed in 4.2.1 the product is safe for the user, provided the ordinary use.

Evaluation: 3

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4.3.4 Criterion: As a consequence of 4.1, 4.2: Safety and analytical check during component production, system integration and whole life cycle of the product

As already discussed in 4.2.2 a safety concept is implemented and analytically checked.

Transportation incidents with nano-silver suspension have the highest risk regarding the life cycle of the product (more explanations in 4.3.8).

Evaluation: 2

4.3.5 Criterion: Assessment of the principal environmental toxicity of the drugs under consideration of dose, particle properties (size, surface charge) and chemistry

Considering the boundary conditions, the principal environmental toxicity is limited.

Mobility of nano-silver powder in dynamic fluids is limited because of surface affinity.

This is the reason for a low accumulation risk.

Environmental conditions can lead to following reactions (oxidation and sulfate-formation (insoluble in water)).

Evaluation: 2

4.3.6: Criterion: Assessment of the overall system - related to the working principle

Regarding the desired additional antimicrobial functionality in the sense of catalysis the product is sustainable and safe on product level.

This can be underlined by 7 years of field experience.

The more mechanisms of antimicrobial activity, the lower the risk of resistancy formation.

Evaluation: 3

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4.3.7: Criterion: Risk assessment and emission propability

Risk = toxicity * exposition

Summarizing the discussed issues on toxicity and exposition propability the risk is very limited. Furthermore an excellent benefit/risk-ratio could be obtained.

Evaluation: 3

4.3.8 Criterion: Consequences in case of emission, chemical background concentration, mobility and accumulation

Low risk in case of product emission, for nano-particles are present in very low concentration and integrated in a secondary phase.

Transportation incidents with nano-silver suspension have a higher risk. In this case a local and transient contamination of environment will occur, killing microorganisms on surface of existing biofilms. Since the suspension is delivered in a diluted form, aquatic toxicity can be avoided.

Nano-silver powder on the one hand follows flow dynamics in air and water quite good. Since the surface affinity is high on the other hand the mobility is poor. Therefore accumulation is not to be expected. In the environment - depending on reaction conditions - oxidation and sulfate-formation (insoluble in water) can occur.

Chemical background concentration in soil is 0,1 ppm.

Evaluation: 2

4.3.9 Criterion: GHS (Globally Harmonized System) classification of components

GHS classification ensured by component suppliers.

Evaluation: 3

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4.3.10 Criterion: CLP (Regulation on Classification, Labeling and Packaging of substances and mixtures) compliance

CLP compliance ensured by component suppliers.

Evaluation: 3

4.3.11 Criterion: If applicable:

BPD (Biocide Product Directive) compliance

Not applicable, product is not subject to BPD
(Evaluation to be adapted in excel-sheet).

Evaluation: -

4.3.12 Criterion: Potential to replace a harmful existing technology

The product replaces competitor's products containing human-toxic conventional biocides.

Evaluation: 3

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5 Ethical, social and economic consequences and perspectives

5.1 Criterion: Ethical issues of paradigm shift

Paradigm shift and switching to non-human-toxic sustainable components improves the ethical act.

Evaluation: 3

5.2 Criterion: Availability of components and resource conservation

High efficacy at low concentration in combination with a sustainable quasi catalytic effect protects resources

Evaluation: 3

5.3 Criterion: Social consequences of technology change

Positive social consequences are to be expected depending on degree of technology change.

Evaluation: 2

5.4 Criterion: Economic consequences related to production company and national / international economy

Since product introduction in 2005 up to now the economic success for the manufacturer is evident (international reference objects, „Technology Fast 50 Award 2009“).

Yet the influence on national and international economy is small.

Evaluation: 2

5.5 Criterion:

The product development is embedded in a general nano suspension technology for a variety of different applications.

Evaluation: 3

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5.6 Criterion: Connectivity to further developments

Similar product developments (e.g. nano-silver wall-paper) are carried out.

Evaluation: 3

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6.0 Appendix

6.1 Product data sheet

Bioni Nature

First class interior paint based on green nano-technology

Product

Product Description:

Pure acrylic interior paint based on green nano-technology which meets the highest of performance expectations. It provides an extremely durable, washable finish, is low-VOC and odor-free and permanently prevents the growth of mold and mildew on the paint film.

Features:

- Is specially formulated based on green nano-technology to prevent growth of microbes on the paint film
- Resists moisture and is vapor-permeable
- Exceeds indoor air quality regulations measured in VOC (Volatile Organic Compounds)
- Eco-friendly formula for environmental protection. Can earn LEED credits.
- Odor-free - can be applied in occupied areas
- Fire rating: Class A (ASTM E84). No drip-off.
- Water-based, free of solvents and safe to use
- Has superior flow, hiding and adhesion qualities
- Comes in white and 1750 colors
- Tested by independent laboratories

Technical Information:

Form: liquid

Color: white and 1750 colors

Finish: matte

Solids (% by Volume): approx. 58%

Thinner: water

Vehicle Type: 100% Acrylic resin

pH: approx. 9

Weight per Gallon: 9.6 lbs (1.15 kg/l)

VOC (ISO 11890-2): 4 g/l; 0.03 lbs/gal (=0.36%)

Packaging:

1 and 3 Gallon pail.

Recommended Use

For indoor use. Ideal for all types of interiors including residential homes, hotels, resorts and commercial buildings as well as high-traffic areas where durability is a necessity. It's highly recommended for children's rooms, schools, retirement homes and other environments for people with high sensitivity to allergens, odors and toxins. Also ideal for high-moisture areas such as bathrooms, kitchens, gyms, laundry-rooms and basement-areas.

Application

Area of Application:

For internal use on old and new plastered walls, ceilings, previously-painted walls and ceilings, concrete, sand-lime bricks, various wall panels.

Application Methods:

To be applied by brush, roller (use a high-quality lambskin roller) or sprayed using suitable equipment. **Stir thoroughly before use.**

Surface Preparation:

The surface must be fully cured, clean, dry and free of dirt, contaminants and release agents. For preparing cementitious substrates refer to ASTM D-4258 and ASTM D-4261. Apply 1 coat Bioni Grip as a primer on new surfaces.

MILDEW: Remove mildew before painting by scrubbing and washing. Apply Bioni Clean or Bioni IsoZem. **WARNING!** If you scrape, sand, or remove old paint, you may release lead dust. **LEAD IS TOXIC. EXPOSURE TO LEAD DUST CAN CAUSE SERIOUS ILLNESS, SUCH AS BRAIN DAMAGE, ESPECIALLY IN CHILDREN. PREGNANT WOMEN SHOULD ALSO AVOID EXPOSURE.** Wear a NIOSH-approved respirator to control lead exposure. Clean up carefully with a HEPA vacuum and a wet mop. Before you start, find out how to protect yourself and your family by contacting the National Lead Information Center at 1-800-424-LEAD or log on to www.epa.gov/lead.

Typical Recommended Paint System:

- 1 coat Bioni Clean if area *lightly* mildewed or
- 1 coat Bioni IsoZem if area *badly* mildewed or
- 1 coat Bioni Grip (if area is not mildewed but needs to be prepared before painting)
- 2 coats **Bioni Nature**.

Spreading Rate:

200-300 sq. ft. per Gallon per coat, applied at 6.5 mils wet, 3.75 mils dry depending on the substrate and texture.

Thinning / Mixing:

Single pack. Ready to use. If necessary (i.e. if RH <50%, direct sunlight, windy conditions), thin sparingly with clean water up to 1/2 pint per Gallon. The characteristics of the product can be affected if mixed with other substances.

Conditions during Application:

The temperature of the substrate and ambient should be > 41°F during application and drying.

Curing / Drying (at 68°F, 50% RH):

1 hour (to touch) / 12 hours (to recoat).

Storage:

Can be stored for approximately 24 months in a cool but frost-free area (unopened).

Clean-up:

Clean spills and spatters immediately with soap and warm water. Clean hands and tools immediately after use with soap and warm water.

Disposal

Handle disposal of waste material in manner which complies to local, state, province and federal laws and regulations.

Check www.earth911.org for recycling and disposal information in your area.

Health and Safety

DO NOT TAKE INTERNALLY. KEEP OUT OF REACH OF CHILDREN. Use only with adequate ventilation. Do not breathe spray mist or sanding dust. Ensure fresh air entry during application and drying. Avoid contact with eyes and prolonged or repeated contact with skin. Avoid exposure to dust and spray mist by wearing a NIOSH approved respirator during application, sanding and clean up. Follow respirator manufacturer's directions for respirator use. Close container after each use. **FIRST AID:** SKIN CONTACT: Wash thoroughly with soap and water. EYE CONTACT: Flush immediately with water for 10-15 minutes and contact a physician. RESPIRATORY PROBLEMS: Remove affected person to fresh air immediately and contact a physician. **Read the current Material Safety Data Sheet (MSDS) for additional health and safety information.**

LIMITATION OF LIABILITY:

The information herein is given to the best of our knowledge based on practical experience and laboratory testing. The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

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6.2 Product safety data sheet

Product: <i>Bioni Nature</i>					
Date of Publication: January 1 st 2010			Page: 1/7		
MSDS-No.: BN-US-2010-1-2					
1. Product and Company Identification					
Product Name: Bioni Nature					
Manufacturer: Bioni CS GmbH Lessingstr. 21 D-46149 Oberhausen Germany Telephone: +49 208 6217553 Fax: +49 208 6217555			Distributor: Bioni USA and Americas LLC 1680 Fruitville Road, S-102 Sarasota, FL 34236 USA Telephone: (941) 914 94 11 Fax: (941) 296 74 22		
Emergency Telephone Numbers: Giftnotruf Berlin (24 hours / support in German and English) Telephone: +49 030 30686790					
2. Composition / Information on Ingredients					
Chemical Nature of the preparation: Acrylic copolymer emulsion with Nanotechnology					
Hazardous Components:					
			Occupational Exposure Limits		
Ingredient	CAS Number	Weight %	OSHA PEL	NIOSH REL	ACGIH TLV
Silver	7440-22-4	< 1%	0.01 mg/m ³	0.01 mg/m ³	0.1 mg/m ³
Titanium Dioxide	13463-67-7	< 20%	15 mg/m ³ **		10 mg/m ³ *
*: as Dust **: Total Dust					
OSHA: Occupational Safety and Health Administration (US Dept. of Labour) NIOSH: National Institute for Occupational Safety and Health ACGIH: American Conference of Governmental Industrial Hygienists PEL: Permissible Exposure Limit REL: Recommended Exposure Limit TLV: Threshold Limit Value					
3. Hazards Identification					
Routes of Exposure INHALATION of vapor or spray mist. EYE and Skin contact with the products, vapor or spray mist.					
Effects of Exposure EYES: Irritation SKIN: Prolonged or repeated exposure may cause skin irritation. INHALATION: Inhalation of vapors may cause respiratory tract irritation. INGESTION: Although ingestion is not considered a significant route of exposure, this material may cause gastrointestinal irritation if ingested.					

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Product: <i>Bioni Nature</i>	
Date of Publication: January 1 st 2010	Page: 2/7
MSDS-No.: BN-US-2010-1-2	
4.	First Aid Measures <i>General Information</i> In all cases of doubt, or when symptoms persist, seek medical advice and show this Safety Data Sheet. <i>Inhalation</i> If affected, remove from exposure and seek medical advice. <i>Skin</i> Wash skin with soap and plenty of water. Get medical attention if symptoms occur. <i>Eyes</i> Flush eyes with large amounts of water for 15 minutes. Get medical attention. <i>Ingestion</i> If swallowed, seek medical advice immediately. Do not induce vomiting.
5.	Fire Fighting Measures <i>Flash Point</i> No Data <i>Suitable extinguishing media</i> Use Water fog (or if unavailable fine water spray), alcohol foam, dry agent (carbon dioxide, dry chemical powder). <i>Protection of Firefighters</i> Wear positive-pressure self-contained breathing apparatus and protective fire fighting clothing.
6.	Accidental Release Measures <i>Personal Precautions</i> Wear adequate personal protective equipment (see section 8). <i>Environmental Precautions</i> Do not allow to enter drains or watercourses. If the product contaminates lakes, rivers or sewages, inform appropriate authorities in accordance with local regulations. <i>Methods of Cleaning Up</i> Contain and collect spillage with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13).
7.	Handling and Storage <i>Handling</i> Keep area ventilated. Avoid contact with eyes, skin and clothing. For personal protection see Section 8.

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Product: *Bioni Nature*

Date of Publication: January 1st 2010

Page: 3/7

MSDS-No.: BN-US-2010-1-2

7. Handling and Storage (cont'd)

Storage

Keep container tightly closed when not in use. Store in cool, frost-free, dry and well-ventilated place away from sources of heat and combustible materials. Keep out of reach of children.

Hygiene Practices

Wash thoroughly after handling. Avoid contact with eyes and skin.

8. Exposure Controls / Personal Protection

Occupational Exposure Limits

This product may contain materials classified as nuisance particulates which may be present at hazardous levels only during sanding or abrading of the dried coating film. The applicable limits for nuisance dusts are:

			Occupational Exposure Limits		
Ingredient	CAS Number	Weight %	OSHA PEL 8-hour TWA	NIOSH REL 10-hour TWA	ACGIH TLV 8-hour TWA
Silver	7440-22-4	< 1%	0.01 mg/m ³	0.01 mg/m ³	0.1 mg/m ³
Titanium Dioxide	13463-67-7	< 20%	15 mg/m ³		10 mg/m ³

Engineering controls and hygienic practices

Ensure adequate ventilation and avoid breathing vapor and spray mist.

Avoid contact with skin and eyes.

Remove contaminated clothing.

When using do not eat, drink and smoke.

Wash hands after using.

Handle in accordance with good industrial hygiene and safety practice.

Personal protective Equipment:

Respiratory System

Not required in case of sufficient ventilation. When sanding or abrading the dried paint film, wear a dust/mist respirator approved by NIOSH/MSHA for dust which may be generated from this product, underlying coatings, or the abrasive.

Hand Protection

Use chemical resistant gloves.

Eye Protection

If there is a risk of eye contact wear safety spectacles with unperforated sideshields.

Skin and Body Protection

Use protective clothing.

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Product: <i>Bioni Nature</i>	
Date of Publication: January 1 st 2010	Page: 4/7
MSDS-No.: BN-US-2010-1-2	
9. Physical and Chemical Properties	
Form:	liquid
Colour:	white
Odour:	almost odourless
Flash Point:	no data
Specific Gravity at 20°C:	1.15 g/cm ³
Water Solubility:	Miscible with water
pH:	8.5 - 9.5
VOC content:	< 5 g/l
10. Stability and Reactivity	
<i>Chemical Stability</i> Stable under normal conditions of use.	
<i>Conditions to Avoid</i> Heat, flames, incompatible materials and freezing temperatures below 0°C (32 °F).	
<i>Materials to avoid</i> Stable under recommended storage and handling conditions (see section 7).	
<i>Hazardous Decomposition Products</i> None known under normal conditions of storage and use.	
11. Toxicological Information	
Silver is not listed as a human carcinogen by IARC, NTP, OSHA or ACGIH. Inhalation of high amounts of metallic silver vapours may cause lung damage with pulmonary oedema. Repeated long-term exposure to silver dust may cause a grey-blue discoloration of the eyes, nose, throat and skin (argyria/argyrosis).	
Rats exposed to Titanium Dioxide dust at 250 mg/m ³ developed lung cancer. Such exposure levels are not attainable in the workplace. If the product is handled in accordance with this Safety Data Sheet and the product label no adverse health effects are expected. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:	
<i>Skin Contact</i> Contact with skin may result in irritation.	
<i>Eye Contact</i> May be an eye irritant.	
<i>Inhalation</i> No adverse effects expected.	
<i>Ingestion</i> No adverse effects expected.	
<i>Toxicological Data</i> No LD50 data available for the product.	

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Product: <i>Bioni Nature</i>	
Date of Publication: January 1 st 2010	Page: 5/7
MSDS-No.: BN-US-2010-1-2	
12. Ecological Information	
Do not allow to enter drains or watercourses.	
Silver may be hazardous to the environment; special attention should be given to aquatic organisms.	
13. Disposal Considerations	
Product Recommendation: Do not allow to enter drains or watercourses. Handle disposal of waste material in manner which complies to local, state, province and federal laws and regulations.	
Packaging Recommendation: Dispose according to local regulations.	
14. Transport Information	
DOT Hazard Classification: No	
IMO/IMDG (Sea) and IATA/ICAO (Air): NON-DANGEROUS GOOD	
15. Regulatory Information	
TSCA (Toxic Substances Control Act) Certification TSCA Inventory: All chemicals in this products are listed, or are exempt from listing, on the TSCA INVENTORY.	
SARA (Superfund Amendments and Reauthorization Act of 1986) TITLE III Section 302 Extremely Hazardous Substances (EHSs) / 40 CFR Part 355: There are no components present in this product at a level which could require reporting under the statute.	
CERCLA (Comprehensive Environmental Response Compensation and Liability Act of 1980) Hazardous Substances / 40 CFR Part 302.4: Following Chemicals in this product are listed: Silver Releases in quantities equal or greater than Reportable Quantity (RQ): There are no components present in this product at a level which could require reporting under the statute.	

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Product: <i>Bioni Nature</i>											
Date of Publication: January 1 st 2010	Page: 6/7										
MSDS-No.: BN-US-2010-1-2											
15. Regulatory Information (cont'd)											
<p>EPCRA (Emergency Planning and Community Right-to-Know Act) Section 313 Toxic Chemical Release / 40 CFR Part 372: Following Chemicals in this product are listed: Silver (CAS 7740-22-4) The concentration of Silver in this product is lower than the "De Minimis Concentration" of 1%. There are no components present in this product at a level which could require reporting under the statute.</p> <p>EPCRA (Emergency Planning and Community Right-to-Know Act) Section 311/312 Hazardous Chemical Storage Reporting Requirements / 40 CFR Part 370: Hazard Category Compensation For Reporting Under Sections 311 and 312 (for this product):</p> <table><tr><td>Fire Hazard:</td><td>No</td></tr><tr><td>Sudden Release of Pressure:</td><td>No</td></tr><tr><td>Reactive:</td><td>No</td></tr><tr><td>Immediate (Acute) Health Hazards:</td><td>No</td></tr><tr><td>Delayed (Chronic) Health Hazard:</td><td>No</td></tr></table> <p>OSHA (Occupational Safety and Health Standard) Toxic and Hazardous Substances/ 29 CFR Part 1910 Subpart E: Following Chemicals in this product are listed: Silver (CAS 7740-22-4): 0.01 mg/m³ Titanium Dioxide (CAS 13463-67-7): (15 mg/m³) Total Dust</p> <p>CLEAN WATER ACT Silver (CAS 7740-22-4) is listed as a PRIORITY POLLUTANT and as TOXIC POLLUTANT under the Clean Water Act (CWA).</p> <p>CLEAN AIR ACT - CAA Section 112(x) Toxic and Flammable Substances / 40 CFR 68.130 There are no components present in this product listed.</p> <p>STATE-RIGHT-TO-KNOW:</p> <p>California Proposition 65 This product contains no "CHEMICALS KNOWN TO THE STATE TO CAUSE CANCER OR REPRODUCTIVE TOXICITY".</p> <p>Massachusetts Right to Know Substance List (MSL) (105 CMR Section 670.000) There are no components present in this product at a level which could require reporting under the statute.</p> <p>Pennsylvania Right to Know Hazardous Substance List Following Chemicals in this product are listed: Silver (CAS 7740-22-4) Silver is part of the ENVIRONMENTAL Hazard list.</p>		Fire Hazard:	No	Sudden Release of Pressure:	No	Reactive:	No	Immediate (Acute) Health Hazards:	No	Delayed (Chronic) Health Hazard:	No
Fire Hazard:	No										
Sudden Release of Pressure:	No										
Reactive:	No										
Immediate (Acute) Health Hazards:	No										
Delayed (Chronic) Health Hazard:	No										

Ranking of Nanoproducts

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15.	<p>Regulatory Information (cont'd)</p> <p>California SCAQMD (South Coast Air Quality Management District) Rule 443.1: VOC's (Volatile Organic Compounds) This product contains < 1% by weight VOC.</p> <p>CANADA</p> <p>DSL (Domestic Substances List) All chemicals in this products are listed on the DSL.</p> <p>WHMIS (Workplace Hazardous Materials Information System) Ingredient Disclosure List Following Chemicals in this product are listed: Silver (CAS 7740-22-4) Disclosure at 1,0% according to the ingredient disclosure list. The concentration of Silver in this product is lower than the 1%. There are no components present in this product at a level which could require reporting under the statute.</p> <p>NPRI (National Pollutant Release Inventory) Following Chemicals in this product are listed: Silver (CAS 7740-22-4)</p>
16.	<p>Other Information</p> <p>The information in this MSDS was obtained from sources which we believe are reliable. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESSED OR IMPLIED, REGARDING ITS CORRECTNESS.</p> <p>The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.</p> <p>This MSDS was prepared and is to be used only for this product. If the product is used as a component in another product, this MSDS information may not be applicable.</p>

Ranking of Nanoproducts

6.3 Literature

Bemerkungen	Review	Review	Modellstudie – Multikompartiment Modell	Modellstudie – Freisetzung beim Entsorgungsprozess	Größenklassen durch Filtration 20-100nm, 100- 400nm und Trennung nach Partikeln und Ionen nach REM & ToF SIMS	Review – Ökotoxikologie ökotoxikologische Studie	ökotoxikologische Studie, Verwendung sehr hoher Konzentrationen	
Analytik	o	o	o	o	+	+	+	
Dispergierung	o	o	o	o	o	o	-	
Bezugsquelle der Materialien	o	o	o	o	(+)	-	-	
Versuchsdurchführung	o	o	+	+	+	+	+	
Versuchsaufbau	o	o	+	+	+	+	-	
Masse	o	o	+	+	+	-	-	
BET-Oberfläche	o	o	o	o	o	-	-	
pH-Wert	o	o	o	o	-	-	-	
Persistenz - Löslichkeit / Dispergierbarkeit	o	o	o	o	o	-	-	
Stabilität von Suspensionen	o	o	o	o	o	-	-	
Oberflächenreinheit / Oberflächenverunreinigung	o	o	o	o	+	+	-	
Oberflächenladung / Zeta Potential	o	o	o	o	-	-	-	
Spezifische Oberfläche	o	o	o	o	-	-	-	
chemische Zusammensetzung	o	o	o	o	+	-	-	
Aggregation / Agglomeration	o	o	o	o	+	-	-	
Partikelmorphologie / Kristallphase und Kristallinität (REM/TEM- Aufnahmen)	o	o	o	o	+	+	-	
Partikelanzahlgrößen- verteilung	o	o	o	o	-	-	-	
Primärpartikelgröße	o	o	o	-	+	+	-	
Literatur	Wijnhoven et al. 2009		Blaser et al. 2008	Müller & Nowak 2008	Benn & Westerhoff 2008	Hagenhoff et al. 2009		Ökotoxikologie
	Luoma 2008					Ratte 1999		
						Lee et al. 2007		
						Asharani et al. 2008		

Table 26.1
Review of the literature dealing with the release of nanosilver out of products
 +: information available, -: information missing, o: information not relevant
 (source: UBA-report 52/2010).