

The Silver Nanotechnology Commercial Inventory

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The Silver Nanotechnology Commercial Inventory was compiled by Emma Fauss during an internship with the Project on Emerging Nanotechnologies. This work was completed as part of her graduate thesis work at the University of Virginia with support from the National Science Foundation SES awards #0708914 and #0530100. The inventory is neither comprehensive nor complete, and only contains those products and companies that were available on the market or had the potential to contact or affect the public directly or indirectly in 2007. The opinions expressed are those of the author and do not reflect those of The Project on Emerging Nanotechnologies, the Woodrow Wilson International Center for Scholars or The Pew Charitable Trusts.

Introduction

To compliment the Project on Emerging Nanotechnologies' Consumer Product Inventory the Silver Nanotechnology Commercial Inventory (SNCI) adds new categories which illuminate the implications of nanosilver usage. The SNCI examines nanosilver applications that are available on the market or have the potential to contact or affect the public directly or indirectly. The inventory includes products that claimed to use "silver nanotechnology" or "silver colloids" or are associated with a precursor product which makes these claims.¹ This includes consumer products, medical applications and precursor products that will be incorporated into final products.

Silver nanotechnology utilizes nanoscale silver to bestow antibacterial properties onto a given product. Generally, this involves the application or incorporation of nano-sized silver particles into or on the surface of a product. The purpose of the SNCI is to provide a cross section of silver nanotechnology applications that are currently on the market. These include products ranging from cleaning sprays, skin creams, ATM buttons, and sports clothing. All of the nanotechnology applications contained within this database incorporate nano-sized silver particles (or "nanosilver") into their products.

Nanosilver technologies appear in a variety of manufacturing processes and end products. It can appear imbedded in a coating which is applied to the product by the manufacturer (coating). Some products come in a liquid form and are meant to be applied to form a coating (coating & spray). Nanosilver can be presented in a liquid form such as a homeopathy colloid or contained within a shampoo (liquid). It can also be embedded in a solid such as a polymer master batch or be suspended in a bar of soap (solid). Nanosilver can also be utilized in the textile industry by incorporating it into the fiber (spun) or produced as a powder (powder).

The database was designed with the purpose of adding a level of transparency for the public in respect to the use of silver nanotechnology. There is an on-

¹ Any statements, claims and views expressed by a manufacturer or third-party contained in this inventory are solely those of the party making the statement or claim.

going debate about the benefits and risks of certain nanotechnologies introduced into the market place. This database provides a snapshot of the publicly available information about products available on the market. The search was conducted as if an “inquisitive” consumer were searching for publicly-available data on different nanosilver products.

The information collected covers a broad range of information pertinent to silver nanotechnology. The majority of the data collected is from company and product websites. Additional information comes from product listings, information pages, external documents, inquiries made to the company or unaffiliated external articles; these cases are noted as such.

There are many data gaps, denoted as “NA”, throughout the inventory. These gaps are important, as they represent actual (or lack of) information available to the consumer. A later section addresses some of the trends the data gaps highlighted by this inventory follow. This inventory will provide a usable framework for future data collection on this subject, should it be attempted.

The total number of commercial product records in the inventory is 240, accounting for 214 general commercial products and 26 precursor products. There were a total of 65 companies involved in the design and manufacturing of the commercial products listed, representing eleven countries: China, Germany, Iran, Japan, New Zealand, Singapore, Korea, Taiwan, Thailand, The United Kingdom and the United States of America.

Methodology

The development of the SNCI began in 2007, designed to evaluate nanosilver products currently on the market and aid in understanding what information companies were and were not providing. Entries are primarily based on Internet searches and, as of now, are limited to product information available in English.

The product search began by searching “silver” on the Project on Emerging Nanotechnologies’ Consumer Products Inventory. The resulting product search led to parent companies and intermediary companies which, in turn, led to press releases, news articles, advertisements, information brochures, company toxicity

studies and additional commercial products. In some cases, foreign search engines were used to explore foreign markets. Blind searches were also performed, scanning the Internet for companies and manufacturers referenced as having worked with nanosilver. No attempt was made to verify manufacturer claims about the use of silver nanotechnology in any products, nor has any independent testing of the products occurred.

Product information incorporated in the SNCI originated from the company website or product listing, unless otherwise noted. Individual product information includes the date the entry was created and/or modified, along with particulars as to when and where the data was recorded. In some cases companies were solicited for information through phone and/or e-mail. The context under which these companies were approached was that of an "interested" consumer. The elicited response from these companies was assumed to be the response any consumer might obtain by directly contacting the company. These cases are noted as such throughout the SNCI. This was done, in part, to see what information is made available by public inquiry and to clarify certain claims on their websites. Company policies regarding information on their products are mutable and have, in many cases, changed or removed products from their listings (see Sharper Image Corporation's Miracle Food Storage sidebar). By dating and recording available data future updates can identify trends in public transparency concerning silver nanotechnology.

Criteria for Entry into the Inventory

- A consumer or commercial product which can be purchased
- A precursor to another product
- Product that contains a form of nanosilver
- Product that is identified as containing a nano or colloid component

Sharper Image Corporation's Miracle Food Storage	
Sharper Image Product Information 2006 Claims silver nanotechnology "FresherLonger™ Miracle Food Storage containers Are Naturally Anti-Germ, Anti-Mold & Anti-Fungus" "Real silver-yes, the mined mineral found in silver-ware – is naturally anti-germ, anti-mold and anti-fungus. <i>Silver in microscopic particle antibacterial agent. That is why silver nanoparticles are infused into the polypropylene containers of the FresherLonger™ system. Compared to your regular food storage containers, the 24-hour growth of bacteria inside FresherLonger containers with antibacterial silver nanoparticles is reduced by over 98percent! Created by advanced nanotechnology ("nano" indicating one billionth), these silver nanoparticles average only about 25nm (nanometers) in diameter – 25 billionth of a meter; one 200 thousandth of a human hair. Their natural color gives FresherLonger™ Miracle Food Storage containers their distinctive golden hue."</i>	Sharper Image Product Information 07.2007 No Claims mentioning silver nanotechnology "End the expense, disappointment and frustration of tossing out costly food that has spoiled or grown "furry" much too quickly. Keep all kinds of foods fresher for longer – helping to preserve the flavor, nutrients and appearance of fruits, vegetables, herbs, breads, cheeses, soups, sauces and meats. Even raspberries last a long time!" <i>Sharper Image's exclusive FresherLonger™ Miracle Food Storage Containers are made of specially treated air- and odor-impermeable polypropylene and they feature a patent-pending, airtight silicone-gasket locking system that helps prevent spoilage. The containers are spillproof, shatterproof and safe for the dishwasher, microwave and fridge. They help prevent freezer burn too! The translucent containers' rectangular shape makes for efficient storage; they have snap closures on all four sides for extra security. 90-day warranty."</i>
In 2006 Sharper Image was making claims that the FresherLonger™ Miracle Food Storage contained silver nanoparticles that made the product antibacterial. By 2007, those claims had been removed, yet according to the company on 08.09.2007 the product has not changed.	

A commercial product represents a product that a consumer might have contact with. Precursor products represent products that are used in the fabrication/production process of a separate end product. "Generic" indicates a product that is available in a range of models and/or sizes offered by that company. This is illustrated by Korean Samsung refrigerators which use a nanosilver coating on the interior surface to prevent bacterial growth. Samsung included this technology in 11 different side-by-side refrigerator models.² The numbers of generic products available which claim to utilize this technology are listed.

² Samsung Corporation, "imagine Side by Side Samsung Refrigerator," <http://www.samsung.com/he/products/refrigerator/sidebyside/index.asp> (accessed July 12, 2007).

Nanosilver Attributes / Characterization

Products utilizing nanosilver technologies include dietary supplements, spray-on disinfectants and anti-odor textile applications to name a few. Forty-five percent of the products listed in the SNCI reported the nanoparticle size used in the product; ranging from 0.3nm to 250nm. Only two products in the database had particle sizes above 100nm in diameter. These two products from NT Base Co., Ltd. and JR Nanotech PLC consisted of powders ranging from 25-250nm, both originating from NT Base Co., Ltd. Because the range included nanoparticles below 100nm they were included in the database. The average nanoparticles size of all reported products was 24 nm. (Refer to “Appendix B Average Particle Size Calculation” for further information) The distribution of commercial products is displayed in Figure 1. Each category is divided into general commercial and precursor products.

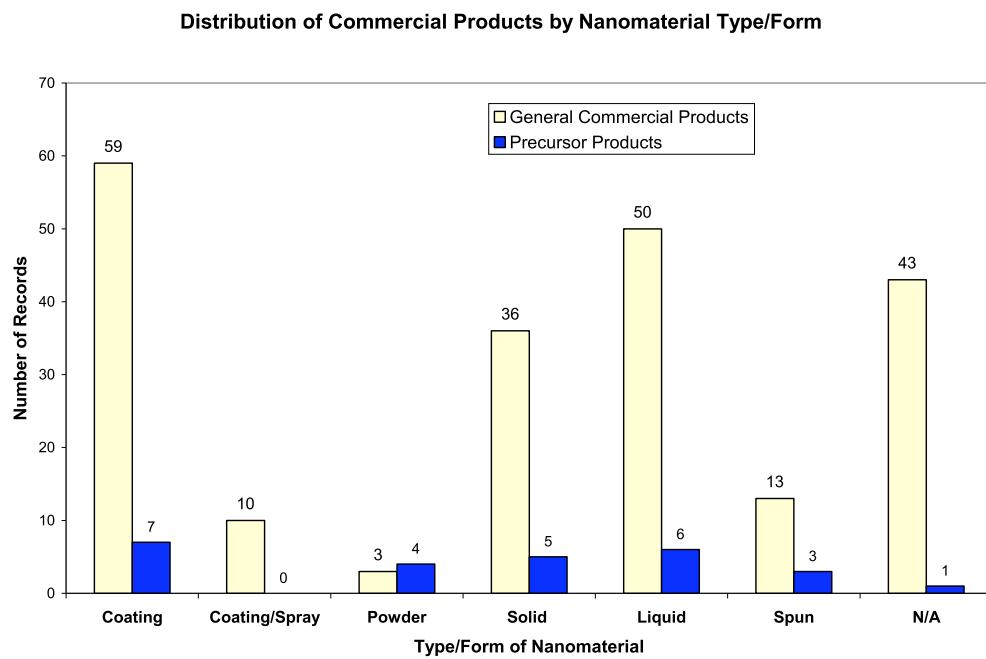


Figure 1. Distribution of Commercial Products by Nanomaterial Form

Product Categories

The commercial products were categorized under a scheme similar to the PEN Consumer Product Inventory. Two additional categories were added, "Medical Applications" and "Public". In addition, subcategories under each major category were included which allows further organization of the products. Subcategories were added to "Cross-Cutting" and medical health related products were moved under "Medical Applications". The "Public" category includes products which the public would likely have contact with, but an individual would not necessarily buy. This includes such products as ATM buttons and bus railings (See Antibacterial Handrail sidebar). The categories (subcategories) are as follows: Appliances (Laundry & Clothing Care; Large Kitchen Appliances; Heating, Cooling and Air), Automotive (Maintenance & Filtration Accessories; Exterior; Tires), Cross-Cutting (Coatings; Fabric Thread; Powder; Colloid; Master Batch), Electronics and Computers (Cameras and Film; Video; Luxury; Mobile Devices and Communications; Computer Hardware; Television; Display), Food and Beverage (Cooking; Storage; Food; Supplements), Goods for Children (Basics; Toys and Games), Health and Fitness (Personal Care; Sporting Goods; Clothing; Cosmetics; Filtration; Sunscreen), Home and Garden (Paint; Home Furnishings; Cleaning; Construction Materials; Hardware; Pets; Bedding / Pillows), Medical Applications (Dressings; Instruments; Devices with prolonged contact with the body); Hospital Hardware; Hospital Supplies; Pharmaceuticals, and Public (Hardware; Cleaning Applications).

The inventory lists each product by Type/Form (the manufacturing process to incorporate the nanotechnology into the

Look Kirei No Mist	
COMPANY	Lion Corp
COUNTRY	Japan
TYPE/FORM	Coating & Spray
EXPECTED LIFETIME	N/A
HEALTH & FITNESS → PERSONAL CARE	
APPLIED HOW	"New disinfectant 'silver ion' ingredient: ionized nano-silver particle attached to the surface of alumina-silica just 15 nanometers in diameter." (Feb 1, 2006 Press Release "New Lineup of Three Items Released")
RECOMMENDED USES	As a disinfectant spray.
ANTIBACTERIAL CLAIM	"Just spray and disinfectant silver ions curb gunk and odor caused by bacterial infestation to preserve cleanliness."

Antibacterial Handrail	
COMPANY	Nano Care Technology, Ltd.
COUNTRY	China
TYPE/FORM	Coating
EXPECTED LIFETIME	N/A
PUBLIC → HARDWARE	
APPLIED HOW	It is applied in a coating of thickness 2.88 to 3.79 micrometers (average 3.32 micrometers).
RECOMMENDED USES	Typical applications: tableware, kitchenware, personal care products, watch accessories, door handles, pet care products, public facilities, etc.”
ANTIBACTERIAL CLAIM	“On the completion of four years R&D program, NCT is pleased to introduce a revolutionary nano-silver based patented technology to be applied on the surface of products, providing antibacterial substance and hardness enhancement.”



product). “Coating” includes products that are coated during the manufacturing process. “Liquid” includes products which are meant to stay in a liquid, colloid or cream form. Generally, all of the “Liquid” products are fabricated by incorporating a silver colloid into the final product. “Coating & Spray” has attributes of both the coating and liquid categories. The defining characteristic of these products is that they are meant to be used as a liquid spray coating.

A majority of the nanosilver applications listed fall under the “Coating” heading (66), followed by “Liquid” (56), “Solids” (41), and “NA”(44), which do not specify what form their nanosilver product takes.

“Spun” represents textile companies and refers to the process of integrating nanosilver into textiles that are being spun. It is not entirely clear if this is a coating or the creation of a solid, such as a suspension of nanosilver integrated into the thread itself (as with the spinning of wool or the extruding of polymer fabrics).

The “Spun” heading contains 16 of the listed products.

There are products with relevance to more than one category. This means that one record or product can be listed under multiple categories, one example being the X-System™ Nano-Silver Scent Elimination Spray made by E47. This product is designed to control odor such that “Odor molecules from outside sources, such as smoke, food and gasoline vapors, are altered with a fast-acting technology that renders them undetectable to the noses of wild game. Odor-causing bacteria will be controlled by the long lasting protection of nano-size silver. X-System Nano-Silver will not bleed or leave a white powdery residue, and

it will not stain or fade clothing.¹³ This product is not only meant for cleaning “Home and Garden” category, but also fits under the “Sporting Goods” Subcategory.

The Health and Fitness markets are seeing the biggest emergence of products utilizing nanosilver (131 records see Fig.2) compared to other categories such as appliances (15), medical applications (10), and electronics and computers (8).

“Health & Fitness” includes as subcategories Personal Care (71), Sporting Goods (11), Clothing (56), and Cosmetics (17) with no records under Filtration or Sunscreen applications. Figure 3-a illustrates the breakdown of products within the Health and Fitness category. In addition, Figure 3-b displays the overlap of “Personal Care”

products that are listed under multiple categories. “Personal Care” items included things that one would use to take care of themselves such as facial soap, salves, toothpaste and hairbrushes. The cosmetics classification includes products which are meant to be applied to and have prolonged contact with the skin. These include face creams and skin treatments. Clothing, a sub-category within Health and Fitness, is another large area (56). The use of nanosilver in textiles can be utilized in a variety of ways. By incorporating the nanosilver into a cotton thread, such as with Smart Silver produced by NanoHorizons, the thread can then be woven into a variety of products from underwear to jackets. (See Smart-Silver™ product sidebar.) As with many products utilizing nanosilver the “clothing” category crosses into other categories. Many of the textile companies sug-

Cor Soap	
COMPANY	Plank™
COUNTRY	United States
TYPE/FORM	Solid
EXPECTED LIFETIME	6-9 months*
HEALTH & FITNESS → PERSONAL CARE	
APPLIED HOW	The colloidal silver is used in conjunction with silica, collagen, chitosan, and sericin to form a facial/body soap.
RECOMMENDED USES	As a facial soap.
ANTIBACTERIAL CLAIM	“The particles of Cor soap’s active ingredients are dramatically reduced in size, reaching deep below the surface, killing bacteria, minimizing wrinkles, moisturizing and feeding vital nutrients to the skin.... Silver is fast emerging as one of the best antibacterial agents. It also has healing properties which speeds the growth and repair of cells.”

*expected lifetime of product with recommended use

³ E47, “X-system Scent Elimination Spray,” <http://www.xsystem.com/scentspray.html> (accessed June 11, 2007).

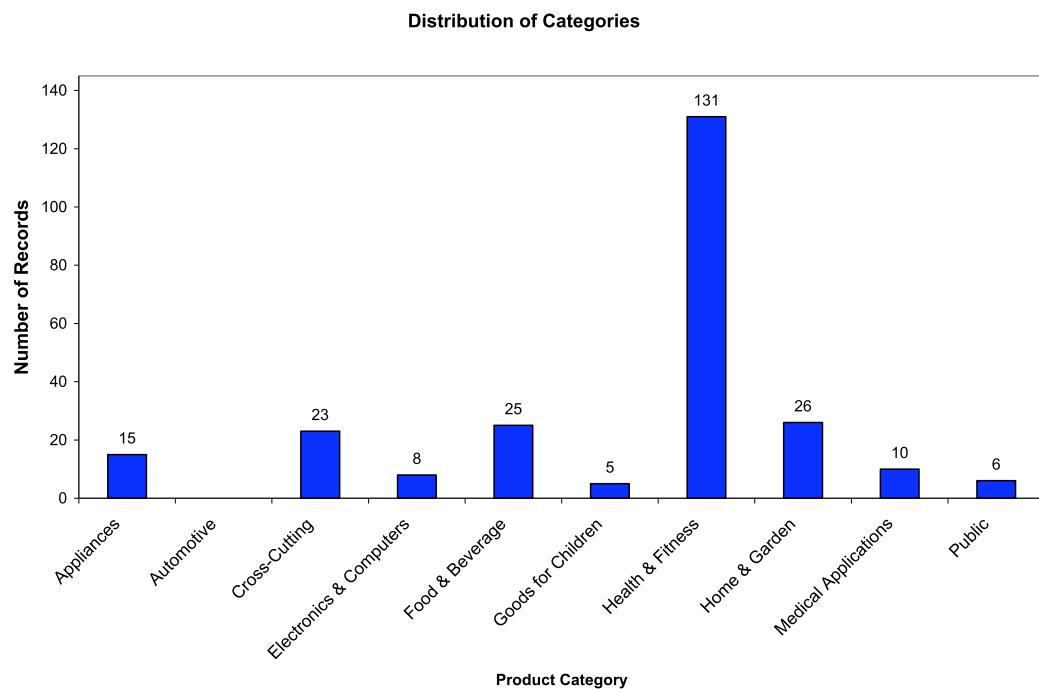


Figure 2. Distribution of Product Categories

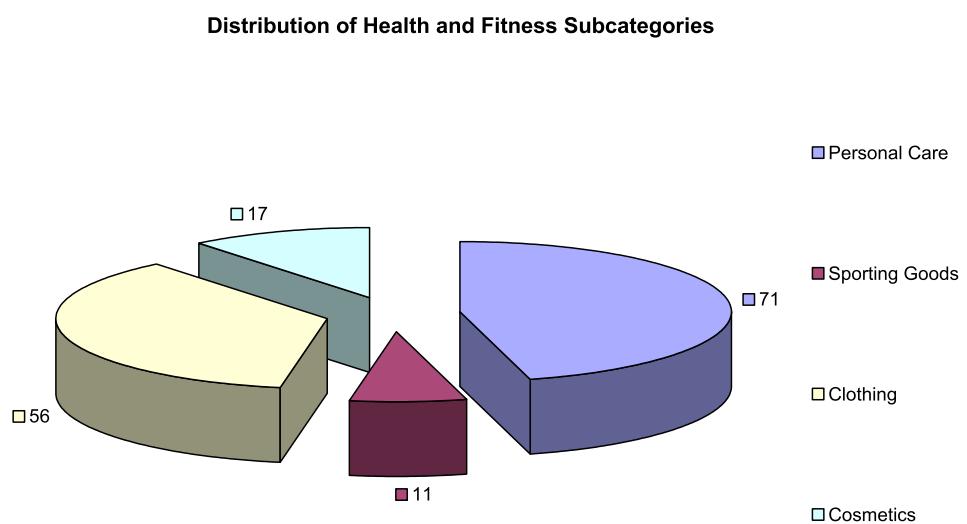


Figure 3-a. Distribution of Health and Fitness

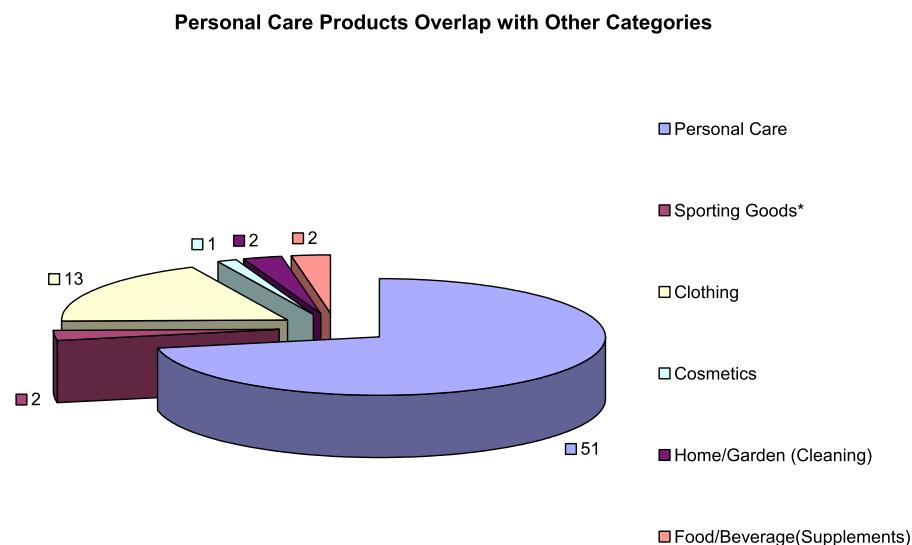


Figure 3-b. Shows the break down of products in the Personal Care category that are also listed under other categories. *Leg wrap by NanBabies is listed under clothing, personal care and sporting goods

gested other applications for their fabrics such as wound care and hospital bedding. While these uses were purported and often images of final products were displayed, finished products were not located in our search.

Wound dressings and medical applications typically use structures and design applications of silver ions instead of nanosilver per say. In many of these applications, the idea is to store silver ions and incorporate a time-release mechanism. This usually involves some form of moisture layer that the silver ions are transported through to create a protective barrier against bacteria. Despite the historical use of silver in health-related fields, direct application of silver nanotechnologies remains rare.

Daewoo Electronics, LG Electronics Inc. and Samsung have the largest variety of appliances and models. These companies produced vacuum cleaners, air fil-

		
Shampoo & Conditioner	Nanosil Toothpaste	Professional Hairbrush
COMPANY Skybright Natural Health APPLIED HOW "Both formulations contain our own Colloidal Silver, so have the added ability of helping rid the scalp of flaking or itchiness. All of the ingredients are derived from vegetable or plant extracts and are G.E. free."	COMPANY Nano Plasma Center Co, Ltd. APPLIED HOW nanosilver mixed with toothpaste, ingredients: "Activation: Silicon dioxide, SMFP (Sodiummonofluorophosphate) Aminocaproic acid Inactivation: Xylitol, Sodium pyrophosphate, Ag, Eucalyptus oil, PEG1500, Sorbitol, Hydrated silica, Cellulose gum, Flavor, SLS etc."	COMPANY Sang Shin Industrial Co, Ltd. APPLIED HOW "Using Nanosilver technology, Sang Shin is producing high-quality brush bristles for your healthy hair. To accomplish this, we produce brush bristles by mixing and processing Nylon 66 raw materials and anti-bacterial Nanosilver materials."

ters, refrigerators and washing machines beginning in 2002.⁴ They were presented as the next wave in modern appliances. Most of them featured a nano-coating.

4 Thomas Braun, "Asia Pacific Nanotechnology Forum News Forum," Asia Pacific Nanotechnology Forum 2, no. 4 (October 2003), under "Korea Nanotechnology the Fast Pace," http://www.apnf.org/fileadmin/user_upload/downloads/APNFNjv2no4.pdf (accessed July 30, 2007).

Precursor Products

Precursor products are generally not a consumer or commercial product themselves. They utilize silver nanotechnology in the manufacturing process of other commercial products. Some of these precursor products are developed in-house while others are sold to the manufacturing market through intermediary companies. There are cases where precursor products are advertised as "enhancement" technology directly to manufacturing companies and not to individual consumers. This is especially prominent in the textile industry where the intermediary company will either produce a precursor nanosilver thread or fabric or they will work with the manufacturer to incorporate the process of making antibacterial/anti-odor fabric with nanosilver. A polymer enhanced with nanosilver can be found in different industries such as sports wear and hospital bedding. Nanocid™ produces a variety of polymers with high concentrations of silver nanoparticles (also referred to as a "masterbatch") from which polyester fiber

can be created and then used in various applications.⁵

Twenty-six precursor products were identified within the SNCI. A majority of these precursors have products associated with them, but in some cases the resulting consumer products were not found. These intermediary companies provided a large amount of information about their technology to manufacturing companies and focus their advertising on manufacturers, not individual consumers. While these intermediaries gave a long list of applications for their precursor products and sometimes even provided pictures of those

SmartSilver™	
COMPANY	NanoHorizons, Inc
COUNTRY	United States
TYPE/FORM	Spun
EXPECTED LIFETIME	Permanent
CROSS CUTTING → FABRIC THREAD	
APPLIED HOW	Nanoparticles "are also chemically and permanently bonded to the fibers that are being enhanced." "SmartSilver™ is available in Masterbatch, CottonPro, Staple Fiber and Polyurethane."
RECOMMENDED USES	Fabrics
ANTIBACTERIAL CLAIM	"SmartSilver™: The Smarter Anti-Odor and Antimicrobial Answer."

⁵ Nanocid™, "Nanocid application in medicine, Health & Cosmetics," <http://www.nanocid.com/> (accessed July 17, 2007).

resulting products, there was no mention of product names or manufacturers that used their precursor product. Certain companies mentioned who was using their products, however finding those products at the manufacturer's web site proved difficult and often there was no form of information that these products contained nanosilver.

Larger corporations utilizing nanosilver in their products often would have press releases or a line in the product description mentioning nanosilver but would not explain the technology or define it as using a specific precursor product. These companies tend to have a variety of product models, but the specifics on their silver nanotechnologies were not revealed. In the case of Germany's Daewoo Electronics, the explanation of their "Nanosilver Poly Technology" describes it as "a nanoparticle-containing polymer network that can act against microscopic organisms."⁶ As a result of utilizing precursor products, it's possible there are far more nanosilver products out there that are not being labeled as such by manufacturers.

Distribution of Precursor Products

Many of the precursor products that are being developed are marketed for a specific group of applications. This is particularly apparent in the development of nanosilver coatings. A coating technique can be applied to a variety of applications in which an antibacterial coating might be useful, such as medical instruments, kitchenware and/or kitchen appliances. In addition some precursor products can be utilized across different categories. NANOVER™, made by a Korean company called Nanogist Co., Ltd. demonstrates this versatility. They offer an intermediary in three different types of colloids composed of nano-silver-titanium-dioxide with an average particle size of 5nm (1,000ppm, 5,000ppm, 10,000-50,000ppm). The actual size of the incorporated particle is <1nm. They claim antimicrobial protection anywhere from 6 months to 5 years.

⁶ Daewoo Electronics, "Glossary," http://www.daewoolelectronics.co.uk/gb/products/living_clean_glos.htm (accessed August 2, 2007).

It is said to be effective in products in concentrations lower than 10ppm. The range of products, listed by category, can be seen in the sidebar.⁷

⁷ Nanogist Co., Ltd., “NANOVER™ APPLICATIONS,” <http://www.nanogist.com/English/application/application.htm> (accessed July 10, 2007).

Data Availability

Figure 4 displays the availability of data (the percentage of data represented in the SNCI) retrieved for each data field. The analysis reflects the level of transparency in the market towards an inquisitive consumer. A field is counted as having data if information was available.

The “Recommended Uses” field contained the highest percentage (98%) of available data. This may be due to a company’s incentive to identify and market towards their prospective customers. The “Application How” field represents how the nanosilver technology was being used.

Approximately 88% of the products listed claimed some form of antibacterial or antimicrobial protection. Antimicrobial and antibacterial claims are characterized by words directed at bacteria such as “harmful,” “repelling,” “kill,” “disinfectant,” “antibiotic,” “suppression” and other phrases that suggest the reduction of microbial or bacterial life.

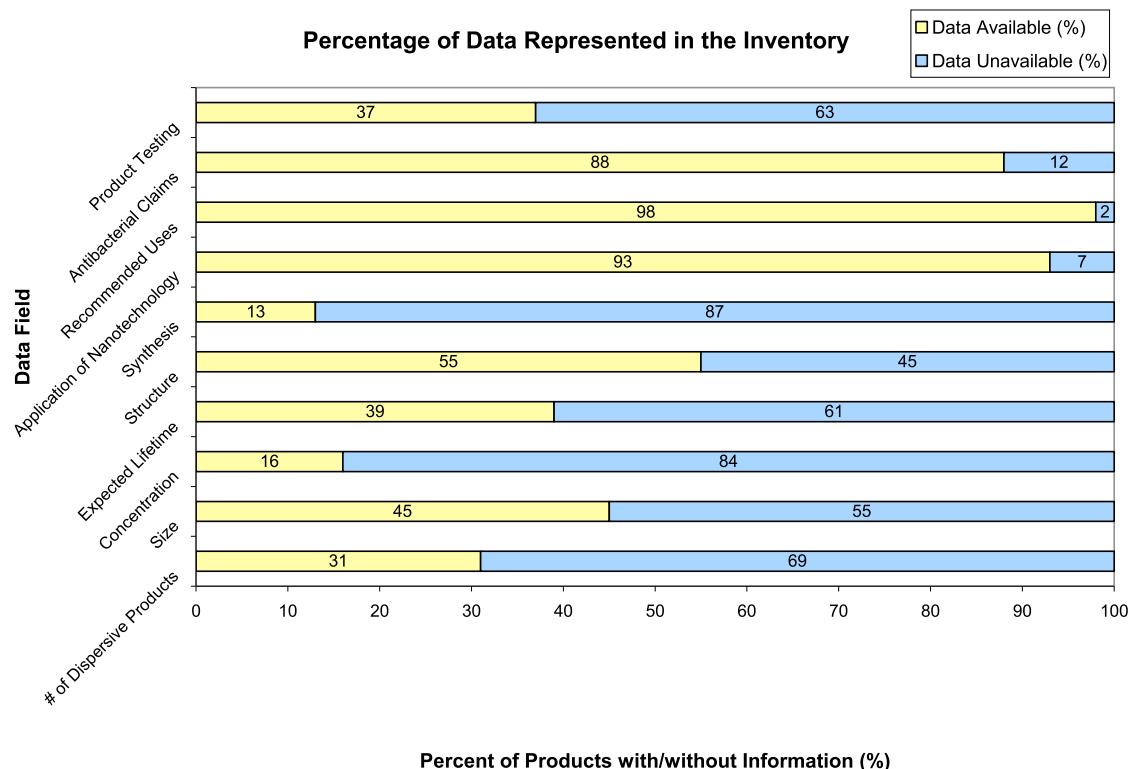


Figure 4. Available Information Represented in the Inventory

Many of the records in the SNCI mention some form of “Product Testing”, referring to the antibacterial effectiveness against different pathogens. Approximately one-third of the products in the inventory mentioned “Product Testing”. Another third of these products referenced tests related to human health. The remaining claims were physical characteristic tests or there was not enough information about the tests to determine the purpose or results. In some instances data on the effectiveness of the product was withheld while others were more transparent and used confirmation reports as proof that their product worked. (See Cosil Whitening Mask product sidebar)

NANOVER™	
COMPANY	Nanogist Co, Ltd
COUNTRY	South Korea
TYPE/FORM	Liquid
CROSS CUTTING → COLLOID	
STRUCTURE OF PARTICLE	
“Nanover™ is nanosilver-based antimicrobial colloid.” Nano-Silver-Titanium-Dioxide “NANOVER™ is not Ag ion, but metallic nanoparticles.”	
APPLICATIONS	
COSMETICS	CLEANER
Makeup	Disinfectant Spray
Mask pack	Detergents
PERSONAL CARE	
Cleansing Soap	Hair Spray
Detergents	Hair Wax
AG-Toothbrush	Hair Gel
AG-Garglin	Hand Sanitizer
AG-Mouth Deodorant	Wet Tissue
Shampoo & Conditioner	Body Cleanser
Hair Mousse	

A majority of the missing data in the inventory relates to product specifications, such as the concentration of nanosilver. Nanoparticle size was reported for 45% of the products listed. Information on how companies synthesized the nanosilver or how they specifically integrated it into their product is lacking. This is demonstrated in the “Synthesis” and “Structure” fields. While 55% of listed entries contain data in the “Structure” field, the data is not specific in most cases. Approximately 80% of the “Coating” records mention nothing about the structure of the particle and/or substrate. Out of the remaining 20% only a handful specifically mention features of that coating.

The “Rate of Ag+ Released” is considered to be a major factor in determining how toxic a product is to bacteria. Only one U.S. company, Natural-

Cosil Whitening Mask	Mesosilver
COMPANY Natural Korea COUNTRY South Korea	
HEALTH & FITNESS → COSMETICS	FOOD & BEVERAGE → SUPPLEMENT HEALTH & FITNESS → PERSONAL CARE
PRODUCT TESTING A copy of each of the following are provided on their web site: <ul style="list-style-type: none"> - Cosil Mask Pack proves to be a 99.9% disinfectant against Staphylococcus and Escherichia coli, tested by FITI Testing and Research Institute - Nano-colloidal Silver (Ag) contained in Cosil Mask Pack is proven to be a safe (non-toxic) material by a result of toxicity test carried out by FDA certified laboratories (RCH Pharmaceutical and Cosmetic Analytical Laboratories). - Nano-Colloidal Silver (Ag) contained in Cosil Mask Pack is clinically tested by both men and women and proven to be safe as shown in the test result issued by FITI Testing and Research Institute" 	PRODUCT TESTING A copy of the following is located on their web site: Testing "Size Distribution Report by Volume" Colloidal Science Laboratory, Inc. Westampton, NJ

Immunogenics Corp. and their product Sovereign Silver™, has information publicly available on the rate in which silver is being released.⁸

⁸ Natural-Immunogenics Corp., "Choose a Silver You Can Trust!," http://www.natural-immunogenics.com/silver_why_sovereign.php (accessed July 17, 2007).

Appendix A. Description of Database Fields

Product Name
The name of the product.
Company
The name of the producer and/or developer of the product.
Company Country
The location of company, company headquarters when available.
Product Category
Each product is listed under one or more categories, depending on the products intended uses.
Number of associated products
If there are multiple models or sizes available for a particular product, those products are mentioned here.
This product uses
The precursor product which is used in the fabrication of the general commercial product.
Type/Form
The type/form describes how the product appears in its final form.
Concentration of Nano Ag
Concentration of nanosilver within the product. Information provided by the manufacturer.
Particle Size
Specifications of nanoparticles used in the product. Information provided by the manufacturer.
Rate of Ag+ Release
The rate of silver ions being released from the product. Provided by the manufacturer. The rate of release is considered to be important in assessing the toxicology of nanosilver products and applications.
Classification
This classifies the product as either nano or colloid per company advertising.
Expected Lifetime
The expected lifetime of the product maintaining its desired nano-enhanced effect. Also referred to as "life of product" and "permanent". Based upon the manufacturers claims.
Is the use dispersive?
Marked yes if products were thought to easily disperse into a liquid. This includes products that could dissolve in water or might be disposed of in public sewers such as soaps, shampoos and cleaning sprays.

Structure of Particle and/or Substrate

A description of the particles being used, what surrounds it and/or other components that are included in the product. Quotes from the manufacturer are provided where applicable.

Synthesis Method

An interpreted description of how the product's silver nanomaterials/nanoparticles were created or manufactured. Quotes from the manufacturer are provided where applicable.

Use of Nanotechnology

A description of how the silver nanotechnology is used or incorporated into the product. This can either be a quote from the manufacturer or an interpretation of how the nanosilver is being utilized.

Recommended Uses

The recommended uses of the product directly stated by the manufacturer or inferred from the product/company website.

Antimicrobial Claims

Claims about silver nanotechnology products having antibacterial or antimicrobial properties; taken from the product website unless otherwise noted. Dates of when quotes were recorded are noted.

Product Testing Information

Reference to product testing and access to reports or documents are listed here.

Company web site

The company or parent company web site.

Product web site

The location of the product listing or product information page.

Appendix B. Average Particle Size Calculation

This average was determined by taking into account each specific nanosilver application. First all of the 109 products that referenced a size or a range of sizes were divided by manufacturer. Out of these products a total of 21 companies were represented and a total of 21 distinct applications were identified (3 companies were removed from this count because their products used a precursor product that was already taken into account). These distinct instances were then taken and averaged as shown below.

COMPANY	RANGE (LOW) [NM]	RANGE (HIGH) [NM]	AVERAGE SIZE [NM]
AgActive			25
Aluwe, LLC			0.65
American Biotech Labs			10
Conseal International, Inc.	<	25	25
Daido Steel Co., Ltd.			7
E47	<	15	15
Lexon Nanotech(LNT), Inc.	10	30	20
Lion Corporation			15
MAHA Corp.			25
NanBabies (Coated)	5	10	7.5
NanBabies (Coating & Spray)	5	10	7.5
Nano Care Technology Ltd			50
Nano Plasma Center Co. Ltd.	0.3	20	10.15
Nanogist Co., Ltd.			5
NanoHorizons	10	15	12.5
Pooghe Laundry LLC*	10	15	12.5
Natural-Immunogenics Corp.			0.8
NT Base Co., Ltd. (Powder)	25	250	150
JR Nanotech PLC*	25	250	150
NT Base Co., Ltd. (Colloid)	25	100	62.5
NUCRYST Pharmaceuticals Corp.	1	100	50.5
Smith & Nephew*	1	100	50.5
Purest Colloids, Inc.	<	0.65	0.65
Total Ventrue Marketing (TVM), Inc.	1	10	5.5
OVERALL AVERAGE SIZE			24

*- Companies that use precursor products already mentioned. Their particle size is not included in the average

Estimated average from a given range.