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[Continued on next page]

(54) Title: FIBERS WITH SURFACE MARKINGS USED FOR CODING

(57) Abstract: Disclosed are fibers comprising one or more branded fibers which exhibit surface markings in a repeated pattern along the length of the branded fibers. The branded fibers can be incorporated into yarns or fiber bands to represent supply chain information of the yarns, fiber bands, and/or articles made from the yards or fiber bands. In a specific example, branded fibers can be incorporated into an acetate tow band. The branded fibers can be recovered from a cigarette filter, the repeated pattern decoded, and supply chain information associated with the acetate tow used to make the cigarette filter, such as manufacturer, customer, ship-to location, and even the acetate tow bale, can be obtained.

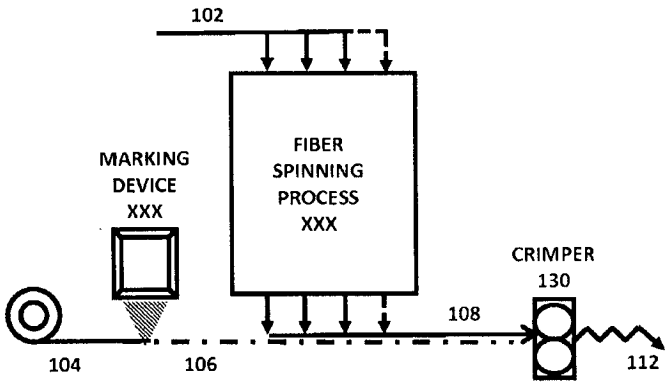

FIGURE 1

Schematic of concurrent branding and acetate tow productions

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FIBERS WITH SURFACE MARKINGS USED FOR CODING

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. 119(e) to United States Provisional Application Serial No. 62/018182, filed June 27, 2014, United States Provisional Application Serial No. 62/105011, filed January 19, 2015, and United States Provisional Application Serial No. 62/164135, filed May 20, 2015, each of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This present disclosure relates to fibers, a fiber band, or a yarn containing branded fibers. The branded fibers can exhibit a repeated pattern of surface markings. The repeated pattern of surface markings can correlate to supply chain information of the fiber band or yarn. The present disclosure also relates to the method for making and characterizing the fiber band or yarn containing the branded fibers. Characterizing of the fiber band or yarn can include isolating the branded fibers, decoding the repeated pattern of surface markings, and correlating the repeated pattern of surface markings to supply chain information. The supply chain information can be used to track the fiber band or yarn from manufacturing through intermediaries, conversion to final product, and/or the consumer.

BACKGROUND

[0003] Many industries have a need to mark, tag, or identify products that allows for the tracking and tracing of products through the supply chain. One of the primary purposes for such track and trace systems is the combating of illicit trade such as counterfeiting and black market sales.

[0004] Anti-counterfeiting measures (ACMs) can be regarded as three different types: Type I (Overt), Type II (Covert) and Type III (Forensic). Type I ACMs are features incorporated into an article that are readily identified and

observable to the naked eye. Examples include watermarks, color shifting inks, colored fibers, bands, or strips incorporated into the article, and holograms. Type II ACMs are features that are incorporated into the article that require some form of instrument to identify the feature in the field. The instruments required are generally those that are readily available and transportable. Some examples include the incorporation of very small text (requiring the use of a magnifying glass), UV responsive inks or threads (requiring illumination with a UV light), and barcodes or RFID tags (requiring a specialized reader). Type III ACMs are hidden attributes that require specialized laboratory equipment to identify. Some Type III examples include nano-text, micro-taggants, DNA inks, and chemical additives.

[0005] As stated above, there are many widely-used packaging and labelling taggants and anti-counterfeiting measures (ACMs) in many industries, but these more overt solutions are often susceptible to countermeasures such as destruction, modification, duplication, repackaging, or relabeling. Altering the physical features of the raw materials of a product can provide a more covert solution that is much more difficult to evade. These taggants may be used to track the fibers through the supply chain. The taggants may change the physical properties of the fibers, yarn fiber bands, and/or derivative articles in a manner that is difficult to copy or alter but is detectable using image analysis and/or other mechanical methods.

[0006] There is a need to manufacture, test, and track fibers in fiber bands or yarns and their derivative articles across a wide spectrum of industries. The ability to identify the source of a fiber band, yarn and/or an article comprising the fiber band or yarn can be achieved by embedding some form of a code in the fiber(s) during the manufacturing process that can then be later identified, retrieved, and used to identify the fiber band and/or the article.

[0007] Identification tags can be incorporated into the fibers, fiber band, or yarn that can denote, for example, manufacturer, manufacture site, customer, and ship-to location among other supply chain information that might be useful for the track and trace of the fiber band, yarn and/or article.

[0008] The disclosed exemplary embodiments can be used, for example, to combat the continuing and growing illicit-trade problem of tobacco products, particularly cigarettes. It has been estimated that 10-12% of all cigarette sales are illicit, either counterfeit copies or sales that avoid paying excise taxes on the cigarettes (Tobacco International, "Tackling Illicit Trade, Pt. I," December 2013). To combat this illicit trade requires a global effort consisting of manufacturers, distributors, regulators, and customs/law enforcement, as well as retailers who sell the cigarettes to consumers. There is a need to be able to track and ultimately trace components used in the construction of a cigarette. For example, the ability to track part of the supply chain path of acetate tow contained in the filter of a black market cigarette may give helpful information on the source of these illicit cigarettes.

[0009] Manufacturers of acetate tow typically assign a bale identifier (e.g., number) to each bale of acetate tow produced. Upon assignment, the bale number is associated with supply chain components such as manufacturer, manufacturing site, manufacturing line, production run, and production date. As the bale of acetate tow moves through the supply chain, additional supply chain components such as, for example, customer and ship-to location can be associated with the bale number. In other words, acetate tow manufacturers have systems in place to track and trace some of the supply chain components for bales of acetate tow. Currently, however, an equivalent of a bale number is not encoded in the acetate tow band itself. Therefore, once the label is removed from a bale of acetate tow or the acetate tow band is converted into a filter rod or cigarette filter, the supply chain information is lost.

[0010] There is a need for a traceable acetate tow that is readily manufactured, does not impact the performance of a cigarette filter, and is detectable, not only in an acetate tow band, but also in a single or a set of cigarettes/ cigarette filters. There is a need for a traceable acetate tow that is readily accepted by cigarette manufacturers and consumers, such as an acetate tow that does not require adding chemicals which may impact taste and/or require regulatory approval. There is a need for traceable acetate tow

that does not impact the pressure drop and yield of a cigarette filter. There is a need for traceable acetate tow that maintains its traceability when bloomed, plasticized, and formed into a filter.

[0011] There is a need for traceable acetate tow that contains supply chain information including a manufacturer, the customer, or the ship-to location such that the information can be decoded from a single or a set of cigarettes. There is a further need for traceable acetate tow with supply chain information at the level of the acetate tow bale in order to implement a traceable acetate tow system with minimal supply chain costs and complexities.

BRIEF SUMMARY

[0012] The embodiments disclose fibers comprising standard fibers one or more identification fibers. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The taggant surface markings and the repeated pattern are representative of at least one supply chain component of the standard fibers.

[0013] Additional disclosed embodiments include an acetate tow band comprising fibers. The fibers comprise one or more identification fibers and standard fibers and the standard fibers comprise cellulose acetate. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The taggant surface markings and the repeated pattern are representative of at least one supply chain component of the acetate tow band.

[0014] Further embodiments encompass methods of making an acetate tow band comprising fibers. The fibers comprise standard fibers and identification

fibers and the standard fibers comprise cellulose acetate. The method comprises: (a) obtaining the identification fibers; (b) producing the standard fibers on a first fiber production process; and (c) combining the identification fibers and the standard fibers into the acetate tow band. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The taggant surface markings and the repeated pattern are representative of at least one supply chain component of the acetate tow band.

[0015] Yet additional embodiments encompass methods of characterizing a fiber sample. The fiber sample comprises fibers and the fibers comprise standard fibers and identification fibers. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The method comprises (1) optionally separating the branded fibers from the fiber sample; (2) applying imaging technology to the branded fibers; (3) determining the repeated pattern of the taggant surface markings. The taggant surface markings and the repeated pattern are representative of at least one supply chain component of the fiber sample.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIGURE 1 shows a schematic process flow diagram of a non-limiting embodiment of branding fibers while coproducing acetate tow fibers and combining them into an acetate tow band.

[0017] FIGURE 2 illustrates the printer settings for Example 1.

[0018] FIGURE 3A shows a photomicrograph of a branded nylon monofilament that has been recovered from a filter rod and 3B shows a

photomicrograph of a branded polyester thread that has been recovered from a crimped acetate tow band.

[0019] FIGURE 4 shows a photomicrograph of an acrylic monofilament fiber engraved using a MACSA carbon dioxide laser

[0020] FIGURES 5A and 5B illustrate non-limiting examples of communication and shipping channels among one or more entities consistent with disclosed embodiments

[0021] FIGURE 6 illustrates a non-limiting example of a computing system used by one or more entities consistent with disclosed embodiments.

[0022] FIGURE 7 illustrates a non-limiting example of a process for embedding supply chain information into fibers, consistent with disclosed embodiments.

[0023] FIGURES 8 and 9 illustrate non-limiting examples of processes for generating correlation data, consistent with disclosed embodiments.

[0024] FIGURE 10 illustrates a non-limiting example of a process for producing identification fibers, consistent with disclosed embodiments.

[0025] FIGURE 11 illustrates a non-limiting example of a process for identifying supply chain information from a sample, consistent with disclosed embodiments.

[0026] FIGURE 12 illustrates a non-limiting example of a process for assigning taggant information to supply chain components, consistent with disclosed embodiments.

DETAILED DESCRIPTION

[0027] The embodiments disclose fibers comprising one or more identification fibers. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The taggant surface markings

and the repeated pattern are representative of at least one supply chain component of the standard fibers.

[0028] Unless otherwise indicated, all numbers expressing quantities of ingredients, properties such as molecular weight, reaction conditions, and so forth used in the specification and claims are to be understood as being modified in all instances by the term "about."

[0029] It is to be understood that the mention of one or more process steps does not preclude the presence of additional process steps before or after the combined recited steps or intervening process steps between those steps expressly identified. Moreover, the lettering of process steps or ingredients is a convenient means for identifying discrete activities or ingredients and the recited lettering can be arranged in any sequence, unless otherwise indicated.

[0030] As used herein the term "and/or," when used in a list of two or more items, means that any one of the listed items can be employed by itself, or any combination of two or more of the listed items can be employed. For example, if a composition is described as containing components A, B, and/or C, the composition can contain A alone; B alone; C alone; A and B in combination; A and C in combination; B and C in combination; or A, B, and C in combination.

[0031] The term "fibers", as used herein, refers to thin flexible threadlike objects. Fibers can be natural fibers or man-made. The term "polymer", as used herein refers to the base material from which the fibers are made. Non-limiting examples of polymers include acrylic, modacrylic, aramid, nylon, polyester, polypropylene, rayon, polyacrylonitrile, polyethylene, PTFE, and cellulose acetate. The term "filament", as used herein, refers to a single fiber. The term "fiber band", as used herein, refers to multiple fibers placed adjacent to each other along their lengths such that the fibers remain untwisted or entangled and form a substantially rectangular cross section with a high width-to-depth ratio. Fiber bands are often formed to allow for effective crimping of the fibers and can be cut into a staple or processed as a continuous band, depending on the end use. Fiber bands are typically not

woven or knitted into a fabric article unless first converted into staple to form a thread. Fibers can also be in the form of yarns. The term "yarn, as used herein, refers to multiple fibers placed adjacent to each other along their lengths, often twisted or entangled together to improve fiber cohesiveness and performance, and typically forming a substantially rounded cross section. Yarn can be processed as continuous strands or cut into smaller lengths, depending on the end use.

[0032] Fibers can be identification fibers and/or standard fibers. The term "standard fibers", as used herein, refers to fibers which are manufactured for the primary purpose and use in producing articles. Standard fibers have not been purposefully manipulated to comprise distinct features used to identify and track the standard fibers, yarn, a fiber band, and/or an article comprising standard fibers. The term "identification fibers", as used herein, refers to the fibers having distinct features such that the identification fibers can be used to identify and track the standard fibers, yarn, a fiber band, and/or an article comprising the standard fibers and the identification fibers.

[0033] The term "distinct features", as used herein, refers to variances among fibers that can be identified using imaging technology. Non-limiting examples of distinct features include cross-section shapes, cross-section sizes, optical properties, and surface markings. The term "combination of distinct features", as used herein, refers to the two or more distinct features exhibited by an identification fiber.

[0034] The term, "optical properties", as used herein, refers to electromagnetic radiation responses observed when the fibers are exposed to a specific electromagnetic radiation sources. The term includes color which can be observed with the human eye as well as with an instrument such as one capable of identifying a spectrophotometric signature. Non-limiting examples of electromagnetic radiation include x-ray, ultraviolet, visible light, infrared, and so-called "T-ray" (terahertz frequencies). The term "taggant optical properties", as used herein refers to a collection of known optical

properties used by one or more manufacturer in a system for determining fibers, fiber band, and/or yarn supply chain information.

[0035] The term, "surface markings", as used herein, refers to variances in the fibers produced by physically altering the fiber surface. Non-limiting examples include engraving the fiber, morphological modification, printing on the fiber surface, and chemically producing a pattern of optical properties. The term "taggant surface markings", as used herein refers to a collection of known surface markings used by one or more manufacturer in a system for determining chain information.

[0036] The term "alphanumeric code", as used herein, refers to information that is represented using the characters or letterings belonging to a common alphabetic and numerical system or language, including special characters such as punctuation marks and including any script or printing style for that language. Non-limiting examples include the Latin alphabet, Roman numerals, and Arabic numbering.

[0037] The term "digital code", as used herein, refers to information that is represented using a string of discrete, discontinuous values. Non-limiting examples include binary coding systems, Morse Code, bar coding systems (including 1-D linear and 2-D matrix),

[0038] The term "analog code", as used herein, refers to information that is represented by modulating a continuously variable physical quantity such as spatial position, a dimension, or a magnitude.

[0039] The term an "ideographic code", as used herein, refers to information that is represented by a graphic symbol or pictograph, independent of any particular language or alphanumeric system.

[0040] The term "metadata", as used herein, refers to a portion or multiple portions of the pattern that represents a code that contains information about the remaining code within the pattern. Non-limiting examples of this information includes the format, read-start position, read-end position, read direction of any code the pattern represents. The metadata could also include information that represents the manufacturer of the fiber. The metadata may

use the same or similar coding system as that used for the remaining portion of the pattern or it may use a different coding system to easily differentiate it from the remaining portion of the pattern.

[0041] The term "read-start position," as used herein, refers to the position where a code or a portion of a code begins.

[0042] The term "read-end position," as used herein, refers to the position where a code or a portion of a code ends. .

[0043] The term "read-direction," as used herein, refers to the linear direction a particular portion of the code must be read to reliably decode the information.

[0044] The term "the repeated pattern is essentially one-dimensional", as used herein, refers to a pattern where the useful information associated with the pattern is along one direction or can be determined by observing the variation along a single line through the pattern.

[0045] The term "engraving", as used herein, refers to the removal of material from the fiber surface or the creation of raised or recessed areas on the fiber surface such that the resulting discontinuities in the fiber surface can be detected optically or by other analytical means. Engraving can be performed by contact equipment, such as equipment that uses abrasive surfaces, blades, or embossers, or by noncontact equipment, such as lasers or other high energy radiation sources.

[0046] The term "laser engraving", as used herein, refers the use of a laser to engrave the surface of a fiber.

[0047] The term "morphological modification", as used herein, refers to a change in the physical form or condition of the fiber or the fiber surface such that the change can be observed optically, either manually or through magnification, or through other analytical techniques. Non-limiting examples of morphological modification include changes to texture, roughness, opacity, crystallinity, density, or degree of polymer orientation. Morphology modification can be performed by contact equipment, such as equipment that

uses abrasive surfaces, or by noncontact equipment such as lasers or other high energy radiation sources.

[0048] The term "vary along the length", as used herein, refers to the use of various levels and/or patterns of one or more surface markings along the length of an identification fiber. The term, "repeating patterns", as used herein, refers to a repeated identical sequence of surface makings along the length of the identification fibers. Each repeated pattern is representative of the same code of the same information.

[0049] The term "essentially not susceptible to solvent bonding", as used herein, refers to a condition such that the fibers are not, under the normal processing conditions of the fibers or the articles made from the fibers, sufficiently soluble in a bonding agent to allow for permanent bonding at the contacting points of two or more fibers when the bonding agent is present at the contact points.

[0050] The term "essentially insoluble in a solvent", as used herein, refers to a condition such that the fibers are not sufficiently soluble in a solvent such that when exposed to that solvent under a certain set of conditions, the fiber and any surface markings remain detectable.

[0051] The term "dissolved portion of the fiber sample", as used herein, refers to a solution containing the dissolved standard fibers and the dissolving solvent, to the exclusion of any non-soluble identification fibers in the sample.

[0052] The term, "cellulose acetate", as used herein, refers to an acetate ester of cellulose wherein the hydrogen in the hydroxyl groups of the cellulose glucose unit is replaced by acetyl groups through an acetylation reaction. In some embodiments, suitable cellulose acetates may have a degree of substitution less than about 3 acetyl groups per glucose unit, preferably in the range of 2.2 to about 2.8, and most preferably in the range of 2.4 to 2.7.

[0053] The terms, "cellulose acetate tow", "acetate tow", or "acetate tow band" as used herein, refers to a continuous, crimped fiber band comprising of cellulose acetate fibers.

[0054] The term, "article", as used herein, refers to a unit produced from standard fibers, yarn, and/or a fiber band, including other components and additives needed to meet the functional requirements of the intended use. Non-limiting examples include fabrics and other textile products, non-wovens, absorbent products, filters, filter rods, cigarette filters and liquid storage reservoirs. The term "article comprising fibers, yarn and/or fiber bands", as used herein, refers to the article comprising the fibers, yarn and/or fiber bands with a recognition that, in some embodiments, significant physical changes can occur to the fibers, yarn and/or fiber band, when it is used to make an article.

[0055] The term, "filter", as used herein refers to a semi-permeable fibrous material. Non-limiting examples of filters include a filter rod, and items made from a filter rod such as a cigarette filter. The term "filter rod", as used herein, refers to a rod-like article, of any cross-sectional shape, produced from a fiber band and other components or additives, which can be subsequently used as a whole unit, or cut into lengths to form multiple units, for filtration of a vapor stream. Filter rods can be used to filter tobacco products, for example, traditional cigarette filters and/or other applications for other tobacco products including heat-not-burn products. Filter rods can also be used for new products comprising tobacco and other ingredients such as, for example, other plants or plant derivatives. Filter rods can be used to filter other plants and plant derivatives, with or without tobacco present. Additionally filter rods can be used to filter any vapor stream used to deliver an active ingredient such as in e-cigarette.

[0056] The term, "cigarette filter", as used herein, refers to a component of the cigarette or other smoking device which removes or decreases one or more elements from a smoke stream. The term cigarette filter is intended to encompass the filter on any smoking device including the non-limiting examples of a cigarette, a cigarette holder, a cigar, a cigar holder, a pipe, a water pipe, a hookah, an electronic smoking device, a roll-your-own cigarette, a roll-your-own cigar, and a paper.

[0057] The term, "supply chain information" as used herein, refers to information regarding the production of the standard fibers, yarn, and/or fiber band and information regarding the distribution of the standard fibers, yarn, and/or fiber band after its production. Supply chain information includes "supply chain components" such as, for example, manufacturer, manufacture site, manufacture line, production run, production date, a package, bale, customer, customer ship-to location, warehouses, freight carrier, and/or shipment paths or routes. Supply chain components can apply to fibers, yarn, fiber bands, and/or articles.

[0058] The term, "manufacturer", as used herein, refers to the entity that produces the standard fibers, yarn and/or fiber band.

[0059] The term "manufacture site", as used herein, refers to the geographic location or locations of the manufacturer, designated by any level of specificity including full address, continent, country, state, province, county, or city.

[0060] The term "manufacture line", as used herein, refers to specific process equipment or set of equipment used by the manufacturer to produce the standard fibers, yarn, and/or fiber band.

[0061] The term "production run", as used herein, refers to a group or set of similar or related goods that are produced by using a particular set of manufacturing procedures, processes, or conditions and/or product specifications.

[0062] The term "customer", as used herein, refers to an entity to which the fibers, fiber band, and/or yarn is sold and shipped for further processing into an intermediate article or a finished product article; or an entity that purchases the fibers, yarn and/or fiber band for resale.

[0063] The term, "ship-to location", as used herein, refers to the geographic location of the customer designated for delivery of the fibers, yarn and/or, fiber band by any level of specificity including full address, continent, country, state, province, county, or city.

[0064] The term, "bale" as used herein, refers to a packaged unit of fiber bands, typically of a cubical shape, compressed to a high density, and wrapped, contained, and protected by packaging material.

[0065] The term, "warehouse" as used herein, refers to the geographical location of the warehouse designated for delivery of the fibers, yarn and/or, fiber band by any level of specificity including full address, continent, country, state, province, country, or city.

[0066] The term, "correlating", as used herein refers to establishing the relationship between two or more pieces of information.

[0067] The term, "manufacturer specific taggants", as used herein, refers to the particular taggants incorporated into fibers, yarn and/or, fiber band by a particular manufacturer. The term, "manufacturer specific taggant set" refers to the taggant cross-section shapes and/or taggant cross-section sizes associated with a particular manufacturer.

[0068] The term, "fibers are produced", "producing fibers", and "fiber production process", as used herein, refers to the process steps of spinning fibers up through the gathering of the fibers.

[0069] The term "concurrently to producing", as used herein, refers to process of surface marking identification fibers at the same time that the standard fibers are being produced, either prior to or after the identification fibers are combined with the standard fibers.

[0070] The term, "identification fibers are packaged", as used herein, refers to the process steps of transferring identification fibers from the spinning machine and packaging the identification fibers, for example, onto a spool or into a bale. The identification fibers would subsequently need to be removed from the package in order to be incorporated into fibers, yarns, fiber band, and/or article comprising the standard fibers.

[0071] The term "fiber sample", as used herein, refers to the item comprising fibers, in any physical form, being analyzed using imaging technology. The fiber sample can comprise a portion of a set of fibers, yarn, a fiber band, or an article which has been prepared for image analysis.

[0072] The terms, "imaging technology", and "image analysis techniques" as used herein, refer to the equipment and software used to detect and quantify differences in reflection, absorption, transmission, and emittance of electromagnetic radiation. Imaging technology encompasses both electromagnetic radiation level detection and automated shape and/or size recognition.

[0073] Fibers, a fiber band, and/or a yarn comprise individual fibers. The material from which the fibers are made is not particularly limiting. The fibers can comprise, for example, acrylic, modacrylic, aramid, nylon, polyester, polypropylene, rayon, or cellulose acetate. In one aspect, the fibers comprise cellulose acetates, cellulose triacetates, cellulose propionates, cellulose butyrates, cellulose acetate-propionates, cellulose acetate-butyrates, cellulose propionate-butyrates, cellulose acetate-phthalates, starch acetates, acrylonitriles, vinyl chlorides, vinyl esters, vinyl ethers, and the like, any derivative thereof, any copolymer thereof, and any combination thereof. In one aspect, the fibers comprise cellulose acetate. In one aspect, the fibers comprise natural fibers such as, for example, cotton, hemp, and/or silk.

[0074] In one aspect, the fibers, fiber band, or yarn comprises standard fibers and one or more identification fibers. Fibers are typically produced from a polymer. In one aspect, one or more of the identification fibers comprise the same polymer as the standard fibers. In another aspect, one or more of the identification fibers comprise a different polymer than the standard fibers band. In one aspect, the taggant surface markings and the repeated pattern are representative of a code of the fibers. In other aspects the fibers comprise identification fibers and standard fibers and the code is representative of at least one supply chain component of the fibers and/or standard fibers.

[0075] The size of the individual fibers is not particularly limiting. The size can be given in terms of effective diameter, and in one aspect, the effective diameter of the fibers range, for example, from 0.1 μm to 1000 μm, 1 μm to 500 μm, 1 μm to 100 μm, 1 μm to 30 μm, 10 μm to 1000 μm, 10 μm to 500 μm, 10 μm to 100 μm, 10 μm to 30 μm. In one aspect, the standard fibers

comprise cellulose acetate for which size is often given in terms of denier per filament (dpf) which is defined as the weight, in grams, of a single filament 9000 meters in length. In one aspect, the size of the fibers ranges from 0.5 to 1000 dpf; 0.5 to 500 dpf; 0.5 to 100; 0.5 to 5 dpf; 0.5 to 30 dpf; 0.5 to 10 dpf; 1 to 1000 dpf; 1 to 500 dpf; 1 to 100; 1 to 5 dpf; 1 to 30 dpf; 1 to 10 dpf. In one aspect, the dpf of the fibers ranges from, for example, 1 to 30 dpf, 1 to 20 dpf, 1 to 10 dpf, 2 to 30 dpf, 2 to 20 dpf, or 2 to 10 dpf.

[0076] The number of fibers making up a fiber band is not particularly limiting. In one aspect, the number of fibers in a fiber band can range from 10 to 50,000. In other non-limiting examples, the number of fibers in a fiber band ranges from 10 to 40,000; 10 to 30,000; 10 to 20,000; 10 to 10,000; 10 to 1000; 100 to 50,000; 100 to 40,000; 100 to 30,000; 100 to 20,000; 100 to 10,000; 100 to 1000; 200 to 50,000; 200 to 40,000; 200 to 30,000; 200 to 20,000; 200 to 10,000; 200 to 1000; 1000 to 50,000; 1000 to 40,000; 1000 to 30,000; 1000 to 20,000; 1000 to 10,000; 5000 to 50,000; 5000 to 40,000; 5000 to 30,000; 5000 to 20,000; 5000 to 10,000; 10,000 to 50,000; 10,000 to 40,000; 10,000 to 30,000; or 10,000 to 20,000.

[0077] Identification fibers can comprise one or more branded fibers. The branded fibers exhibit one or more taggant surface markings wherein the taggant surface markings form a repeated pattern along the length of the branded fibers. In one aspect, branded fibers can be a monofilament wherein the taggant surface markings form a repeated pattern along the length of the monofilament. In other aspects, the branded fibers can be a thread or yarn wherein the taggant surface markings form a repeated pattern along the length of the thread or yarn. The repeated pattern can be representative of a code which can correlate to information such as, for example, supply chain information.

[0078] In some aspects, the repeated pattern comprises an alphanumeric code, a digital code, an analog code, or an ideographic code. In some aspects, the repeated pattern comprises an alphanumeric code or a digital code. In some aspects, the repeated pattern comprises a digital code.

[0079] The repeated pattern along the length of the branded fibers may include metadata. The metadata can be useful in reading the pattern on the branded fibers. The metadata can be especially useful if the length of the branded fiber incorporated into an article is approximately the same size or smaller than the length of the repeated pattern. In one aspect, the metadata comprises read-start position, read-end position, read direction, or the spacing of the digits within the code.

[0080] The digital code of the repeated pattern is not particularly limited. In some aspects the pattern is in the form of a bar code, either a 1-D linear or 2-D matrix type code. In some aspects the pattern could be a visual representation of a Morse code. In some aspects the digital code comprises a binary code. In one aspect, the repeated pattern is essentially one-dimensional.

[0081] In one aspect, the digital code is a binary coding system, the two conditions or characters of each binary digit can be the presence or absence of a surface marking in a digit or location. In an alternative aspect, the two conditions could be one of two different surface markings in a digit. In some aspects the digital code could be a binary representation of a place-value system of base x, where x is a power of 2 (or a binary). In one aspect, for example, when large number of combinations or integer values is to be coded, a hexadecimal (base 16) numbering system can be used to provide a notation that is more compact than a simple binary string. In a non-limiting illustration of such a hexadecimal system, 4 binary digits could make up each digit of the hexadecimal code, providing the 16 combinations or conditions for each of the hexadecimal digits. Base-x numbering systems can also be represented by x-number of unique surface markings in any digit or spacial location. In a non-limiting example, 5 different color dots can form the basis of a base-5 numbering system.

[0082] Multiple numbering or coding systems may be used in a single string of encoded information. In some aspects, the repeated pattern can contain a portion of binary coding with the sequence used to represent the

manufacturer of the fiber or article and another portion of the pattern that is a binary representation of a hexadecimal system used to represent unique bale numbers of the manufacturer.

[0083] One skilled in the art recognizes that the selection of the number of digits for the binary code depends upon the complexity of information being captured and the space available for the taggant surface markings. In one aspect, the number of digits in the binary code ranges from 2 to 500. In other non-limiting examples, the number of digits in the binary code ranges from 4 to 100, 10 to 100, 20 to 100, 4 to 50, 10 to 50, or 20 to 50.

[0084] One skilled in the art also recognizes that the length of the repeated pattern on the fibers may be influenced by the length the fiber incorporated in typical articles. In one aspect, the length of the repeated pattern ranges from 2 mm to 500 mm. In other non-limiting examples, the length of the repeated pattern ranges from 2 to 200 mm, 2 to 30 mm, 10 to 200 mm, or 10 to 30 mm.

[0085] The manner in which the repeated pattern appears on the branded fiber is not particularly limited, so long as the pattern is recognizable. Non-limiting examples of how the repeated pattern is incorporated on the branded fiber include printing, engraving, morphological modifications of the fiber, or chemically producing a pattern of optical properties.

[0086] In some aspects, the fibers further comprise standard fibers. In some aspects, the branded fibers are readily separated from the standard fibers by either physical or chemical means. In order to facilitate the separation of the branded fibers, the branded fiber can comprise a different polymer than the standard fibers. In some aspects, the branded fibers are essentially insoluble in a solvent, wherein the standard fibers are soluble in that same solvent. In some aspects the branded fibers are essentially insoluble in acetone or methylene chloride. In some aspects, the branded fibers are essentially not susceptible to cold-solvent bonding with triacetin or any other solvent or plasticizer that is used to form an article by solvent-bonding the standard fibers. In some aspects, the branded fibers comprise

acrylic, modacrylic, aramid, nylon, polyester, polypropylene, rayon, polyacrylonitrile, polyethylene, cellulose triacetate, or PTFE.

[0087] An article can comprise the fibers, yarn, and/or a fiber band. The article is not particularly limited. Non-limiting examples of articles comprising the fibers or the fiber band include fabrics and other textile products, non-wovens, absorbent products, filters, filter rods, cigarette filters, liquid storage reservoirs, paper and/or currency. In one aspect, the article comprises a filter rod. In another aspect, the article comprises a cigarette filter. Additional non-limited examples of articles include medical items such as medical tape, bandages, or cloth, wicking devices used for vapor delivery, and pharmaceutical products including packaging.

[0088] In one aspect, the fibers, yarn, fiber band, and/or article have determinable supply chain information. The supply chain information can include manufacturer, manufacture site, manufacturing line, production run, production date, package, bale, warehouse, customer, and/or ship-to location.

[0089] In one aspect, the supply chain information comprises supply chain components. In one aspect, at least one supply chain component comprises a manufacturer of the standard fibers, a manufacture site of the standard fibers, a manufacturing line of the standard fibers, a production run of the standard fibers, a production date of the standard fibers, a package of the standard fibers, a warehouse of the standard fibers, a customer of the standard fibers, a ship-to location of the standard fibers, a manufacturer of a yarn or fiber band comprising the standard fibers, a manufacturing site of the yarn or fiber band, a manufacturing line of the yarn or fiber band, a production run of the yarn or fiber band, a production date of the yarn or fiber band, a package of the yarn or fiber band, a warehouse of the yarn or fiber band, a customer of the yarn or fiber band, a ship-to location of the yarn or fiber band, a manufacturer of an article comprising the standard fibers, a manufacture site of the article, a manufacturing line of the article, a production run of the article, a production date of the article, a package of the article, a warehouse of the article, a customer of the article, or a ship-to location of the article.

[0090] In another aspect at least one supply chain component comprises the manufacturer of the yarn or fiber band. In one aspect, the supply chain component comprises the manufacture site of the yarn or fiber band. In one aspect the supply chain component comprises the manufacturing line of the yarn or fiber band. The manufacturing line of the yarn or fiber band is the manufacturing line on which the yarn or fiber band was produced. In one aspect, the supply chain component comprises the production run of the yarn or fiber band. The production run of the yarn or fiber band is the production run within which the yarn or fiber band was produced. In one aspect, the supply chain component comprises the production date of the yarn or fiber band. The production date of the yarn or fiber band is the production date on which the yarn or fiber band was produced. In one aspect, the supply chain component comprises the package of the yarn or bale of the fiber band. In one aspect, the supply chain component comprises the warehouse of the yarn or fiber band. The warehouse of the yarn or fiber band is the warehouse to which the manufacturer plans to send or has sent the fiber band. In one aspect, the supply chain component comprises the customer of the yarn or fiber band. The customer of the yarn or fiber band is the customer to whom the manufacturer plans to send or has sent the yarn or fiber band. In one aspect, the supply chain component comprises the ship-to location of the yarn or fiber band. The ship-to location of the yarn or fiber band is the specific geographic location to which the manufacturer plans to send or has sent the yarn or fiber band.

[0091] The following is a non-limiting illustration of a possible binary coding system that demonstrates the ability to create many different code combinations on the branded fiber contained within a typical cigarette filter.

[0092] In the work of Example 1 below, the length of the crimped monofilament fiber or thread within a typical 21mm length cigarette filter was shown to be approximately 25.2mm. In addition, a spacing of printed marks of 0.5mm was shown to be readily achievable using the printer of the example. Such a spacing applied to a 25 mm fiber length would allow up to

50 bits or digits to be encoded on the branded fiber within each cigarette filter. Each bit would contain binary-type (0 or 1) information corresponding to existence or non-existence of a printed mark within the space.

[0093] In order to eliminate translational and rotational decoding errors in decoding, metadata in the form of a header may be desired with the coded sequence. The header could provide read start and read direction information. Such a header would allow for the reliable decoding of any one cigarette filter with a coding frequency as low as one code per cigarette filter. The header could take the form of a binary sequence designed such that it could not be confused with the characters of the code itself. For example, for a hexadecimal system in binary notation, the 10 bit sequence 0011111010 might be used.

[0094] Of the remaining 40 bits of the 50 bits available of this example, 39 bits could be used to express 8 hexadecimal characters in binary (8 x 4 digits, plus spaces between each 4-digit character) to encode a sequence that would take the form (####_####_####_####_####_####_####_####). With this format, 4,294,967,296 unique codes could be generated or, by using standard binary numbering, the numbers 0 to 4,294,967,295 could be generated. These codes or numbers could be correlated to supply chain information, such as bale numbers.

[0095] To further illustrate the example, the number 4,294,967,295 would be converted to its hexadecimal binary form 11110111101111011110111101111011101111. The complete code, including the header, would be 00111110101111011110111101111011110111101111011101111.

[0096] The current world-wide demand for acetate tow for cigarette filtration is approximately 700,000,000 kg per year. Assuming an average bale weight of 500 kg, the total number of bales produced in one year is approximately 1.4M. The implementation of a printed coding system of this example could therefore encode supply chain information at the bale level for over 3000 years' worth of production. In some aspects, fewer digits are used in each

code and typical cigarette filters contain more than one repeat pattern of taggant surface markings.

[0097] Additional disclosed embodiments include an acetate tow band comprising fibers. The fibers comprise one or more identification fibers and standard fibers and the standard fibers comprise cellulose acetate. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The taggant surface markings and the repeated pattern are representative of at least one supply chain component of the acetate tow band.

[0098] Embodiments of an acetate tow band encompass acetate tow bands comprising fibers with any combination of attributes disclosed above. Specifically, the identification fiber composition, the sizes and numbers of fibers, the branded fibers, the surface markings, the repeated patterns, the length of the repeated patterns, the supply chain information, and the non-limiting coding/correlation systems apply to the acetate tow band.

[0099] In one aspect, the at least one supply chain component comprises a manufacturer of the acetate tow band, a manufacturing site of the acetate tow band, a manufacturing line of the acetate tow band, a production run of the acetate tow band, a production date of the acetate tow band, a bale of the acetate tow band, a warehouse of the acetate tow band, a customer of the acetate tow band, or a ship-to location of the acetate tow band. In one aspect, the at least one supply chain component comprises the manufacturer of the acetate tow band and the customer of the acetate tow band. In another aspect, the least one supply chain component comprises the manufacturer of the acetate tow band and the customer of the acetate tow band. In one aspect, the at least one supply chain component comprises the bale of the acetate tow band.

[00100] Further embodiments encompass methods of making an acetate tow band comprising fibers. The fibers comprise standard fibers and identification fibers and the standard fibers comprise cellulose acetate. The method comprises: (a) obtaining the identification fibers; (b) producing the standard fibers on a first fiber production process; and (c) combining the identification fibers and the standard fibers into the acetate tow band. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The taggant surface markings and the repeated pattern are representative of at least one supply chain component of the acetate tow band.

[00101] Embodiments of a method of making an acetate tow band encompass acetate tow bands comprising fibers with any combination of attributes disclosed above. Specifically, the identification fiber composition, the sizes and numbers of fibers, the branded fibers, the surface markings, the repeated patterns, the length of the repeated patterns, the supply chain information, and the non-limiting coding/correlation systems apply to the method of making the acetate tow band. The supply chain attributes of embodiments of the acetate tow band described above also applied to the method of making the acetate tow band.

[00102] One skilled in the art recognizes that the embodiments of method of making an acetate tow band, apply generally to making a fiber band or yarn. The identification fibers can be combined with standard fibers into a yarn or fiber band. The method for making a yarn or fiber band encompasses making fibers, a fiber band, or yarn comprising the fibers with any combination of attributes disclosed above.

[00103] In one aspect, at least a portion of the standard fibers are produced on a fiber production process. In another aspect, standard fibers are received from a third party. Obtaining the identification fibers comprises at least one of

(i) producing at least a portion of the identification fibers on the standard fibers' fiber production process, (ii) producing at least a portion of the identification fibers on a process distinct from the standard fibers' fiber production process, or (iii) receiving at least a portion of the identification fibers from a third party.

[00104] In one aspect, a portion of the identification fibers are coproduced with the standard fibers and a portion of the fibers making up a fiber band or yarn are spun and combined directly downstream of the fiber production process.

[00105] When and where the identification fibers are surface marked is not particularly limiting. If the identification and standard fibers are made concurrently on the same spinning equipment, the surface markings can be applied anywhere between the start of the spinning process when the fiber is first physically formed and prior to the packaging of the fibers. In some aspects, the marking can be performed prior to the identification fibers and standard fibers being combined or, at least, prior to subsequent processing of the combined fibers, such as prior to crimping. In some aspects, the branded fibers are produced separately from the standard fibers on a separate spinning process, the surface markings can be applied at any time prior to their combining with the standard fibers, including by a third party, or concurrent with their combining with the standard fibers. In some aspects, the marking can take place just prior to the combining or at any point before the packaging of the fibers.

[00106] Non-limiting examples of methods of surface marking the identification fibers include printing, engraving, morphological modification, and chemically producing a pattern of optical properties. In some aspects, the printing of the surface markings could be performed using a commercial high-speed printer, such as an ink-jet printer, or a custom printer designed for purpose. The printing can be performed with a single ink of one color or with multiple ink colors. In some aspects, engraving could be performed by contact equipment, such as equipment that uses abrasive surfaces, blades, or

embossing rollers, or by noncontact equipment, such as lasers or other high energy radiation sources. In some aspects a morphology modification can be performed by contact equipment, such as equipment that uses abrasive surfaces, or by noncontact equipment such as lasers or other high energy radiation sources. One non-limiting example of such a morphology change is the use of an energy source to induce intermittent fast drying of the fiber during its formation resulting in variations in optical properties of the fiber, such as opacity, or variations in surface roughness.

[00107] In some aspects branded fibers are produced on a second fiber production process followed by applying the taggant surface markings in the repeated pattern. In some aspects, fibers are received from a third party. The taggant surface markings in the repeated pattern can be applied to the fibers to produce branded fibers any time before the branded fibers are combined with the standard fibers into an acetate tow band. The manner in which the taggant surface markings in the repeated pattern is applied to the branded fibers is not particularly limited. In some aspects the taggant surface markings in the repeated pattern are printed on the branded fibers concurrently to producing the standard fibers. In some aspects the taggant surface markings in the repeated pattern are laser engraved on the branded fibers concurrently to producing the standard fibers. In some aspects the concurrently produced branded fibers and the standard fibers are combined prior to crimping the acetate tow band.

[00108] Whether the identification fibers and standard fibers are made on the same or different equipment, the marking of the identification fibers concurrent with the production of (or the combining with) the standard fibers the can be advantageous as it reduces complexity of managing and inventorying of pre-marked fibers and routing those branded fibers to designated production lines at the right time to ensure proper coding of the fiber product. In contrast, concurrent marking of the identification fibers can be readily controlled by standard computer systems (e.g., a PLC or a DCS),

with the coding changed automatically and essentially instantaneously to code the desired supply chain information for the fiber being produced.

[00109] In another aspect, the identification fibers are produced and packaged separately from the standard fibers and the identification fibers are combined with the standard fibers to produce a fiber band or yarn. The standard fibers may also have been packaged before combining with the identification fibers, or the identification fibers may be combined with the standard fibers before packaging of the fiber band or yarn.

[00110] The spinning process used for producing the fibers is not particularly limited. In one aspect, the fibers are produced using dry spinning, solution spinning, melt spinning, electro spinning, gel spinning, multicomponent spinning, melt blowing, and/or solution blowing. In another aspect, the fibers are produced using dry spinning, solution spinning, melt spinning, electro spinning, gel spinning, and/or multicomponent spinning. In a further aspect, the standard fibers comprise cellulose acetate and are produced using dry spinning.

[00111] In some aspects the taggant surface markings in the repeated pattern are applied by process comprising engraving, printing, or morphological modification. In some aspects, the taggant surface markings in the repeated pattern are applied by process comprising printing the taggant surface markings in the repeated pattern on the branded fibers concurrently to producing the standard fibers and combining the branded fibers and the standard fibers before crimping the acetate tow band. In yet additional aspects, the taggant surface markings in the repeated pattern are applied by process comprising laser engraving the taggant surface markings in the repeated pattern on the branded fibers concurrently to producing the standard fibers and combining the branded fibers and the standard fibers before crimping the acetate tow band.

[00112] Figure 1 shows a schematic process flow diagram of a non-limiting embodiment of branding fibers while coproducing acetate tow fibers and combining them into an acetate tow band. Acetate tow band 112 is produced

in manufacturing environment 100. Cellulose acetate spinning solution 102 is fed to fiber spinning process 120 where it is fed to several spinning cabinets, each with several spinnerets (not shown). The fibers 108 exiting each spinning cabinet, often called ends, are gathered together to form a band which is fed into a crimper 130. Identification fiber 104 passes under marking device 110 which imparts surface markings in a repeated pattern to produce branded fiber 106. Non-limiting examples of marking device 110 include a printer and a laser. Branded fiber 106 and cellulose acetate fibers 108 are gathered together and fed to crimper 130 to produced crimped acetate tow band 112.

[00113] Yet additional embodiments encompass methods of characterizing a fiber sample. The fiber sample comprises fibers and the fibers comprise standard fibers and identification fibers. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The method comprises applying imaging technology to the branded fibers and determining the repeated pattern of the taggant surface markings. The taggant surface markings and the repeated pattern are representative of at least one supply chain component of the fiber sample.

[00114] Yet additional embodiments encompass methods of characterizing a fiber sample. The fiber sample comprises fibers and the fibers comprise standard fibers and identification fibers. Each of the identification fibers exhibits at least one distinct feature. The identification fibers comprise one or more branded fibers. The branded fibers exhibit the distinct features comprising one or more taggant surface markings. The taggant surface markings form a repeated pattern along a length of the branded fibers. The method comprises (1) optionally separating the branded fibers from the fiber sample; (2) applying imaging technology to the branded fibers; (3) determining the repeated pattern of the taggant surface markings. The

taggant surface markings and the repeated pattern are representative of at least one supply chain component of the fiber sample.

[00115] Embodiments of methods of characterizing a fiber sample encompass characterizing a fiber sample comprising fibers with any combination of attributes disclosed above. Specifically, the identification fiber composition, the sizes and numbers of fibers, the branded fibers, the surface markings, the repeated patterns, the length of the repeated patterns, the supply chain information, and the non-limiting coding/correlation systems apply to the method of characterizing a fiber sample.

[00116] The process of separating the branded fibers from the standard fibers of an article for the purpose of characterizing the branded fibers can depend on the nature of the article, the orientation, entanglement, and bonding of the fibers within the article, and the differences in the chemical composition of standard and branded fibers. In the case of a typical cigarette filter or similarly solvent-bonded fiber matts, in some aspects, the branded fibers are not susceptible to the solvent bonding agent used in the manufacture of the article, the branded fibers can be located (with or without magnification) and removed by hand or some other means to physically segregate the branded fibers from the rest of the fiber sample. In some aspects, the branded fibers have a solubility profile different from the standard fibers and the standard fibers can be dissolved away from the branded fibers with the use of the right combination of solvents and/or conditions. In some aspects, cigarette filters comprise cellulose acetate and the branded fibers comprise a polymer that is not soluble in acetone such that acetone can be used to dissolve away the standard fibers and segregate the branded fibers. In some aspects, separating the branded fibers from the fiber sample comprises placing the fiber sample in a solvent to produce a solution comprising a dissolved portion of the fiber sample and the branded fibers and removing the branded fibers from the solution.

[00117] In one aspect the standard fibers comprise cellulose acetate and the fiber sample comprises a portion of an article comprising the fibers. In some

aspects the article can be selected from the group consisting of a filter rod and a cigarette filter. In other aspects, the fiber sample comprises a portion of an article comprising the fibers, wherein the article is selected from the group consisting of fabrics and other textile products, non-wovens, and absorbent products.

[00118] In one aspect, the imaging technology comprises the use of electromagnetic radiation at visible wavelengths. In another aspect, the image technology comprises the use of electromagnetic radiation at invisible wavelengths. The equipment useful for imaging technology is not particularly limited. Non-limiting examples include human visual inspection, microscopy, electron microscopy, confocal microscopy, and optical scanning.

[00119] The imaging technology can be applied to the fiber sample parallel to the length of the fibers. This direction allows, for example, a view of a pattern of surface markings on the fibers.

[00120] The imaging technology may also be applied to the article comprising the fibers, fiber band, or yarn.

[00121] In one aspect, the method for characterizing the fiber sample further comprises (a) correlating the taggant surface markings and/or the repeated pattern of the taggant surface markings to a database comprising manufacturer-specific taggants; and (b) determining at least one supply chain component of the fiber sample. The supply chain component comprises a manufacturer of the standard fibers, a manufacture site of the standard fibers, a manufacturing line of the standard fibers, a production run of the standard fibers, a production date of the standard fibers, a package of the standard fibers, a warehouse of the standard fibers, a customer of the standard fibers, a ship-to location of the standard fibers, a manufacturer of a yarn or fiber band comprising the fibers, a manufacturing site of the yarn or fiber band, a manufacturing line of the yarn or fiber band, a production run of the yarn or fiber band, a production date of the yarn or fiber band, a package of the yarn or fiber band, a warehouse of the yarn or fiber band, a customer of the yarn or fiber band, a ship-to location of the yarn or fiber band, a manufacturer of an

article comprising the fibers, a manufacture site of the article, a manufacturing line of the article, a production run of the article, a production date of the article, a package of the article, a warehouse of the article, a customer of the article, or a ship-to location of the article. In one aspect the correlating is among the distinct features and/or the combinations of distinct features. In another aspect, the correlating is among the distinct features, the combinations of distinct features, and/or the total number of each of the distinguishable identification fibers. In another aspect, the correlating is among the distinct features, the combinations of distinct features, the total number of each of the distinguishable identification fibers, and/or the taggant total identification fiber number. In one aspect, at least one supply chain component comprises a manufacturer of a yarn comprising the fibers, a manufacturing site of the yarn, a manufacturing line of the yarn, a production run of the yarn, a production date of the yarn, a package of the yarn, a warehouse of the yarn, a customer of the yarn, a ship-to location of the yarn.

[00122] In one aspect, the supply chain information comprises the manufacturer of the yarn or fiber band. In one aspect, the supply chain information comprises the manufacture site of the yarn or fiber band. In one aspect the supply chain information comprises the manufacturing line of the yarn or fiber band. The manufacturing line of the yarn or fiber band is the manufacturing line on which the yarn or fiber band was produced. In one aspect, the supply chain information comprises the production run of the yarn or fiber band. The production run of the yarn or fiber band is the production run within which the yarn or fiber band was produced. In one aspect, the supply chain information comprises the production date of the yarn or fiber band. The production date of the yarn or fiber band is the production date on which the yarn or fiber band was produced. In one aspect, the supply chain information comprises the bale of the yarn or fiber band. In one aspect, the supply chain information comprises the customer of the yarn or fiber band. The customer of the yarn or fiber band is the customer to whom the manufacturer plans to send or has sent the yarn or fiber band. In one aspect,

the supply chain information comprises the ship-to location of the yarn or fiber band. The ship-to location of the yarn or fiber band is the specific geographic location to which the manufacturer plans to send or has sent the yarn or fiber band.

[00123] In one aspect, the fiber sample comprises a portion of a filter, comprising an acetate tow band, wherein the method further comprises correlating the repeated pattern of taggant surface markings to a database comprising manufacturing specific taggants, and wherein the at least one supply chain component comprises a bale of the acetate tow band.

[00124] The disclosed embodiments also include making an article with fibers, a fiber band, and/or yarn having any of the disclosed features. The disclosed embodiments also include characterizing an article comprising a fibers, fiber band, or yarn having any of the disclosed features.

[00125] FIGURES 5A and 5B illustrate non-limiting examples of an environment 500 depicting communication and shipping channels among entities consistent with disclosed embodiments. In one embodiment, environment 500 of FIGURES 5A and 5B may include one or more manufacturers 510, one or more customers 520, a black market 540 or other illicit trade network, one or more requesting parties 530, one or more laboratories 560, and communication network 550. The components and arrangement of the components included in environment 500 (e.g., as illustrated in FIGURES 5A and 5B) may vary. Thus, environment 500 may include other components that perform or assist in the performance of one or more processes consistent with the disclosed embodiments.

[00126] In some aspects, network 550 may be any type of network configured to provide communication means between systems of components of environment 500 (e.g., manufacturing system 512 and/or laboratory system 562). For example, network 550 may be any type of network (including infrastructure) that facilitates communications, exchanges information, etc., such as the Internet, a Local Area Network, near field communication, and/or other suitable connection(s) that enables the sending and receiving of

information between the components systems associated with environment 500. In other embodiments, one or more component systems of environment 500 may communicate directly through a dedicated communication link(s), such as links between manufacturer 510, customer 520, requesting party 530, and/or laboratory 560.

[00127] Further, and as stated above, manufacturers (e.g., manufacturer 510) may produce cellulose acetate fibers and fiber products that incorporate the cellulose acetate fibers on an industrial scale. In some embodiments, the produced cellulose acetate fibers and fiber products may include standard fibers and identification fibers. Each of the identification fibers exhibits one or more distinct features (e.g., distinct cross-section sizes, distinct cross-section shapes, distinct optical properties, and additionally or alternatively, distinct surface markings.) that visually distinguish the identification fibers from the standard fibers. In some aspect, one or more of the distinct surface markings may represent a taggant surface markings, and the identification fibers may include one or more branded fibers that exhibit one or more of the taggant surface markings. The taggant surface markings exhibited by the branded fibers may, in certain aspects, form a repeated pattern disposed along the length of the branded fibers. The repeated pattern may, for example, be representative of at least one supply chain component associated with the standard fibers, the identification fibers, and/or fibers and fiber products that include the standard and/or identification fibers.

[00128] In other aspects, the repeated pattern may be representative of a code associated with the identification fibers and/or the standard fibers (e.g., an alphanumeric code, a digital code, an analog code, and/or an ideographic code, as described above). In some embodiments, portion of the code may be representative of at least one supply chain component associated with the standard fibers, the identification fibers, and/or fibers and fiber products that include the standard and/or identification fibers.

[00129] In some embodiments, the inclusion of identification fibers in the cellulose acetate fibers may enable manufacturer 510 to tag the cellulose

acetate fibers, and thus, the fiber products that include the cellulose acetate fibers, with supply chain information prior to shipment to customers 520. By way of example, fiber products consistent with the disclosed embodiments may include, but are not limited to, cellulose acetate tow, loose bands of cellulose acetate tow, bales of cellulose acetate tow, and fabrics and other articles that include the cellulose acetate fibers and/or tow.

[00130] For example, and in the context of cigarette manufacturing, customer 520 may use a bale of acetate tow to produce various intermediate and/or final stage products (e.g., loose tow band, filter rods, filters, and/or cigarettes) and a fraction of these products can ultimately find their way onto the black market (e.g., black market 440). Thus, because supply chain information can be determined from a sample of any black market product having tagged identification fibers, a party interested in combating illicit trade (e.g., requesting party 530) may obtain a black market product and submit a sample for analysis in order to identify supply chain information associated with the black market product.

[00131] Thus, in one embodiment, requesting party 530 may provide the sample to manufacturer 510, as depicted in FIGURE 5A. Manufacturer 510 may, in certain aspects, analyze the sample using any of the exemplary techniques outlined above to identify at least one component of a supply chain associated with the sample. For example, the sample may include standard and identification fibers, which may include branded fibers exhibiting one or more taggant surface markings that form a repeated pattern along a length of the branded fibers. Based on the analysis, manufacturer 510 may identify, within the identification fibers, the one or more branded fibers that exhibit the one or more taggant surface markings. Manufacturer 510 may also identify the repeated pattern formed by the taggant surface markings along the length of the branded fibers (e.g., through an application of an imaging technology to the branded fibers, as described above).

[00132] In certain aspects, manufacturer 510 may access correlation data mapping components of the supply chain to the exhibited taggant surface

markings and additionally or alternatively, to the identified repeated pattern formed by the taggant surface markings along the length of the branded fibers. Manufacturer 510 may identify the at least one component of the supply chain based on, for example, a comparison of the exhibited taggant surface markings and/or the identified repeated pattern to the accessed correlation data. In some instances, manufacturer 510 may transmit information identifying the at least one supply chain component to requesting party 530 (e.g., across network 550).

[00133] In the exemplary embodiments described above, manufacturer 510 may analyze the sample to identify at least one component of a supply chain associated with the sample. The disclosed embodiments are, however, not limited to exemplary analyses conducted by manufacturer 510, and in further embodiments, customer 520, requesting party 530, or a third-party (not shown) may conduct the analysis for identifying supply chain information from tagged fibers.

[00134] For example, as illustrated in FIGURE 5B, a laboratory 560 may act on behalf of requesting party 530 and perform the analysis on the sample to identify the at least one supply chain component associated with the sample. In some instances, laboratory 560 may represent a governmental entity, a quasi-governmental entity, or a private entity capable of performing the analysis, and requesting party 530 may contract with or retain laboratory 560 to perform the analysis on a one-time or recurring basis.

[00135] In other instances, however, laboratory 560 may be established by one of more of manufacturer 510, customers 520, and/or requesting party 530 in order to regularly and reliably identify supply chain components associated with samples taken from illicitly traded cellulose acetate fibers or fiber products that incorporate the cellulose acetate fibers (e.g., as obtained by requesting party 530 from black market 540). Laboratory 560 may, in certain aspects, perform the analysis of the sample in accordance with one or more procedures established by a manufacturer 510, customers 520, and/or requesting party 530. For example, one or more of manufacturer 510,

customers 520, and/or requesting party 530 may collectively establish standardized procedures and protocols for receiving and handling samples, analyzing the samples to identify the supply chain components in an accurate and repeatable manner, and reporting portions of the identified supply chain components to manufacturer 510, customers 520, and/or requesting party 530. Further, in additional embodiments, laboratory 560 may also assign the taggant surface markings, repeated patterns formed by taggant surface markings, and/or portions of the codes represented by the repeated patterns to various components of the supply chain (e.g., manufacturers) to uniquely identify these supply chain components. In further embodiments, customer 520, requesting party 530, or a third-party (not shown) may assign the taggant surface markings, repeated patterns formed by taggant surface markings, and/or portions of the codes represented by the repeated patterns to various components of the supply chain (e.g., manufacturers) to uniquely identify these supply chain components.

[00136] In one embodiment, as illustrated in FIGURE 5B, requesting party 530 may provide the sample to laboratory 560. Laboratory 560 may, in certain aspects, analyze the sample to identify at least one component of a supply chain associated with the sample (e.g., a manufacturer). For example, using any of exemplary techniques described above, laboratory 560 may analyze the sample to identify the identification fibers that exhibit one of more distinct features, including, for example, one or more branding fibers that exhibit one or more taggant surface markings. Laboratory 560 may further identify one or more repeated patterns formed by the taggant surface markings along the length of the branded fibers. Further, laboratory 560 may access correlation data, and using any of the exemplary techniques described above, identify the at least one supply chain component based on a comparison of the exhibited taggant surface markings and the identified repeated patterns to the accessed correlation data.

[00137] In additional embodiments, laboratory 560 may function as a centralized facility that assigns unique taggant surface markings, unique

repeated patterns, and unique codes (or portions of codes) represented by the repeated patterns to various components of the supply chain (e.g., to manufacturer 510). For example, laboratory 560 may assign, to manufacturer 510, a taggant surface marking, a repeated pattern formed by the assigned taggant surface marking, and/or a portion of a code represented by the assigned repeated pattern.

[00138] When exhibited by branded fibers included within cellulose acetate fibers and corresponding fiber products produced by manufacturer 510, the assigned taggant surface marking, assigned repeated pattern, and/or assigned code portion may uniquely represent manufacturer 510 and may enable laboratory 560 (and additionally or alternatively, any other entity within environment 500) to identify manufacturer 510 as a source of the fibers or fiber products using any of the analytical techniques described above. Further, laboratory 560 (and additionally or alternatively, any other entity within environment 500) may also establish and maintain data records (e.g., within a centralized database implemented using the exemplary computing systems outlined below) that identify a correlation between the various supply chain components (e.g., manufacturer 510) and corresponding ones of the assigned taggant surface markings, repeated patterns, and/or code and code portions .

[00139] The disclosed embodiments are, however, not limited to the assignment of exemplary taggant surface markings, exemplary repeated patterns, and/or exemplary code and code portions to manufacturer 510. In further embodiments, laboratory 560 may assign any additional or alternate taggant information, and further, any additional or alternate set or combinations of sets of taggant surface markings, repeated patterns, and/or code and code portions to uniquely identify manufacturer 510.

[00140] In certain aspects, laboratory 560 may establish a centralized repository for data and data records (e.g., using any of the exemplary computing systems outlined below) that correlate the various supply chain components (e.g., manufacturer 510) to corresponding ones of taggant

surface markings, repeated patterns formed by taggant surface markings, and/or codes and code portions represented by the repeated patterns. Further, in other aspects, laboratory 560 may access the centralized repository and generate one or more reports specifying the taggant surface markings, repeated patterns formed by the taggant surface markings, and/or codes represented by the repeated patterns that uniquely identify at least one of the supply chain components (e.g., manufacturers). Laboratory 560 may, in some instances, generate the reports at predetermined intervals or in response to received requests (e.g., from requesting party 530, manufacturer 510, etc.), and may provide the generated reports to various parties and entities within environment 500 (e.g., across network 550).

[00141] In some embodiments, laboratory 560 may access the centralized repository to identify at least one supply chain component (e.g., manufacturer 510) associated with taggant surface markings and/or a repeated patterns formed by the taggant surface markings determined by laboratory 560 (e.g., using any of the analytical techniques outlined above) and additionally or alternatively, obtained from any third party or other entity within environment 500. Further, and as described below, the centralized repository may enable laboratory 560 to determine whether proposed taggant surface markings, proposed repeated patterns capable of being formed by the taggant surface markings, and/or proposed codes representable by the repeated patterns (e.g., as selected by manufacturer 510) are capable of uniquely representing fibers and fiber products of manufacturer 510 that are introduced into the supply chain.

[00142] In certain embodiments, laboratory 560 may receive one or more proposed taggant surface markings, a proposed repeated pattern, and/or a proposed code (or code portion) representable by the proposed repeated pattern from manufacturer 510. Laboratory 560 may, for example, compare the proposed taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) against the established data records (e.g., within the centralized repository) to determine whether these the proposed

taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) are capable of uniquely identifying manufacturer 510 (e.g., the proposed taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) are assigned to no other supply chain components, such as another manufacturer). If the proposed taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) could uniquely represent manufacturer 510, laboratory 560 may assign the proposed taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) to manufacturer 510, update the data records to reflect the assignment, and provide confirmation of the assignment to manufacturer 510 (e.g., between computing systems of laboratory 560 and manufacturer 510 across network 550).

[00143] Alternatively, if laboratory 560 previously assigned the proposed taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) to another manufacturer (or the proposed taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) are inappropriate to represent manufacturer 510), laboratory 560 may assign one or more alternate taggant surface markings, an alternate repeated pattern, and/or an alternate code (or code portion) representable by the alternate repeated pattern to manufacturer 510, update the data records to reflect the alternate assignment, and provide confirmation of the alternate assignment to manufacturer 510. In other aspects, laboratory 560 could provide, to manufacturer 510, an indication of the assignment of the proposed taggant surface markings, proposed repeated pattern, and/or proposed code (or code portion) to another manufacturer, and request that manufacturer 510 propose one or more additional taggant surface markings, an additional repeated pattern, and/or an additional code (or code portion) representable by the additional repeated pattern for assignment by laboratory 560, as described above.

[00144] In certain aspects, upon confirmation of the assignment, manufacturer 510 may obtain and/or produce branded fibers exhibiting the

assigned taggant surface markings, which form the assigned repeated pattern, and which represent the assigned code and/or code portion. In other aspects, however, manufacturer 510 may further correlate the assigned taggant surface markings, the assigned repeated patterns, and/or the assigned code (or code portion) represented by the assigned repeated patterns to one or more upstream components of the supply chain (e.g., a manufacture site, a manufacturing line, a production run, a production date, a bale) and/or various downstream components of the supply chain (e.g., a warehouse, a customer, a ship-to location, etc.). For example, manufacturer 510 may further specify that additional code or code portions associated with the assigned repeated pattern (i.e., code portions distinct from those representing manufacturer 510) uniquely represent a particular customer within the supply chain (e.g., customer 520) or a particular bale produced and shipped by manufacturer 510.

[00145] The disclosed embodiments are, however, not limited to techniques that enable manufacturer 510 to correlate customer 520 and/or a particular bale to the assigned taggant surface markings, the assigned repeated patterns, and/or the assigned code (or code portion) represented by the assigned repeated patterns. In further embodiments, manufacturer 510 may specify any additional or alternate taggant information (e.g., distinct features, combinations of distinct features, etc.) to represent other upstream or downstream supply components (or combinations thereof) in conjunction with the assigned taggant surface markings, the assigned repeated patterns, and/or the assigned code (or code portion) represented by the assigned repeated patterns.

[00146] In some aspects, while laboratory 560, or another entity, may maintain information linking manufacturer 510 to assigned taggant surface markings, the assigned repeated patterns, and/or the assigned code (or code portion) represented by the assigned repeated patterns, manufacturer 510 may hold confidential additional taggant information (e.g., distinct features, combinations of distinct features, non-assigned code portions, etc.) that links

identification fibers, and thus fiber products produced by manufacturer 510, to other upstream and downstream components of the supply chain. The confidentiality of the additional taggant information may, in certain instances, enable manufacturer 510 to prevent laboratory 560 from identifying customers (e.g., customer 520), ship-to locations, warehouses, and other internal supply chain components (e.g., manufacture site or line, and production run or date) associated with manufacturer 510.

[00147] The embodiments described above identify particular combinations of taggant information that correlate to a specific component of a supply chain and, when exhibited in identification fibers of a sample, enable a laboratory, a manufacturer, or other entities to identify the specific supply chain component associated with the sample. One of ordinary skill in the art would, however, understand that the disclosed embodiments are not limited to the particular combinations or taggant information outlined above, and in further embodiments, specific supply chain components may be correlated with any additional or alternate physical, chemical, and/or optical characteristic exhibited by the identification fibers, which include, but are not limited to, distinct features, and/or combinations of distinct features. Moreover, while not depicted in FIGURES 5A and 5B, one of skill in the art would understand that entities associated with environment 500 (shown and not shown) may employ one or more warehouses to store raw materials, intermediate products, final stage products, etc. in conducting operations consistent with disclosed embodiments.

[00148] Further, the disclosed embodiments are, however, not limited to the assignment of taggant surface markings, repeated patterns, and/or codes and code portions to various components of the supply chain (e.g., manufacturers). In further embodiments, manufacturer 510, laboratory 560, customers 520, requesting party 530, or a third-party (not shown) may assign other taggant information to the various components of the supply chain, which include, but are not limited to, distinct features, and/or combinations of distinct features.

[00149] FIGURE 6 illustrates a non-limiting example of a computing system 600 used by one or more entities consistent with disclosed embodiments. Variations of exemplary system 600 may be used by manufacturer 510 (e.g., as manufacturer system 512), customer 520, requesting party 530, and/or laboratory 560 (e.g., as laboratory system 562). In one embodiment, system 600 may comprise one or more processors 621, one or more input/output (I/O) devices 622, and one or more memories 623. In some embodiments, system 600 may take the form of a server, mainframe computer, or any combination of these components. In some embodiments, system 600 may take the form of a mobile computing device such as a smartphone, tablet, laptop computer, or any combination of these components. Alternatively, system 600 may be configured as a particular apparatus, embedded system, dedicated circuit, and the like based on the storage, execution, and/or implementation of the software instructions that perform one or more operations consistent with the disclosed embodiments.

[00150] Processor 621 may include one or more known processing devices, such as mobile device microprocessors or any various other processors. The disclosed embodiments are not limited to any type of processor(s) configured in system 600.

[00151] Memory 623 may include one or more storage devices configured to store instructions used by processor 624 to perform functions related to the disclosed embodiments. For example, memory 623 may be configured with one or more software instructions, such as program(s) 624 that may perform one or more operations consistent with disclosed embodiments when executed by processor 621. The disclosed embodiments are not limited to separate programs or computers configured to perform dedicated tasks. For example, memory 623 may include a single program 624 that performs the functions of system 600, or program 624 may comprise multiple programs. Memory 623 may also store data 625 that is used by one or more programs 612, such as correlation data mapping distinct features to one or more components of the supply chain information.

[00152] I/O devices 622 may be one or more devices configured to allow data to be received and/or transmitted by system 600. I/O devices 622 may include one or more digital and/or analog devices that allow components of environment 500 to communicate with other machines and devices, such as other components of environment 500. For example, I/O devices 622 may include a screen for displaying messages, distinct feature information, supply chain information, or providing other information to the user, such as an employee of manufacturer 510, customer 520, requesting party 530, and/or laboratory 560. I/O devices 622 may also include one or more digital and/or analog devices that allow a user to interact with system 600 such as a touch-sensitive area, keyboard, buttons, or microphones. I/O devices 622 may also include other components known in the art for interacting with a user.

[00153] The components of system 600 may be implemented in hardware, software, or a combination of both hardware and software, as will be apparent to those skilled in the art. For example, although one or more components of system 600 may be implemented as computer processing instructions, all or a portion of the functionality of system 600 may be implemented instead in dedicated electronics hardware.

[00154] System 600 may also be communicatively connected to one or more database(s) 627. System 600 may be communicatively connected to database(s) 627 through network 550. Database 627 may include one or more memory devices that store information and are accessed and/or managed through system 600. By way of example, database(s) 627 may include Oracle™ databases, Sybase™ databases, or other relational databases or non-relational databases, such as Hadoop sequence files, HBase, or Cassandra.

[00155] The databases or other files may include, for example, data and information related to distinct features, supply chain information, correlation data mapping the distinct features (e.g., taggant surface marking(s)), repeated pattern(s) formed by taggant surface markings, and/or code(s) associated with the repeated pattern(s) to the supply chain information, data indicative of

distinct features (e.g., taggant surface marking(s)), repeated pattern(s) formed by taggant surface markings, and/or code(s) associated with the repeated pattern(s) assigned to the supply chain information, etc. For example, the databases and other files may include correlation data mapping the supply chain components to distinct features (e.g., taggant surface marking(s)), repeated pattern(s) formed by taggant surface markings, and/or code(s) associated with the repeated pattern(s) included in fiber samples, as described above. Further, by way of example, the databases and other files may also include distinct features (e.g., taggant surface marking(s)), repeated pattern(s) formed by taggant surface markings, and/or code(s) associated with the repeated pattern(s) included in fiber samples assigned to supply chain components by laboratory 560, as outlined above.

[00156] Systems and methods of disclosed embodiments, however, are not limited to separate databases. In one aspect, system 600 may include database 627. Alternatively, database 627 may be located remotely from the system 600. Database 627 may include computing components (e.g., database management system, database server, etc.) configured to receive and process requests for data stored in memory devices of database(s) 627 and to provide data from database 627.

[00157] Although the above description has designated laboratory 560 as the entity assigning various taggants, in other aspects, manufacturer 510, customer 520, requesting party 530 or a third-party entity not shown may be the one assigning taggants for identification fibers. Furthermore, as seen from Figures 5A and 5B, although the description has focused on cellulose acetate tow and the black market associated with cigarette filters, the embodiments clearly apply to fibers of any material and any article subject to illicit trade.

[00158] FIGURE 7 illustrates a non-limiting example of a process for embedding supply chain information into fibers, as seen and described above with respect to disclosed embodiments.

[00159] FIGURE 8 illustrates a non-limiting example of a process for generating correlation data, as seen and described above with respect to

disclosed embodiments. For example, as described in FIGURE 8, manufacturer 510 (and additionally or alternatively, laboratory 560) may generate a first structured list of the supply chain components having one or more corresponding attributes, and may generate a second structured list of taggant surface markings available for application to or inclusion within identification fibers. In one instance, the supply chain components may represent one or more corresponding attributes. Manufacturer 510 may identify repeated patterns capable of being formed by the taggant surface markings along lengths of identification fibers (i.e., branded fibers). In some aspects, manufacturer 510 may map elements of the first structured list to elements of the second structured list, and may map the supply chain components of the first structured list to the identified repeated patterns. Manufacturer 510 may, in additional aspects, store correlation data (e.g., in database 627) reflecting the mapping of the elements of the first and second structured lists.

[00160] FIGURE 9 illustrates an additional non-limiting example of a process for generating correlation data, as seen and described above with respect to disclosed embodiments. For example, as described in FIGURE 9, laboratory 560 (and additionally or alternatively, manufacturer 510) may generate a first structured list of components of the supply chain. In one instance, the supply chain components may represent one or more corresponding attributes. Laboratory 560 may also identify one or more taggant surface markings appropriate for application to or inclusion within identification fibers (i.e., branded fibers), and may generate a second structured list that includes potential repeated patterns capable of being formed by the identified taggant surface markings. In some aspects, laboratory 560 may generate a third structured list identifying potential codes or code portions that are assignable to the potential repeated patterns of the second structured list and capable of representing the supply chain components of the first structured list. Laboratory 560 may further map elements of the first structured list to elements of the second structured list, and further map elements of the first

structured list to elements of the third structured list. In some aspects, laboratory 560 may store correlation data (e.g., in database 627) reflecting the mappings of the attributes of the supply chain components to the potential repeated patterns and potential code and code portions.

[00161] FIGURE 10 illustrates a non-limiting example of a process for producing identification fibers, as seen and described above with respect to disclosed embodiments.

[00162] FIGURE 11 illustrates a non-limiting example of a process for identifying at least one supply chain component associated with a fiber sample, as seen and described above with respect to disclosed embodiments.

[00163] FIGURE 12 illustrates a non-limiting example of a process for assigning, to supply chain components, taggant surface markings, repeated patterns, and code and code portions that uniquely represent the supply chain components, as seen and described above with respect to disclosed embodiments.

[00164] Listed below are non-limiting embodiments A1-A24.

[00165] A1. Fibers comprising one or more identification fibers, wherein each of the identification fibers exhibits at least one distinct feature, wherein the identification fibers comprise one or more branded fibers, wherein the branded fibers exhibit the distinct features comprising one or more taggant surface markings, wherein the taggant surface markings form a repeated pattern along a length of the branded fibers, and wherein the taggant surface markings and/or repeated pattern is representative of a code of the fibers.

[00166] A2. The fibers of embodiment A1, further comprising standard fibers and wherein the code is representative of at least one supply chain component of the fibers or the standard fibers.

[00167] A3. The fibers of any of embodiments A1 or A2, wherein the repeated pattern comprises an alphanumeric code, a digital code, an analog code, or an ideographic code.

[00168] A4. The fibers of embodiment A1, wherein the repeated pattern includes metadata.

[00169] A5. The fibers of embodiment A4, wherein the metadata comprises a read-start position, a read-end position, a read direction, spacing of the digits within the code.

[00170] A6. The fibers of any of embodiments A3-A5, wherein the repeated pattern comprises a digital code and wherein the digital code comprises a binary code.

[00171] A7. The fibers of embodiment A6, wherein a number of digits in the binary code ranges from 2 to 500, 4 to 100 10 to 100, 20 to 100, 4 to 50, 10 to 50, or 20 to 50.

[00172] A8. The fibers of any of embodiments A1-A7, wherein the length of the repeated pattern ranges from 2 mm to 500 mm, 2 to 200 mm, 2 to 30 mm, 5 mm to 200 mm, 5 mm to 30 mm, 10 to 200 mm, or 10 to 30 mm.

[00173] A9. The fibers of any of embodiments A1-A8, wherein the repeated pattern is essentially one-dimensional.

[00174] A10. The fibers of any of embodiments A1-A9, wherein the repeated pattern is printed on the branded fibers.

[00175] A11. The fibers of any of embodiments A1-A9, wherein the repeated pattern is imparted on the branded fibers by engraving or morphology modification.

[00176] A12. The fibers of any of embodiments A2-A11, wherein the standard fibers comprise cellulose acetate.

[00177] A13. The fibers of any of embodiments A2-A12, wherein the branded fibers are essentially insoluble in a solvent, wherein the standard fibers are soluble in the solvent.

[00178] A14. The fibers of any of embodiments A12 or A13, wherein the branded fibers are essentially insoluble in acetone or methylene chloride.

[00179] A15. The fibers of any of embodiments A12-A14, wherein the branded fibers are essentially not susceptible to solvent bonding with triacetin.

[00180] A16. The fibers of any of embodiments A1-A15, where in the branded fibers comprise acrylic, modacrylic, aramid, nylon, polyester,

polypropylene, rayon, polyacrylonitrile, polyethylene, cellulose triacetate, or PTFE.

[00181] A17. The fibers of any of embodiments A2-A16, wherein the at least one supply chain component comprises a manufacturer of the standard fibers, a manufacture site of the standard fibers, a manufacturing line of the standard fibers, a production run of the standard fibers, a production date of the standard fibers, a package of the standard fibers, a warehouse of the standard fibers, a customer of the standard fibers, a ship-to location of the standard fibers, a manufacturer of a fiber band comprising the fibers, a manufacturing site of the fiber band, a manufacturing line of the fiber band, a production run of the fiber band, a production date of the fiber band, a package of the fiber band, a warehouse of the fiber band, a customer of the fiber band, a ship-to location of the fiber band, a manufacturer of an article comprising the fibers, a manufacture site of the article, a manufacturing line of the article, a production run of the article, a production date of the article, a package of the article, a warehouse of the article, a customer of the article, or a ship-to location of the article.

[00182] A18. An acetate tow band comprising fibers, comprising the fibers of any of embodiments of any of A2-A17, wherein the standard fibers comprise cellulose acetate.

[00183] A19. The acetate tow band of embodiment A18, wherein the at least one supply chain component comprises a manufacturer of a acetate tow band, a manufacturing site of the acetate tow band, a manufacturing line of the acetate tow band, a production run of the acetate tow band, a production date of the acetate tow band, a bale of the acetate tow band, a warehouse of the acetate tow band, a customer of the fiber band, or a ship-to location of the acetate tow band.

[00184] A20. The acetate tow band of any of embodiments A18 or A19, wherein the at least one supply chain component comprises the bale of the acetate tow band.

[00185] A21. A method of making an acetate tow band comprising fibers of any of embodiments A2-A17, wherein the method comprises: (a) obtaining the identification fibers (b) producing the standard fibers on a first fiber production process; and (c) combining the identification fibers and the standard fibers into the acetate tow band.

[00186] A22. The method of embodiment A21, wherein the obtaining of the identification fibers comprising the branded fibers comprises at least one of (i) the producing the portion of the identification fibers on the second fiber production process followed by applying the taggant surface markings in the repeated pattern to the identification fibers to produce a portion of the branded fibers; (ii) receiving the portion of the identification parties from the third party followed by applying the taggant surface markings in the repeated pattern to the identification fibers to produce a portion of the branded fibers; or (ii) receiving a portion of the branded fibers from the third party.

[00187] A23. The method of embodiment A22, wherein applying the taggant surface markings in the repeated pattern comprises engraving, printing, or morphological modification.

[00188] A24. The method of embodiment A22, wherein the applying comprises printing the taggant surface markings in the repeated pattern on the branded fibers concurrently to producing the standard fibers and combining the branded fibers and the standard fibers before crimping the acetate tow band.

[00189] A25. The method of embodiment A21, wherein the applying comprises laser engraving the taggant surface markings in the repeated pattern on the branded fibers concurrently to producing the standard fibers and combining the branded fibers and the standard fibers before crimping the acetate tow band.

[00190] A26. A method of characterizing a fiber sample, wherein the fiber sample comprises fibers of any of embodiments A2-A17, wherein the method comprises (1) optionally, separating the branded fibers from the fiber sample,

(2) applying imaging technology to the branded fibers, and (3) determining the repeated pattern of the taggant surface markings.

[00191] A27. The method of embodiment A26, wherein the separating comprises placing the fiber sample in a solvent to produce a solution comprising a dissolved portion of the fiber sample and the branded fibers and removing the branded fibers from the solution.

[00192] A28. The fibers of any of embodiments A26 or A27, wherein the standard fibers comprise cellulose acetate, wherein the fiber sample comprises a portion of an article comprising the fibers, and wherein the article is selected from the group consisting of a filter rod and a cigarette filter.

[00193] A29. The fibers of any of embodiments A26 or A27, wherein the fiber sample comprises a portion of an article comprising the fibers, and wherein the article is selected from the group consisting of fabrics and other textile products, non-wovens, and absorbent products

[00194] A30. The fibers of any of embodiments A26-A29, wherein the imaging technology is selected from the group consisting of human visual inspection, microscopy, electron microscopy, confocal microscopy, and optical scanning.

[00195] A31. The fibers of any of embodiments A26-A29, further comprising correlating the taggant surface markings and the repeated pattern to a database comprising manufacture specific taggants and determining the at least one supply chain component, wherein the at least one supply chain component comprises a manufacturer of the standard fibers a manufacture site of the standard fibers, a manufacturing line of the standard fibers, a production run of the standard fibers, a production date of the standard fibers, a package of the standard fibers, a warehouse of the standard fibers, a customer of the standard fibers, a ship-to location of the standard fibers, a manufacturer of a fiber band comprising the fibers, a manufacturing site of the fiber band, a manufacturing line of the fiber band, a production run of the fiber band, a production date of the fiber band, a package of the fiber band, a warehouse of the fiber band, a customer of the fiber band, a ship-to location

of the fiber band, a manufacturer of an article comprising the fibers, a manufacture site of the article, a manufacturing line of the article, a production run of the article, a production date of the article, a package of the article, a warehouse of the article, a customer of the article, or a ship-to location of the article.

[00196] A32. The method of embodiment A31, wherein the fiber sample comprises a portion of a filter, wherein the filter comprises an acetate tow band, and wherein the at least one supply chain component comprises a bale of the acetate tow band.

EXAMPLES

Example 1

[00197] Nylon monofilament of 0.28 mm diameter was printed using an ID Technologies® Ci3300 inkjet printer with the code and settings in Figure 2 entered into the printer's graphic design utility. The ink used was an acetone-based proprietary formulation provided by ID Technologies®. The printed coding was applied on a continuous basis as the nylon monofilament was wound onto a spool as is typical in the production of cellulose acetate yarn. The printer head was placed above the fiber such that the printed bars were perpendicular to the fiber and the fiber's moving direction, ensuring that the ink contacted the fiber. The approximate 1 mm spacing between the resulting print marks on the fiber was obtained by adjusting the width setting on the printer (which controls the time gap between when the bars are printed) and the speed of the fiber (i.e. the surface speed of the winder). Approximately 1000m of encoded or branded fiber was produced.

[00198] The spool of encoded nylon monofilament was withdrawn from its package and fed into the tow band of a cellulose acetate tow production process prior to the crimper. The cellulose acetate tow was a typical commercial, "Y" cross section tow item with a nominal 2.8 filament denier and 31,000 total denier. The tow with the encoded monofilament was crimped,

conditioned and delivered to a baler using standard manufacturing conditions. The tow was not compressed per typical bailer operations.

[00199] Filter rods were produced from the tow on an AF2N plug maker at a tape speed of 300 m/m, forming a filter rod of 120 mm in length of typical tow weights and Triacetin plasticizer levels used in the tobacco industry. The encoded fiber was manually extracted from rods and inspected with a microscope. The printed information remained readily detectible and quantifiable. Figure 3a shows a stitched image of a fiber extracted from a filter rod made with the tow containing the encoded fiber. Spacing and clarity of code is typical of all samples similarly generated.

Example 2

[00200] Example 1 was repeated using a Polypropylene monofilament of 0.2 mm diameter. Although, as with Example 1, the coded monofilament was incorporated into the tow band and processed into a filter rod successfully, the printing ink did not adhere well to the fiber substrate, resulting in a degree of smudging and smearing such that the extracted branded fiber could not be decoded successfully. Although it is believed that a different ink and/or fiber surface modifications would improve ink adherence, no further work was performed with polypropylene fibers.

Example 3

[00201] The acetate tow band production of Example 1 was repeated using a polyester thread. The encoded thread was manually extracted from the tow. As with Example 1, the encoded information remained readily detectible and quantifiable. Figure 3b shows a stitch image of the extracted branded thread. Spacing and clarity of code is typical of all samples similarly generated.

Example 4

[00202] A sample of UHS (acrylic) monofilament fiber with a diameter of 0.193 mm was marked with a pattern using a MACSA carbon dioxide laser.

The marked fiber is shown in Figure 4. Although filter rods were not produced using the pictured monofilament, one skilled in the art would expect filter rod results similar to those of Examples 1 and 3.

[00203] Other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the embodiments disclosed herein. It will be understood that variations and modifications can be effected within the spirit and scope of the disclosed embodiments. It is further intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the disclosed embodiments being indicated by the following claims.

We claim:

1. Fibers comprising one or more identification fibers,
wherein each of the identification fibers exhibits at least one distinct feature,
wherein the identification fibers comprise one or more branded fibers,
wherein the branded fibers exhibit the distinct features comprising one or more taggant surface markings,
wherein the taggant surface markings form a repeated pattern along a length of the branded fibers, and
wherein the repeated pattern is representative of a code of the fibers.

2. The fibers of claim 1, further comprising standard fibers and wherein the code is representative of at least one supply chain component of the fibers or the standard fibers.

3. The fibers of any of claims 1 or 2, wherein the repeated pattern comprises an alphanumeric code, a digital code, an analog code, or an ideographic code.

4. The fibers of claim 3, wherein the repeated pattern includes metadata.

5. The fibers of claim 4, wherein the metadata comprises a read-start position, a read-end position, or a read direction.

6. The fibers of any of claims 3-5, wherein the repeated pattern comprises a digital code and wherein the digital code comprises a binary code.

7. The fibers of claim 6, wherein a number of digits in the binary code ranges from 4 to 100.

8. The fibers of any of claims 1-7, wherein the length of the repeated pattern ranges from 5 mm to 200 mm.

9. The fibers of any of claims 1-8, wherein the repeated pattern is essentially one-dimensional.

10. The fibers of any of claims 1-9, wherein the repeated pattern is printed on the branded fibers.

11. The fibers of any of claims 1-9, wherein the repeated pattern is imparted on the branded fibers by engraving or morphology modification.

12. The fibers of any of claims 2-11, wherein the standard fibers comprise cellulose acetate.

13. The fibers of claim any of claims 2-11, wherein the branded fibers are essentially insoluble in a solvent, wherein the standard fibers are soluble in the solvent.

14. The fibers of any of claims 12 or 13, wherein the branded fibers are essentially insoluble in acetone or methylene chloride.

15. The fibers of any of claims 12-14, wherein the branded fibers are essentially not susceptible to solvent bonding with triacetin.

16. The fibers of any of claims 1-15, where in the branded fibers comprise acrylic, modacrylic, aramid, nylon, polyester, polypropylene, rayon, polyacrylonitrile, polyethylene, cellulose triacetate, or PTFE.

17. An article comprising the fibers is defined in any of claims 1-16.

18. The article of claim 13, which is selected from the group consisting of a filter (preferably a filter rod or a cigarette filter), and fabrics and other textile products, nonwovens, and absorbent products.

19. The article of claim 17 which is an acetate tow band or a filter(preferably a filter rod or a cigarette filter) comprising an acetate tow band.

20. The article of claim 19, wherein the repeated pattern is representative of the at least one supply chain component comprising a manufacturer of a acetate tow band, a manufacturing site of the acetate tow band, a manufacturing line of the acetate tow band, a production run of the acetate tow band, a production date of the acetate tow band, a bale of the acetate tow band, a warehouse of the acetate tow band, a customer of the fiber band, or a ship-to location of the acetate tow band.

21. Method of making an acetate tow band according to any of claims 19 or 20,
wherein the method comprises:
(a) obtaining the identification fibers
(b) producing the standard fibers on a first fiber production process; and
(c) combining the identification fibers and the standard fibers into the acetate tow band.

22. The method of claim 21, wherein the obtaining of the identification fibers comprising the branded fibers comprises at least one of
(i) the producing the portion of the identification fibers on the second fiber production process followed by applying the taggant surface

markings in the repeated pattern to the identification fibers to produce a portion of the branded fibers;

(ii) receiving the portion of the identification parties from the third party followed by applying the taggant surface markings in the repeated pattern to the identification fibers to produce a portion of the branded fibers; or

(ii) receiving a portion of the branded fibers from the third party.

23. The method of claim 22, wherein applying the taggant surface markings in the repeated pattern comprises engraving, printing, or morphological modification.

24. The method of claim 22, wherein the applying comprises printing or laser engraving the taggant surface markings in the repeated pattern on the branded fibers concurrently to producing the standard fibers and combining the branded fibers and the standard fibers before crimping the acetate tow band.

25. A method of characterizing a fiber sample wherein the fiber sample comprises fibers of any of claims 1-16, or an article according to any of claims 17-20,
wherein the method comprises

(1) separating the branded fibers from the fiber sample

(2) applying imaging technology to the branded fibers

(3) determining the repeated pattern of the taggant surface markings.

26. The method of claim 25, wherein the separating comprises placing the fiber sample in a solvent to produce a solution comprising a dissolved portion of the fiber sample and the branded fibers and removing the branded fibers from the solution.

27. The method of any of claims 25-26, wherein the imaging technology is selected from the group consisting of human visual inspection, microscopy, electron microscopy, confocal microscopy, and optical scanning.

28. The method of any of claims 25-27, further comprising correlating the repeated pattern of the taggant surface markings to a database comprising manufacture specific taggants and determining the at least one supply chain component, wherein the at least one supply chain component comprises a manufacturer of the standard fibers a manufacture site of the standard fibers, a manufacturing line of the standard fibers, a production run of the standard fibers, a production date of the standard fibers, a package of the standard fibers, a warehouse of the standard fibers, a customer of the standard fibers, a ship-to location of the standard fibers, a manufacturer of a fiber band comprising the fibers, a manufacturing site of the fiber band, a manufacturing line of the fiber band, a production run of the fiber band, a production date of the fiber band, a package of the fiber band, a warehouse of the fiber band, a customer of the fiber band, a ship-to location of the fiber band, a manufacturer of an article comprising the fibers, a manufacture site of the article, a manufacturing line of the article, a production run of the article, a production date of the article, a package of the article, a warehouse of the article, a customer of the article, or a ship-to location of the article.

29. The method of claim 28, wherein the fiber sample comprises a portion of a filter, wherein the filter comprises an acetate tow band, wherein the method further comprises correlating the repeated pattern of taggant surface markings to a database comprising manufacturing specific

taggants, and wherein the at least one supply chain component comprises a bale of the acetate tow band.

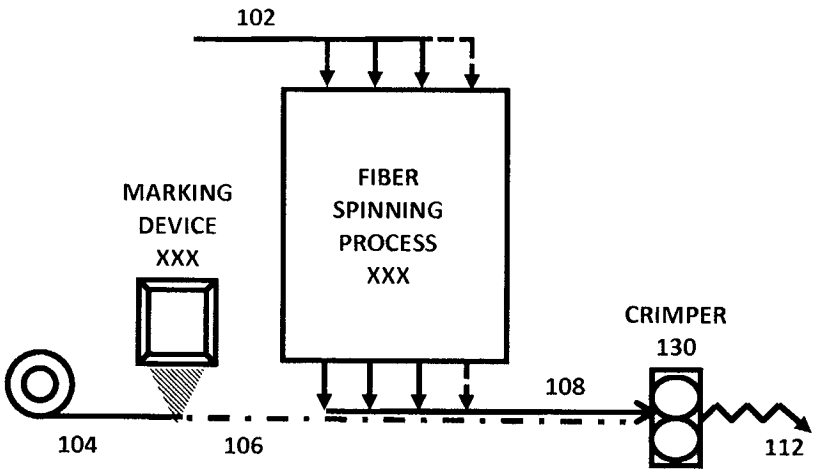

FIGURE 1

Schematic of concurrent branding and acetate tow productions

Code	
Drop Size	Normal
Pixels	9
Delay	10
Width	55
Gap	0
Height	150
Orientation	Upside Down

Figure 2

ID Technology® Ci3300 settings for branded fiber production

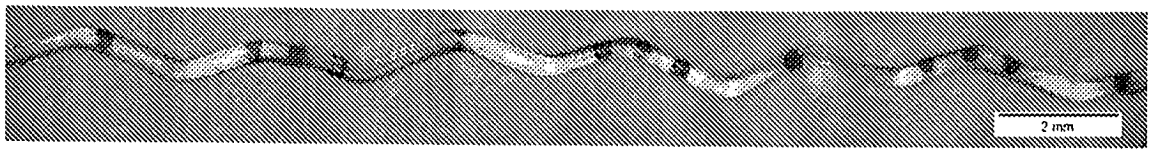

Figure 3a

Stitched image of an encoded nylon fiber extracted from a filter rod

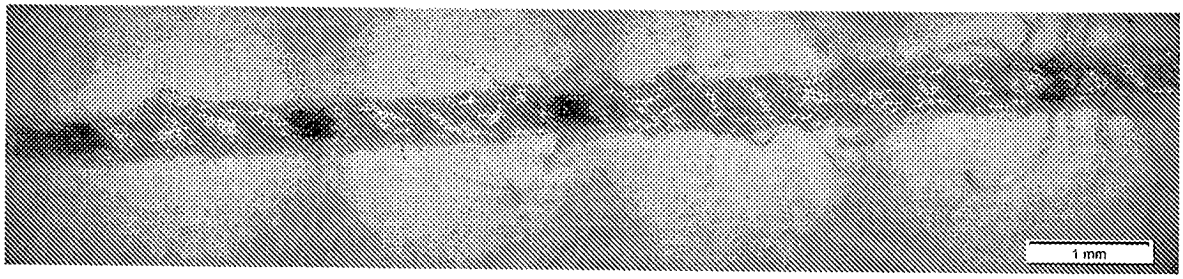

Figure 3b

Stitched image of an encoded polyester thread extracted from a crimped acetate tow band

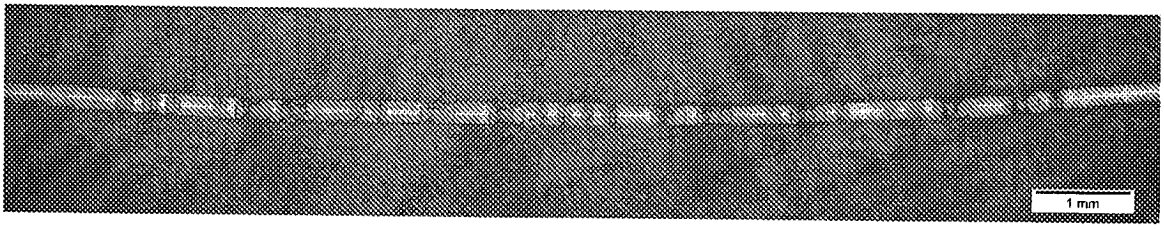

Figure 4

An image of an acrylic monofilament fiber engraved using a MACSA carbon dioxide laser.

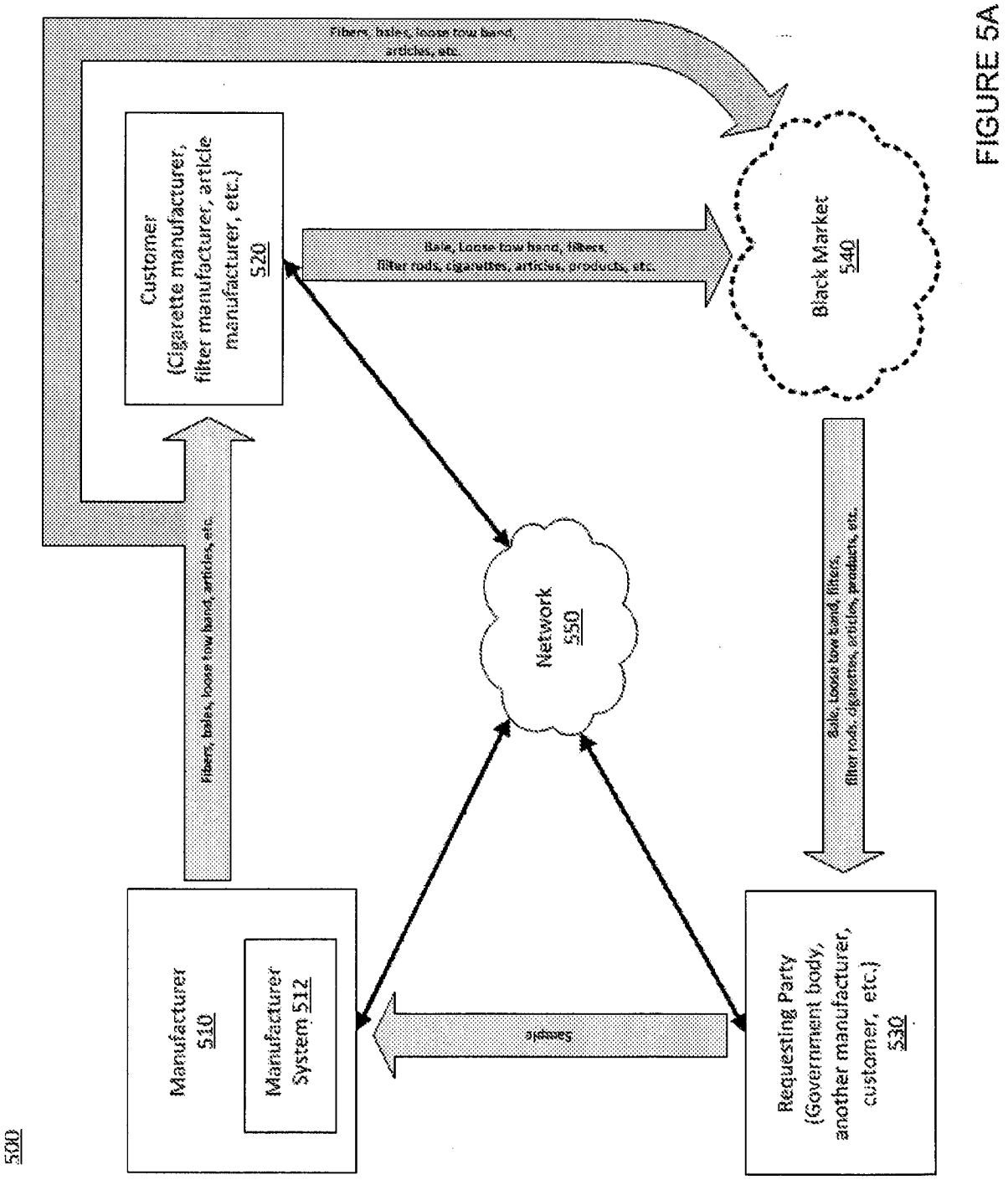
500
Manufacturer 510
Manufacturer System 512
Customer (Cigarette manufacturer, filter manufacturer, article manufacturer, etc.) 520
Requesting Party (Government body, another manufacturer, customer, etc.) 530
Network 550
Black Market 540
Fibers, bales, loose tow band, articles, etc.
Bale, Loose tow band, fibers, filter rods, cigarettes, articles, products, etc.
Fibers, bales, loose tow band, articles, etc.
Bale, Loose tow band, fibers, filter rods, cigarettes, articles, products, etc.
Sample

FIGURE 5A

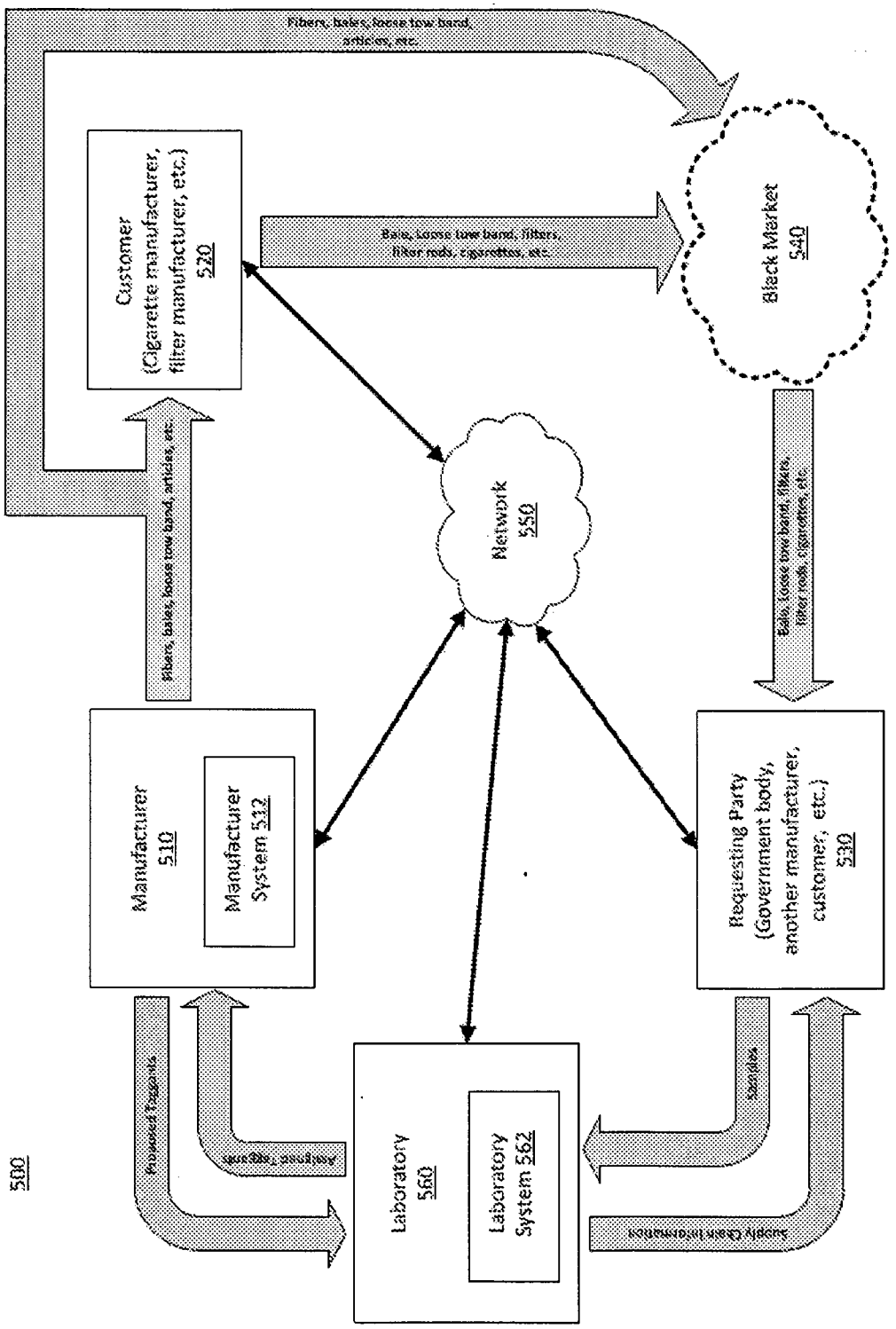
Fibers, bales, loose tow band, articles, etc.
Customer (Cigarette manufacturer, filter manufacturer, etc.) 520
Bale, loose tow band, fibers, fiber rods, cigarettes, etc.
Black Market 540
Network 550
Fibers, bales, loose tow band, articles, etc.
Bale, loose tow band, fibers, fiber rods, cigarettes, etc.
Manufacturer 510
Manufacturer System 512
Requesting Party (Government body, another manufacturer, customer, etc.) 530
Laboratory 560
Laboratory System 562
Proposed Reports
Analysis Reports
Samples
Supply Desk Information
500

FIGURE 5B

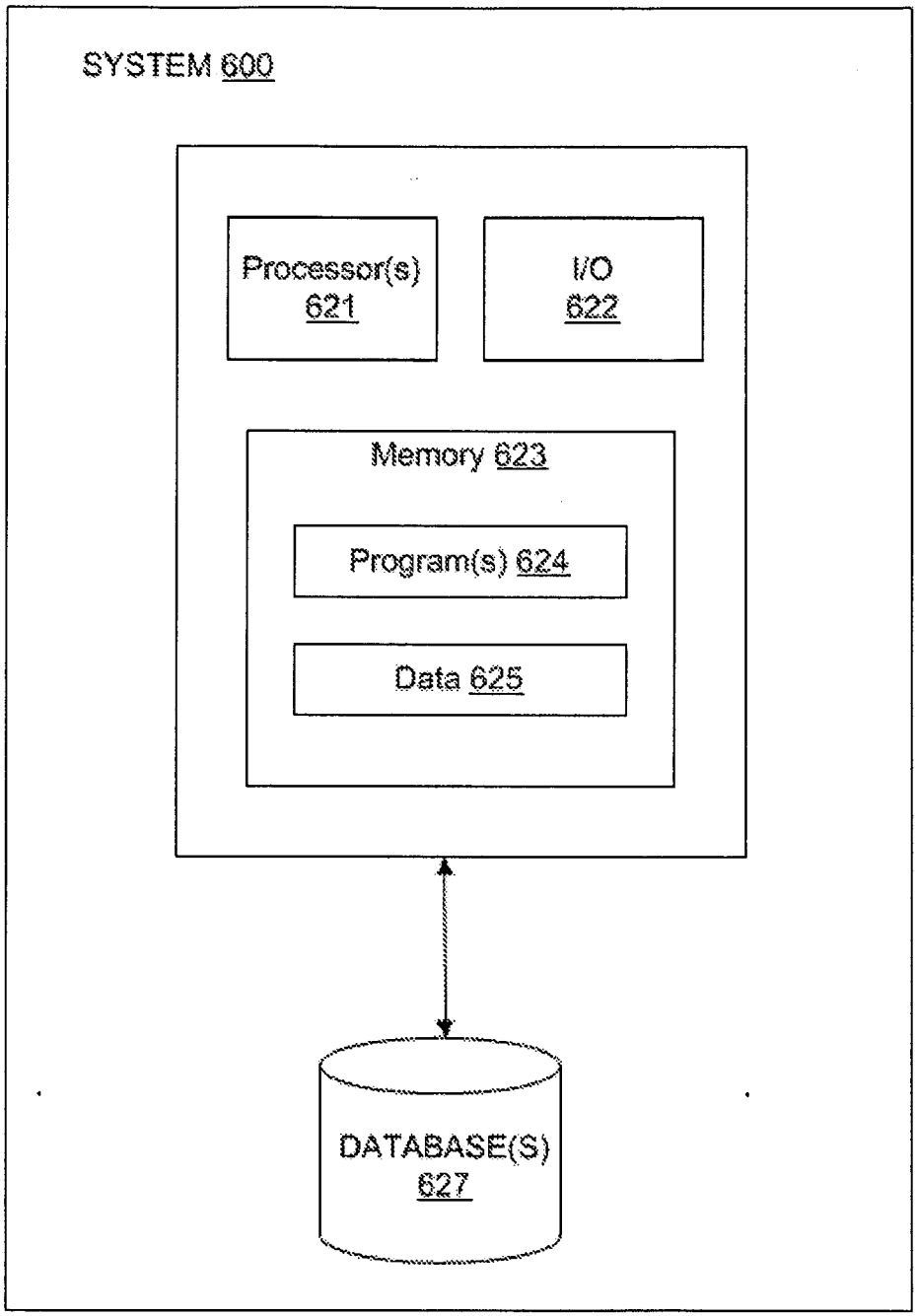
SYSTEM 600
Processor(s) 621
I/O 622
Memory 623
Program(s) 624
Data 625
DATABASE(S) 627

FIGURE 6

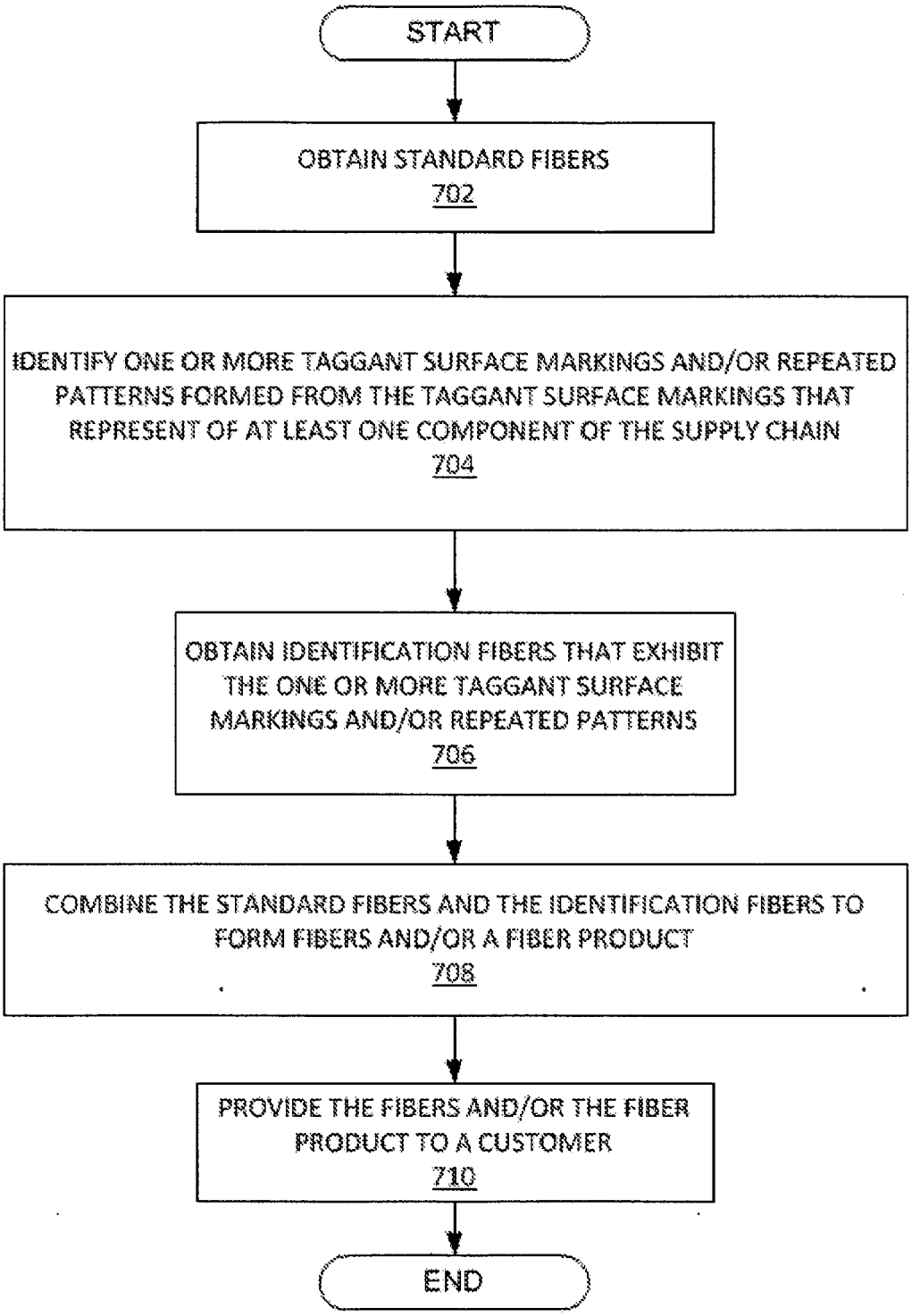
START
OBTAIN STANDARD FIBERS
702
IDENTIFY ONE OR MORE TAGGANT SURFACE MARKINGS AND/OR REPEATED PATTERNS FORMED FROM THE TAGGANT SURFACE MARKINGS THAT REPRESENT OF AT LEAST ONE COMPONENT OF THE SUPPLY CHAIN
704
OBTAIN IDENTIFICATION FIBERS THAT EXHIBIT THE ONE OR MORE TAGGANT SURFACE MARKINGS AND/OR REPEATED PATTERNS
706
COMBINE THE STANDARD FIBERS AND THE IDENTIFICATION FIBERS TO FORM FIBERS AND/OR A FIBER PRODUCT
708
PROVIDE THE FIBERS AND/OR THE FIBER PRODUCT TO A CUSTOMER
710
END

FIGURE 7

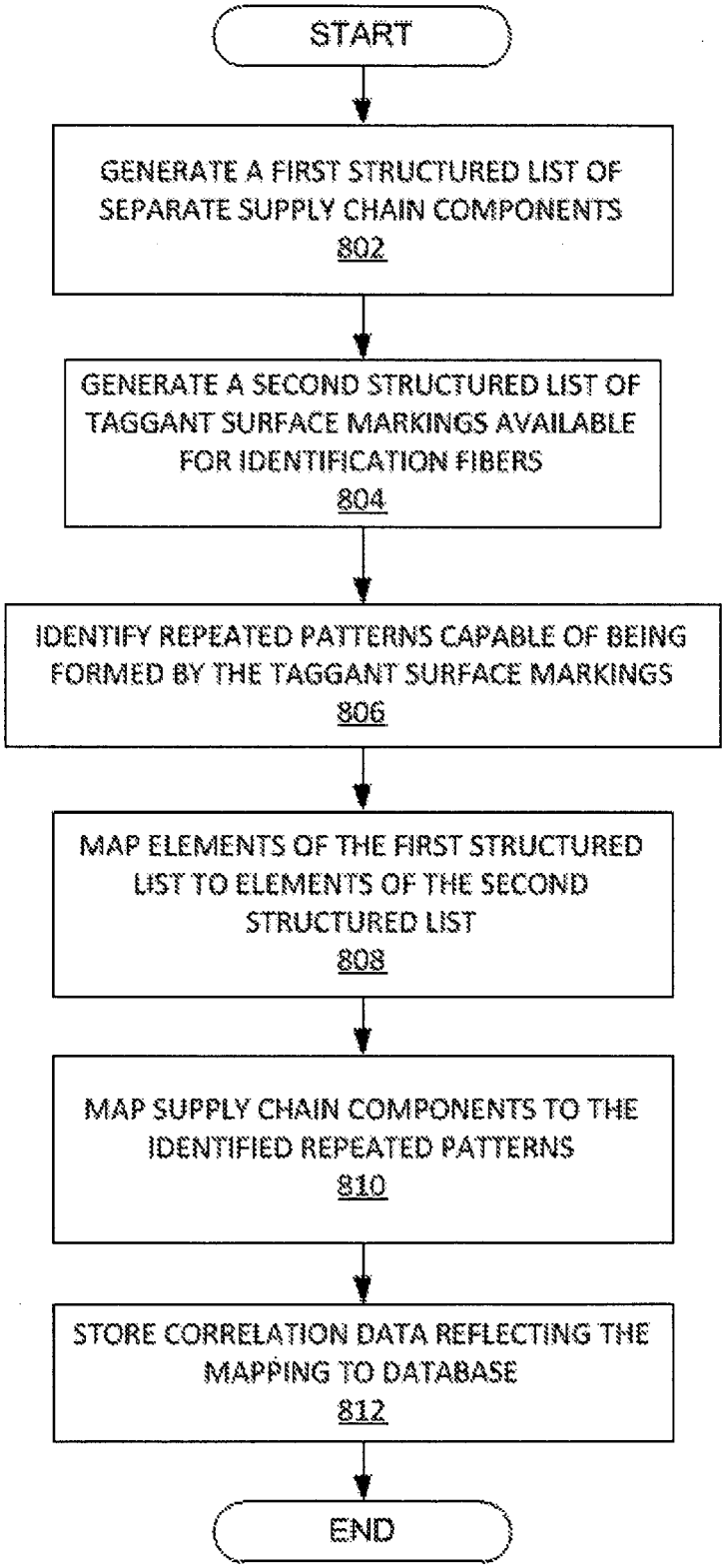
START
GENERATE A FIRST STRUCTURED LIST OF SEPARATE SUPPLY CHAIN COMPONENTS
802
GENERATE A SECOND STRUCTURED LIST OF TAGGANT SURFACE MARKINGS AVAILABLE FOR IDENTIFICATION FIBERS
804
IDENTIFY REPEATED PATTERNS CAPABLE OF BEING FORMED BY THE TAGGANT SURFACE MARKINGS
806
MAP ELEMENTS OF THE FIRST STRUCTURED LIST TO ELEMENTS OF THE SECOND STRUCTURED LIST
808
MAP SUPPLY CHAIN COMPONENTS TO THE IDENTIFIED REPEATED PATTERNS
810
STORE CORRELATION DATA REFLECTING THE MAPPING TO DATABASE
812
END

FIGURE 8

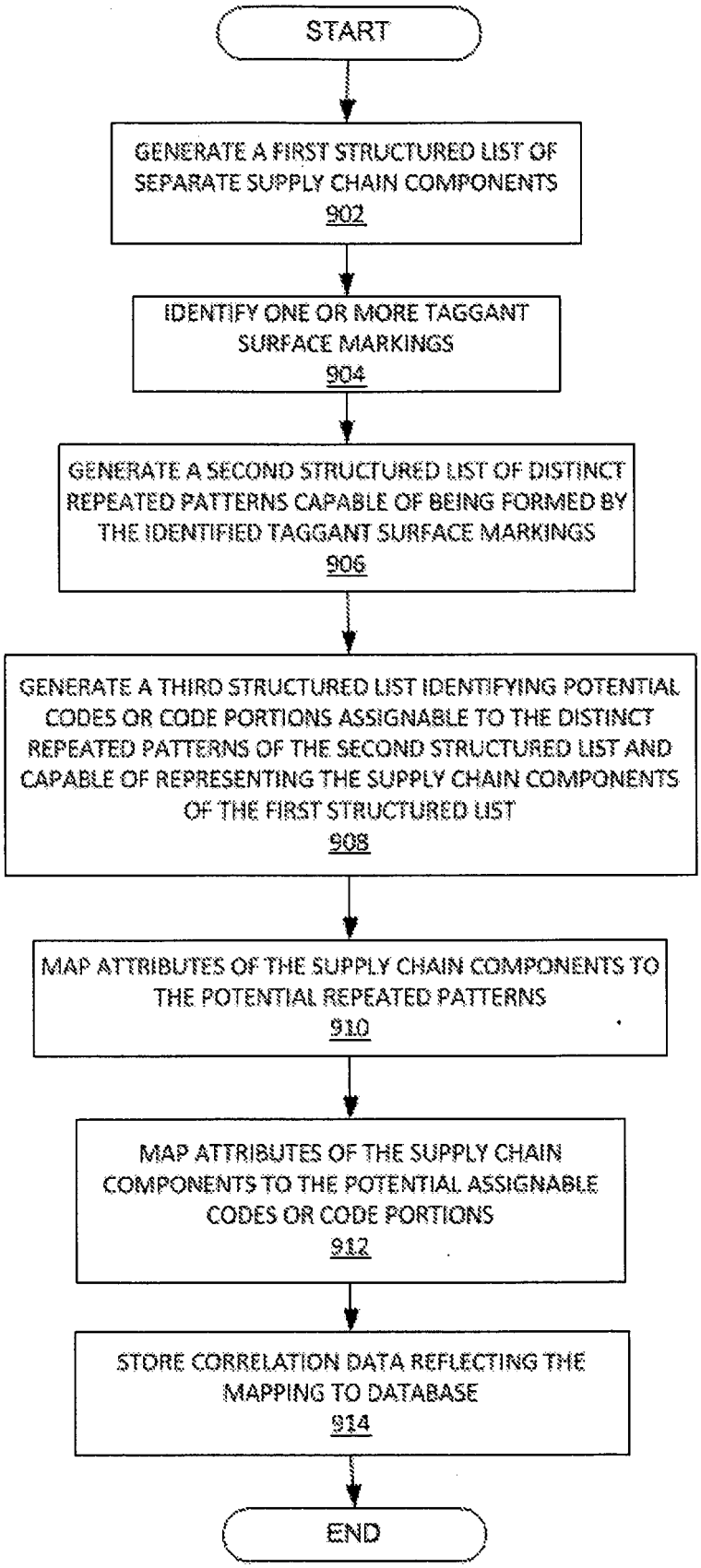
START
GENERATE A FIRST STRUCTURED LIST OF SEPARATE SUPPLY CHAIN COMPONENTS
902
IDENTIFY ONE OR MORE TAGGANT SURFACE MARKINGS
904
GENERATE A SECOND STRUCTURED LIST OF DISTINCT REPEATED PATTERNS CAPABLE OF BEING FORMED BY THE IDENTIFIED TAGGANT SURFACE MARKINGS
906
GENERATE A THIRD STRUCTURED LIST IDENTIFYING POTENTIAL CODES OR CODE PORTIONS ASSIGNABLE TO THE DISTINCT REPEATED PATTERNS OF THE SECOND STRUCTURED LIST AND CAPABLE OF REPRESENTING THE SUPPLY CHAIN COMPONENTS OF THE FIRST STRUCTURED LIST
908
MAP ATTRIBUTES OF THE SUPPLY CHAIN COMPONENTS TO THE POTENTIAL REPEATED PATTERNS
910
MAP ATTRIBUTES OF THE SUPPLY CHAIN COMPONENTS TO THE POTENTIAL ASSIGNABLE CODES OR CODE PORTIONS
912
STORE CORRELATION DATA REFLECTING THE MAPPING TO DATABASE
914
END

FIGURE 9

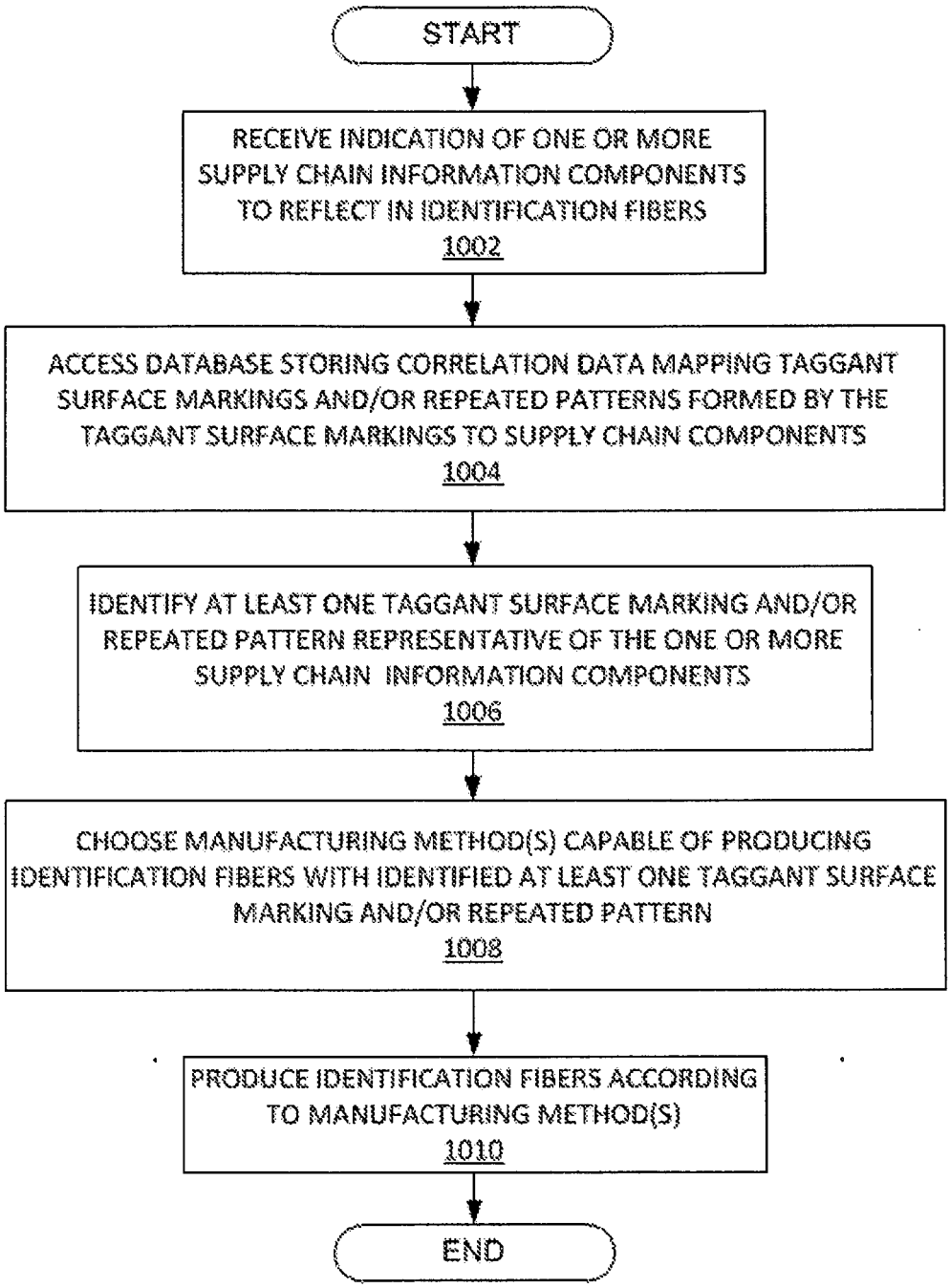
START
RECEIVE INDICATION OF ONE OR MORE SUPPLY CHAIN INFORMATION COMPONENTS TO REFLECT IN IDENTIFICATION FIBERS
1002
ACCESS DATABASE STORING CORRELATION DATA MAPPING TAGGANT SURFACE MARKINGS AND/OR REPEATED PATTERNS FORMED BY THE TAGGANT SURFACE MARKINGS TO SUPPLY CHAIN COMPONENTS
1004
IDENTIFY AT LEAST ONE TAGGANT SURFACE MARKING AND/OR REPEATED PATTERN REPRESENTATIVE OF THE ONE OR MORE SUPPLY CHAIN INFORMATION COMPONENTS
1006
CHOOSE MANUFACTURING METHOD(S) CAPABLE OF PRODUCING IDENTIFICATION FIBERS WITH IDENTIFIED AT LEAST ONE TAGGANT SURFACE MARKING AND/OR REPEATED PATTERN
1008
PRODUCE IDENTIFICATION FIBERS ACCORDING TO MANUFACTURING METHOD(S)
1010
END

FIGURE 10

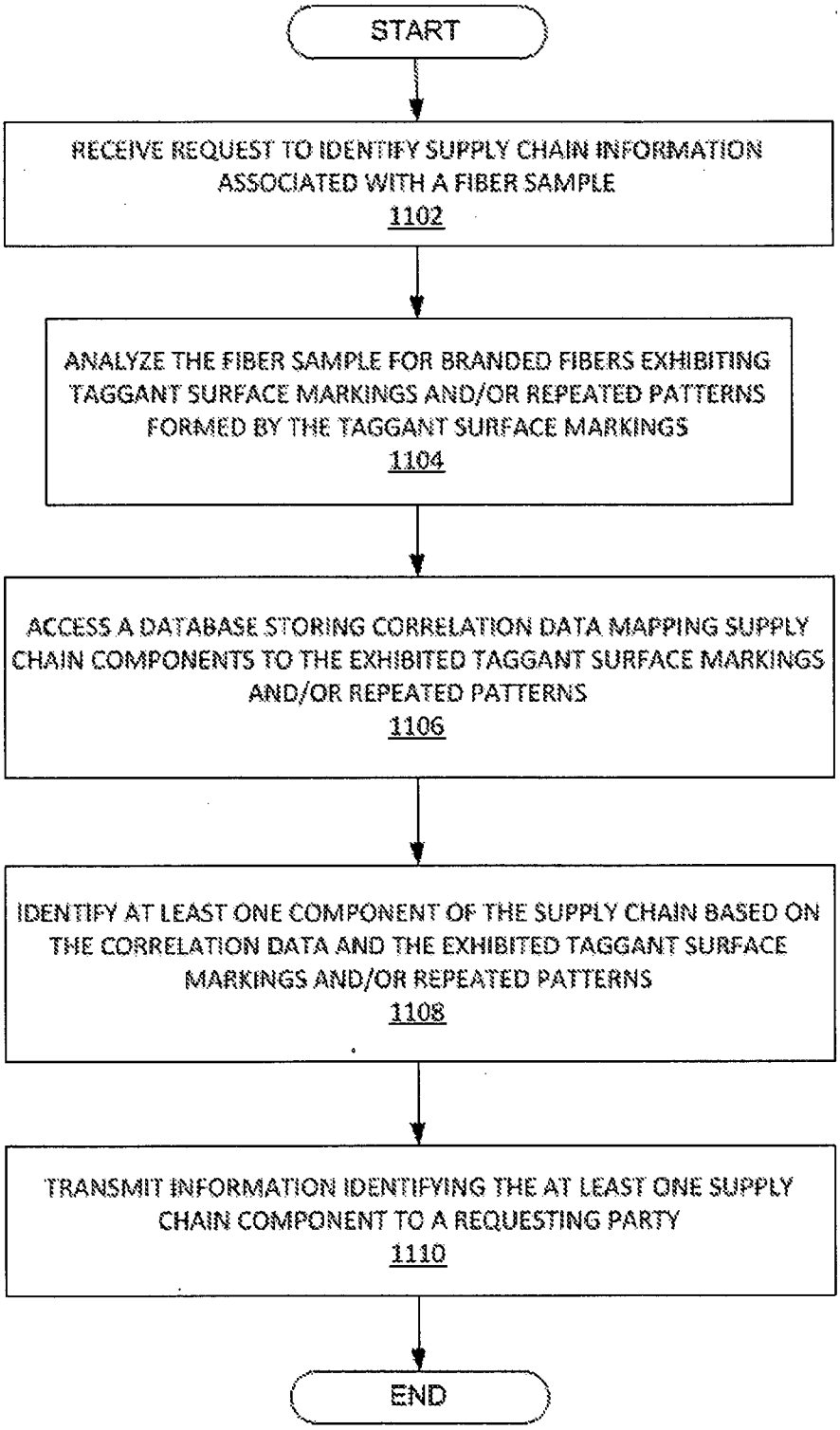
START
RECEIVE REQUEST TO IDENTIFY SUPPLY CHAIN INFORMATION ASSOCIATED WITH A FIBER SAMPLE
1102
ANALYZE THE FIBER SAMPLE FOR BRANDED FIBERS EXHIBITING TAGGANT SURFACE MARKINGS AND/OR REPEATED PATTERNS FORMED BY THE TAGGANT SURFACE MARKINGS
1104
ACCESS A DATABASE STORING CORRELATION DATA MAPPING SUPPLY CHAIN COMPONENTS TO THE EXHIBITED TAGGANT SURFACE MARKINGS AND/OR REPEATED PATTERNS
1106
IDENTIFY AT LEAST ONE COMPONENT OF THE SUPPLY CHAIN BASED ON THE CORRELATION DATA AND THE EXHIBITED TAGGANT SURFACE MARKINGS AND/OR REPEATED PATTERNS
1108
TRANSMIT INFORMATION IDENTIFYING THE AT LEAST ONE SUPPLY CHAIN COMPONENT TO A REQUESTING PARTY
1110
END

FIGURE 11

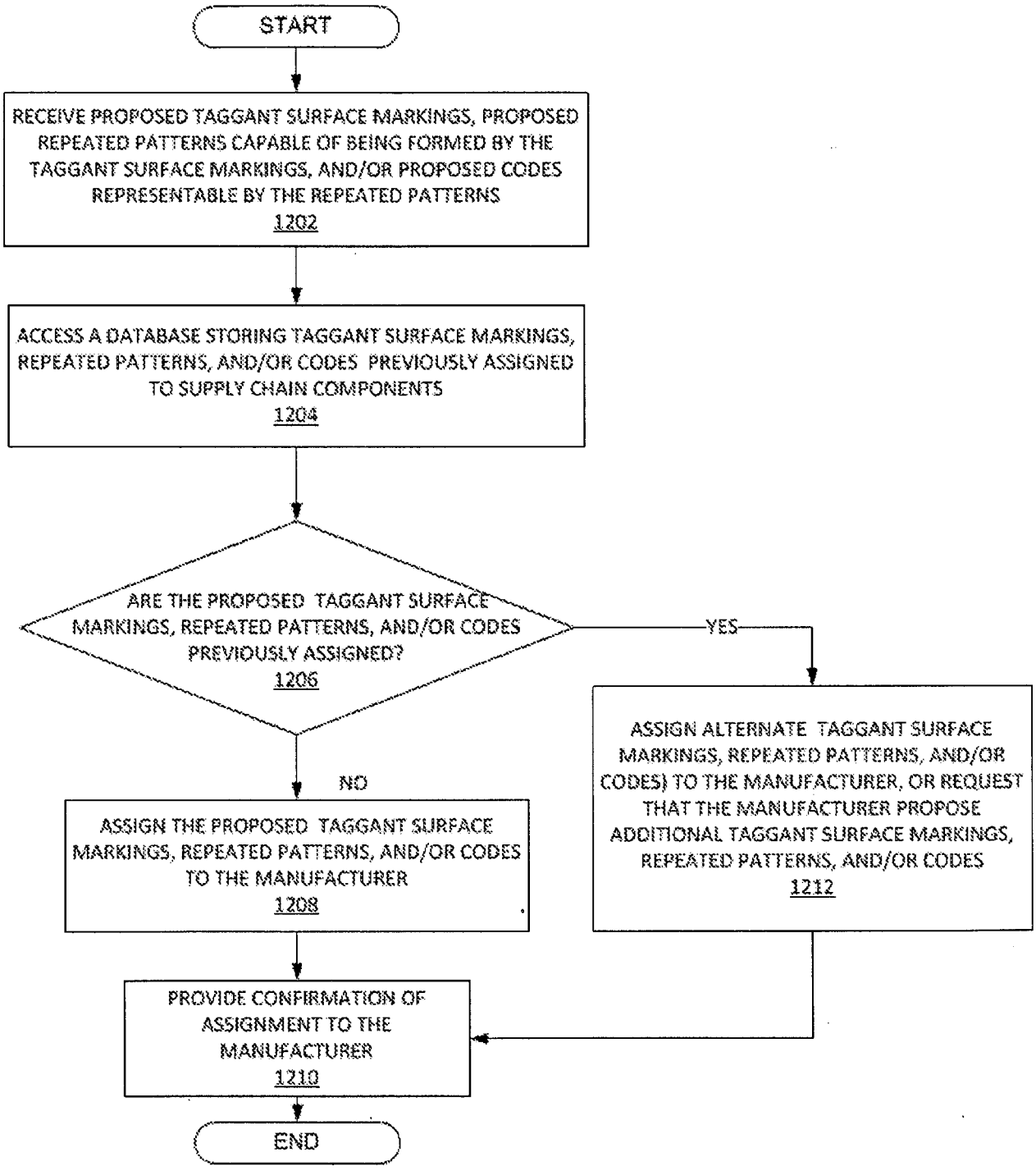
START
RECEIVE PROPOSED TAGGANT SURFACE MARKINGS, PROPOSED REPEATED PATTERNS CAPABLE OF BEING FORMED BY THE TAGGANT SURFACE MARKINGS, AND/OR PROPOSED CODES REPRESENTABLE BY THE REPEATED PATTERNS
1202
ACCESS A DATABASE STORING TAGGANT SURFACE MARKINGS, REPEATED PATTERNS, AND/OR CODES PREVIOUSLY ASSIGNED TO SUPPLY CHAIN COMPONENTS
1204
ARE THE PROPOSED TAGGANT SURFACE MARKINGS, REPEATED PATTERNS, AND/OR CODES PREVIOUSLY ASSIGNED?
1206
YES
NO
ASSIGN ALTERNATE TAGGANT SURFACE MARKINGS, REPEATED PATTERNS, AND/OR CODES) TO THE MANUFACTURER, OR REQUEST THAT THE MANUFACTURER PROPOSE ADDITIONAL TAGGANT SURFACE MARKINGS, REPEATED PATTERNS, AND/OR CODES
1212
ASSIGN THE PROPOSED TAGGANT SURFACE MARKINGS, REPEATED PATTERNS, AND/OR CODES TO THE MANUFACTURER
1208
PROVIDE CONFIRMATION OF ASSIGNMENT TO THE MANUFACTURER
1210
END

FIGURE 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/037637

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06P5/00 A24D3/00 D06M23/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06P A24D D06M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/073442 A1 (UNIV GENT [BE]; HUANG CHAOBO [CN]; LUCAS BART [BE]; DE SMEDT STEFAAN [) 23 June 2011 (2011-06-23) page 5, line 15 - line 18 page 20, line 5 - line 8 claims figure 2d -----	1-25, 27-29
X	WO 95/09947 A1 (ATHEY GRAHAM [GB]; ZORAB JAMES [GB]) 13 April 1995 (1995-04-13) page 1, line 1 - page 2, line 4 page 2, line 34 - page 3, line 16 claims ----- -/--	1-20,25, 27-29

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 September 2015	30/09/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fiocco, Marco

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/037637

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/089688 A1 (EMPIRE TECHNOLOGY DEV LLC [US]; IWAMOTO TAKASHI [JP]) 20 June 2013 (2013-06-20) paragraph [0003] paragraph [0037] paragraph [0064] - paragraph [0066] claims -----	1-10,14, 15,17,18

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2015/037637

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011073442 A1	23-06-2011	NONE	
WO 9509947 A1	13-04-1995	AU 7704994 A	01-05-1995
		DE 69412629 D1	24-09-1998
		DE 69412629 T2	08-04-1999
		EP 0721529 A1	17-07-1996
		GB 2282345 A	05-04-1995
		US 5744000 A	28-04-1998
		WO 9509947 A1	13-04-1995
WO 2013089688 A1	20-06-2013	CN 103974825 A	06-08-2014
		JP 2014534545 A	18-12-2014
		US 2013146664 A1	13-06-2013
		WO 2013089688 A1	20-06-2013

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62/164,135 2015.05.20 US
14/748,865 2015.06.24 US

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2016.12.27

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PCT/US2015/037637 2015.06.25

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WO2015/200598 EN 2015.12.30

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凯文·托德·巴勒姆
吉姆·安德鲁·迪肯森
克拉丽莎·泰特姆

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代理人 吴晓辉 白华胜

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D01D 5/08(2006.01)
D06M 23/16(2006.01)
D01D 5/36(2006.01)
D01F 1/04(2006.01)
D01F 1/06(2006.01)
D01F 2/28(2006.01)
G01N 33/36(2006.01)
G07D 7/12(2016.01)
G07D 7/2033(2016.01)

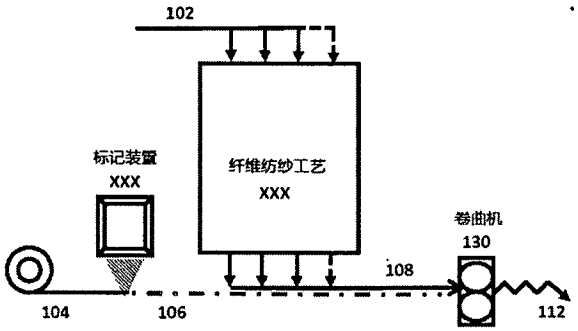
权利要求书3页 说明书24页 附图11页

(54)发明名称

具有用于编码的表面标志的纤维

(57)摘要

公开的是包括一种或多种烙印纤维的纤维，所述烙印纤维沿着其长在重复图案中呈现表面标志。所述烙印纤维能够被并入纱线或者纤维带中以代表所述纱线、纤维带和/或由所述纱线或纤维带制成的制品的供应链信息。在一个特定的实施例中，烙印纤维能够被并入醋酸纤维丝束带中。能够从香烟滤嘴中回收所述烙印纤维，解码所述重复图案，并且能够获得与用于制造所述香烟滤嘴的醋酸纤维丝束相关的供应链信息，诸如制造商、用户、运送地点，和甚至所述醋酸纤维丝束捆包。



CN 106488712 A

1.包括一种或多种识别纤维的纤维，

其中每种所述识别纤维呈现至少一种独特特征，

其中所述识别纤维包括一种或多种烙印纤维，

其中所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征，

其中所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案，并且

其中所述重复图案代表所述纤维的编码。

2.根据权利要求1所述的纤维，其进一步包括标准纤维，并且其中所述编码代表所述纤维或者所述标准纤维的至少一种供应链组件。

3.根据权利要求1或权利要求2中任意权利要求所述的纤维，其中所重复图案包括字母数字编码、数字编码、模拟编码，或者表意编码。

4.根据权利要求3所述的纤维，其中所述重复图案包括元数据。

5.根据权利要求4所述的纤维，其中所述元数据包括读数起始位置、读数终止位置，或者读数方向。

6.根据权利要求3至5中任意权利要求所述的纤维，其中所述重复图案包括数字编码并且其中所数字编码包括二进制编码。

7.根据权利要求6所述的纤维，其中在所述二进制编码中的数字个数范围从4到100。

8.根据权利要求1至7中任意权利要求所述的纤维，其中所述重复图案的长度范围从5mm到200mm。

9.根据权利要求1至8中任意权利要求所述的纤维，其中所述重复图案基本上是一维的。

10.根据权利要求1至9中任意权利要求所述的纤维，其中所述重复图案是印刷在所述烙印纤维上。

11.根据权利要求1至9中任意权利要求所述的纤维，其中通过雕刻或者形态学修饰将所述重复图案赋予所述烙印纤维上。

12.根据权利要求2至11中任意权利要求所述的纤维，其中所述标准纤维包括醋酸纤维素。

13.根据权利要求2至11中任意权利要求所述的纤维，其中所述烙印纤维基本上不溶解于溶剂中，其中所述标准纤维溶解于所述溶剂中。

14.根据权利要求12或权利要求13中任意权利要求所述的纤维，其中所述烙印纤维基本上不溶解于丙酮或者二氯甲烷。

15.根据权利要求12至14中任意权利要求所述的纤维，其中所述烙印纤维基本上不容易受到与三乙酸甘油酯粘结的溶剂的影响。

16.根据权利要求1至15中任意权利要求所述的纤维，其中所述烙印纤维中包括腈纶、改性腈纶、芳纶、尼龙、涤纶、聚丙烯纤维、人造丝、聚丙烯腈、聚乙烯、三乙酸纤维素，或者PTFE。

17.一种制品，其包括权利要求1至16中任意权利要求所定义的纤维。

18.根据权利要求13所述的制品，其选自由过滤器(优选滤棒或者香烟滤嘴)和织物及其他纺织产品、非纺织品，以及吸收剂产品组成的群组。

19.根据权利要求17所述的制品，其是醋酸纤维丝束带或者包括醋酸纤维丝束带的过

滤器(优选滤棒或者香烟滤嘴)。

20.根据权利要求19所述的制品,其中所述重复图案代表所述至少一种供应链组件,其包括醋酸纤维丝束带的制造商、所述醋酸纤维丝束带的加工点、所述醋酸纤维丝束带的生产线、所述醋酸纤维丝束带的生产批量、所述醋酸纤维丝束带的生产日期、所述醋酸纤维丝束带的捆包、所述醋酸纤维丝束带的仓库、所述纤维带的用户,或者所述醋酸纤维丝束带的运送地点。

21.用于制造根据权利要求19或权利要求20中任意权利要求所述的醋酸纤维丝束带的方法:

其中所述方法包括:

(a)获得所述识别纤维;

(b)以第一纤维生产方法生产所述标准纤维;和

(c)将所述识别纤维和所述标准纤维组合到醋酸纤维丝束带中。

22.根据权利要求21所述的方法,其中所述获得包括所述烙印纤维的所述识别纤维包括至少下述步骤之一:

(i)以第二纤维生产方法生产所述识别纤维部分,接着将所述重复图案中的所述示踪剂表面标志应用于所述识别纤维,以生产所述烙印纤维部分;

(ii)从第三方接收所述识别纤维部分,接着将所述重复图案中的所述示踪剂表面标志应用于所述识别纤维,以生产所述烙印纤维部分;或者

(iii)从所述第三方接收所述烙印纤维部分。

23.根据权利要求22所述的方法,其中应用所述重复图案中的所述示踪剂表面标志包括雕刻、印刷,或者形态学修饰。

24.根据权利要求22所述的方法,其中所述应用包括在生产所述标准纤维的同时将所述重复图案中的所述示踪剂表面标志印刷或者激光雕刻在所述烙印纤维上,并且在卷曲所述醋酸纤维丝束带之前将所述烙印纤维和所述标准纤维组合。

25.一种用于表征纤维样品的方法,其中所述纤维样品包括权利要求1至16中任意权利要求所述的纤维,或者根据权利要求17至20中任意权利要求所述的制品,

其中所述方法包括:

(1)将所述烙印纤维从所述纤维样品分离

(2)对所述烙印纤维应用成像技术

(3)确定所述示踪剂表面标志的重复图案。

26.根据权利要求25所述的方法,其中所述分离包括将所述纤维样品置于溶剂中以产生包括所述纤维样品的溶解部分和所述烙印纤维的溶液,和从所述溶液去除所述烙印纤维。

27.根据权利要求25至26中任意权利要求所述的方法,其中所述成像技术选自由人类的视觉检测、显微镜、电子显微镜、共聚焦显微镜和光扫描组成的群组。

28.根据权利要求25至27中任意权利要求所述的方法,其进一步包括将所述示踪剂表面标志的重复图案与包括制造商特异的示踪剂的数据库相关联,和确定所述至少一种供应链组件,其中所述至少一种供应链组件包括所述标准纤维的制造商、所述标准纤维的加工点、所述标准纤维的生产线、所述标准纤维的生产批量、所述标准纤维的生产日期、所述标

准纤维的包装、所述标准纤维的仓库、所述标准纤维的用户、所述标准纤维的运送地点、包括所述纤维的纤维带的制造商、所述纤维带的加工点、所述纤维带的生产线、所述纤维带的生产批量、所述纤维带的生产日期、所述纤维带的包装、所述纤维带的仓库、所述纤维带的用户、所述纤维带的运送地点、包括所述纤维的制品的制造商、所述制品的加工点、所述制品的生产线、所述制品的生产批量、所述制品的生产日期、所述制品的包装、所述制品的仓库、所述制品的用户，或者所述制品的运送地点。

29.根据权利要求28所述的方法，其中所述纤维样品包括过滤器部分，其中所述过滤器包括醋酸纤维丝束带，其中所述方法进一步包括将所述示踪剂表面标志的重复图案与包括生产特异的示踪剂的数据库相关联，并且其中所述至少一种供应链组件包括所述醋酸纤维丝束带的捆包。

具有用于编码的表面标志的纤维

[0001] 对相关申请的交叉引用

[0002] 本申请根据35U.S.C.119(e)要求2014年6月27日提交的美国临时申请序列号62/018182、2015年1月19日提交的美国临时申请序列号62/105011，和2015年5月20日提交的美国临时申请序列号62/164135的优先权，各申请全部在此通过引用并入。

技术领域

[0003] 本申请涉及纤维、纤维带，或者包含烙印纤维的纱线。所述烙印纤维能够呈现表面标志的重复图案。所述表面标志的重复图案能够与所述纤维带或者纱线的供应链信息相关联。本申请还涉及用于制造和表征所述纤维带或者包含所述烙印纤维的纱线的方法。表征所述纤维带或纱线能够包括分离所述烙印纤维、解码表面标志的重复图案，和将表面标志的重复图案与供应链信息相关联。供应链信息能够用于从制造、经过中间商、转化为终产品和/或用户跟踪所述纤维带或纱线。

背景技术

[0004] 许多行业有对产品进行标志、贴标签或识别的需求，这允许通过供应链跟踪和追溯产品。这样的跟踪和追溯系统的一个主要目的是打击非法贸易诸如伪造和黑市销售。

[0005] 防伪措施(ACM)被认为有三种不同类型：类型I(明显的)、类型II(隐蔽的)和类型III(司法的)。类型I的ACM是能够被容易地识别并且肉眼可以观察到的并入制品中的特征。实例包括水印，变色油墨，并入制品中的着色纤维、着色带或者着色条，以及全息照相。类型II的ACM是并入制品中的特征，其需要有些形式的仪器在本领域中识别该特征。所需要的仪器一般是那些容易获得并且便携的。有些实例包括并入非常小的文字(需要使用放大镜)、UV反应性油墨或线(需要使用UV光照射)，以及条形码或者RFID标签(需要专门的读码器)。类型III的ACM是需要专门的实验室设备来识别的隐藏特征。有些类型III的实例包括纳米字体、微示踪剂、DNA油墨和化学添加剂。

[0006] 如上文所述，在许多行业中有许多广泛使用的包装和标识标签以及防伪措施(ACM)，但是这些较为明显的解决方案通常容易受到反措施诸如毁坏、修饰、复制、重新包装或者重新标识的影响。改变产品原材料的物理特征能够提供更难以被规避的更隐蔽的方案。这些示踪剂可以被用于通过供应链跟踪纤维。所述示踪剂可以以一种难以复制或改变但是使用图像分析和/或其他机械方法可以检测的方式改变所述纤维、纱线纤维带和/或衍生制品的物理特性。

[0007] 各种不同的行业均需要制造、测试和跟踪纤维带或纱线以及他们的衍生制品中的纤维。通过在制造过程中将能够随后在后期被识别、恢复并用于识别所述纤维带和/或所述制品的有些形式的密码嵌入纤维中，能够实现对纤维带、纱线和/或包含所述纤维带或纱线的制品的来源识别。

[0008] 识别标签能够被并入所述纤维、纤维带或纱线中，其能够指示例如制造商、加工点、用户和运送地点以及其他供应链信息，这些信息可能有益于跟踪和追溯所述纤维带、纱

线和/或制品。

[0009] 公开的示例性实施方案能够用于例如对抗持续的和不断增长的烟草产品尤其是香烟的非法贸易问题。曾有估计，全部香烟销售的10-12%是非法的，要么是假冒品，要么是逃避支付香烟消费税的销售(烟草国际，“打击非法交易，Pt.I，”2013年12月)。为了对抗这种非法贸易，需要包括制造商、经销商、监管者和用户/执法机关，以及将香烟售卖给销售者的零售商在内的全球的努力。需要能够跟踪并最终能够追溯构成香烟的组分。例如，能够跟踪黑市香烟滤嘴中含有的醋酸纤维丝束的部分供应链途径可以就这些非法香烟的来源提供有用信息。

[0010] 醋酸纤维丝束制造商通常给生产的每捆包醋酸纤维丝束分配一个捆包识别码(即编号)。分配后，该捆包识别码与供应链组件诸如制造商、加工点、生产线、生产批量和生产日期相关联。当醋酸纤维丝束捆包在供应链上移动时，能够将另外的供应链组件诸如例如用户和运送地点与捆包识别码相关联。也就是说，醋酸纤维丝束制造商具有适当的系统以跟踪和追溯醋酸纤维丝束捆包的某些供应链组件。但是，目前在醋酸纤维丝束带本身中并未编码类似捆包识别码的编码。因此，一旦所述标签从醋酸纤维丝束捆包移除，或者所述醋酸纤维丝束带转至滤棒或者香烟滤嘴，则供应链的信息就丢失了。

[0011] 需要可追踪的醋酸纤维丝束，其能够容易地制造，不影响香烟滤嘴的性能，并且不仅能够在醋酸纤维丝束带中能被检测，而且也能够在单支或一组香烟/香烟滤嘴中被检测。需要可追踪的醋酸纤维丝束，其能够容易地被香烟制造商和用户所接受，例如不需要添加可能影响口感的化学物和/或需要注册审批的醋酸纤维丝束。需要可追踪的醋酸纤维丝束，其不影响香烟滤嘴的压力降和产量。需要可追踪的醋酸纤维丝束，其在镀膜、塑化和形成滤嘴时保持其可追溯性。

[0012] 需要可追踪的醋酸纤维丝束，其包含包括制造商、用户或者运送地点在内的供应链信息，以至于能够从单支或一组香烟中解码这些信息。进一步需要含有醋酸纤维丝束捆包水平的供应链信息的可追踪的醋酸纤维丝束，以实现具有最低供应链成本和复杂性的可追踪醋酸纤维丝束系统。

发明内容

[0013] 实施方案公开了包括标准纤维一种或多种识别纤维的纤维。每种所述识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述示踪剂表面标志和所述重复图案代表所述标准纤维的至少一种供应链组件。

[0014] 另外公开的实施方案包括醋酸纤维丝束带，所述醋酸纤维丝束带包括纤维。所述纤维包括一种或多种识别纤维和标准纤维，并且所述标准纤维包括醋酸纤维素。每一种识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述示踪剂表面标志和所述重复图案代表所述醋酸纤维丝束带的至少一种供应链组件。

[0015] 进一步的实施方案包含制造包括纤维的醋酸纤维丝束带的方法。所述纤维包括标准纤维和识别纤维，并且所述标准纤维包括醋酸纤维素。所述方法包括：(a)获得所述识别

纤维；(b)以第一纤维生产方法生产所述标准纤维；和(c)将所述识别纤维和所述标准纤维组合到醋酸纤维丝束带中。每一种识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述示踪剂表面标志和所述重复图案代表所述醋酸纤维丝束带的至少一种供应链组件。

[0016] 另外的实施方案还包含表征纤维样品的方法。所述纤维样品包括纤维并且所述纤维包括标准纤维和识别纤维。每一种识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述方法包括：(1)任选地将所述烙印纤维从所述纤维样品分离；(2)对所述烙印纤维应用成像技术；(3)确定所述示踪剂表面标志的所述重复图案。所述示踪剂表面标志和所述重复图案代表所述纤维样品的至少一种供应链组件。

附图说明

[0017] 图1显示了在共生产醋酸纤维丝束纤维时烙印纤维并将它们组合到醋酸纤维丝束带中的非限制性实施方案的示意流程图。

[0018] 图2图解了实施例1的打印机设置。

[0019] 图3A显示了烙印尼龙单丝的显微照片，该尼龙单丝从滤棒回收，并且3B显示了烙印涤纶线的显微照片，该涤纶线从卷曲的醋酸纤维丝束带回收。

[0020] 图4显示使用MACSA二氧化碳激光雕刻的腈纶单丝纤维的显微照片。

[0021] 图5A和5B与公开实施方案一致，显示一个或多个实体之间通信和运送通道的非限制性实施例。

[0022] 图6与公开实施方案一致，显示一个或多个实体所使用的计算系统的非限制性实施例。

[0023] 图7与公开实施方案一致，显示了用于将供应链信息嵌入纤维的方法的非限制性实施例。

[0024] 图8和图9与公开实施方案一致，显示了用于生成相关性数据的方法的非限制性实施例。

[0025] 图10与公开实施方案一致，显示了用于生产识别纤维的方法的非限制性实施例。

[0026] 图11与公开实施方案一致，显示了用于从样品确定供应链信息的方法的非限制性实施例。

[0027] 图12与公开实施方案一致，显示了用于给供应链组件分配示踪剂信息的方法的非限制性实施例。

具体实施方案

[0028] 实施方案公开了包括一种或多种识别纤维的纤维。每种所述识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述示踪剂表面标志和所述重复图案代表所述标准纤维的至少一种供应链组件。

[0029] 除非另行说明，本说明书和权利要求中使用的表示成分、性质诸如分子量、反应条件等的量的全部数字应当理解为在所有情况下由术语"约"所修饰。

[0030] 应当理解，提及一个或多个方法步骤不排除在组合的所提及步骤之前或之后存在另外的方法步骤或在明确确定的那些步骤之间存在中间方法步骤。此外，除非另行说明，方法步骤或成分的字母编号是确定不连续活动或成分的方便手段，并且提及的字母编号可以以任何序列排列。

[0031] 如本文所使用的术语"和/或"，当用于一系列的两个或多个项目时，是指列出的项目中的任意一个可以单独使用，或可以采用列出的项目中的两个或多个的任意组合。例如，如果组合物被描述为包含组分A、B和/或C，那么组合物可以包含单独A、单独B、单独C、A和B的组合、A和C的组合、B和C的组合，或A、B和C的组合。

[0032] 如本文所使用的术语"纤维"是指细软的丝状物体。纤维可是天然纤维或者是人造的。如本文所使用的术语"聚合物"是指制造纤维的基本原料。聚合物的非限制性实例包括腈纶、改性腈纶、芳纶、尼龙、涤纶、聚丙烯纤维、人造丝、聚丙烯腈、聚乙烯、PTFE和醋酸纤维素。如本文中所使用的术语"长丝"指单条纤维。如本文中所用的术语"纤维带"是指沿着它们的长彼此相邻放置的多根纤维，以使得所述纤维保持不扭绞或缠绕并形成具有较大宽高比的基本上为长方形的横截面。通常形成纤维带以允许所述纤维有效卷曲并能够根据最终用途切割为短纤维或加工为连续的带。除了首先被转变为短纤维以形成线以外，纤维带通常不编织或针织为织物制品。纤维也能够以纱线的形式存在。如本文所使用的术语"纱线"是指沿着它们的长彼此相邻放置的多根纤维，通常捻在一起或缠绕在一起，以改善纤维的粘结性和性能，并且通常形成基本上为圆形的横截面。纱线能够根据最终用途被加工为连续的线或者被切割为较小的长度。

[0033] 纤维能够为识别纤维和/或标准纤维。如本文所使用的术语"标准纤维"是指为了生产制品中的主要目的和用途而制造的纤维。不曾有目的地调整标准纤维以使其包括用于识别和追踪所述标准纤维，纱线、纤维带和/或包括标准纤维的制品的独特特征。如本文所使用的术语"识别纤维"是指具有独特特征的纤维，以使得所述识别纤维能够被用于识别和追踪所述标准纤维、纱线、纤维带和/或包括所述标准纤维和所述识别纤维的制品。

[0034] 如本文所使用术语"独特特征"是指能够使用成像技术识别的纤维之间的差异。独特特征的非限制性实例包括横截面形状、横截面大小、光学性质和表面标志。如本文所使用的术语"独特特征的组合"是指由识别纤维所呈现的两种或多种独特特征。

[0035] 如本文所使用的术语"光学性质"是指当纤维暴露于特定电磁辐射源时所观察到的电磁辐射反应。该术语包括能够用人眼以及用仪器(诸如能够确定光谱光度信号的仪器)观察到的颜色。电磁辐射的非限制性实例包括x-射线、紫外线、可见光、红外线，和所谓的"T射线"(太赫兹频率)。如本文所使用的术语"示踪剂光学性质"是指由一个或多个制造商在用于识别纤维、纤维带和/或纱线供应链信息的系统中使用的已知光学性质的集合。

[0036] 如本文所使用的术语"表面标志"是指通过物理性改变所述纤维表面而产生的纤维间的差异。非限制性实例包括雕刻所述纤维、形态学修饰、印刷在所述纤维表面，以及化学性产生光学性质模式。如本文所使用的术语"示踪剂表面标志"是指由一个或多个制造商在用于确定供应链信息的系统中使用的已知表面标志的集合。

[0037] 如本文所使用的术语"字母数字编码"是指使用属于常用字母和数字系统或语言

的字符或书写文字所代表的信息，包括特殊字符诸如标点符号，并且包括那种语言的任意手写或印刷形式。非限制性实例包括拉丁字母、罗马数字和阿拉伯编号。

[0038] 如本文所使用的术语“数字编码”是指使用一串离散的、不连续的数值代表的信息。非限制性实例包括二进制编码系统、莫尔斯电码、条形码系统(包括1-D线性和2-D矩阵)。

[0039] 如本文中所使用的术语“模拟编码”是指通过调整连续的可变物理量诸如空间位置、维度或数量级而代表的信息。

[0040] 如本文中所使用的术语“表意编码”是指不依赖于任意特别的语言或字母数字系统，由图形符号或象形文字代表的信息。

[0041] 如本文中所使用的术语“元数据”是指所述图案的一部分或许多部分，其代表的编码含有关于该图案中的剩余编码的信息。这种信息的非限制性实例包括该图案代表的任意编码的形式、读数起始位置、读数终止位置、读数方向。所述元数据还可以包括代表所述纤维的制造商的信息。所述元数据可以使用与所述图案的剩余部分所使用的编码系统相同或相似的编码系统，或者其可以使用不同的编码系统，以便更容易地将其与所述图案的剩余部分区分开来。

[0042] 如本文中所使用的术语“读数起始位置”是指编码或编码的一部分开始的位置。

[0043] 如本文中所使用的术语“读数终止位置”是指编码或编码的一部分终止的位置。

[0044] 如本文中所使用的术语“读数方向”是指为了可靠地解码信息，编码的特定部分必须读取的线性方向。

[0045] 如本文中所使用的术语“所述重复图案本质上是一维的”是指一种图案，其中与所述图案相关的有用信息是沿着一个方向的，或者能够通过沿着穿过图案的单一线条观察差异而确定。

[0046] 如本文中所使用的术语“雕刻”是指从所述纤维表面去除材料，或者在所述纤维表面造成突起或凹陷的区域，从而使得在纤维表面上形成的间断点能够通过视觉检测，或者通过其他分析手段检测。雕刻能够通过接触设备实施，诸如使用砂面、刀片或者轧花机的设备，或者通过非接触设备实施，诸如激光或其他高能量辐射源。

[0047] 如本文中所使用的术语“激光雕刻”是指使用激光雕刻纤维表面。

[0048] 如本文中所使用的术语“形态学修饰”是指所述纤维或者所述纤维表面的物理形式或条件的改变，以至于所述改变能够视觉观察到，要么人工地，要么通过放大，或者通过其他分析技术。形态学修饰的非限制性实例包括质地、粗糙度、不透明度、结晶度、密度，或者聚合物取向度的改变。形态学修饰能够通过接触设备实施，诸如使用砂面的设备，或者通过非接触设备实施，诸如激光或其他高能量辐射源。

[0049] 如本文中所使用的术语“沿着长改变”是指沿着识别纤维的长使用一种或多种表面标志的各种标准和/或图案。如本文中所使用的术语，“重复图案”是指沿着所述识别纤维的长重复的表面标志的相同排列。每一个重复图案代表相同信息的相同编码。

[0050] 如本文中所使用的术语“基本上不易受溶剂粘结的影响”是指一种条件，其使得所述纤维在所述纤维或者由所述纤维制成的制品的正常加工条件下不能充分溶解于粘结剂中，以允许当粘结剂存在于接触点时，在两种或多种纤维的接触点处永久粘结。

[0051] 如本文中所使用的术语“基本上不溶解于溶剂中”是指一种条件，其使得所述纤维

不充分溶解于溶剂中，以至于当在某种条件组下暴露于那种溶剂时，所述纤维和任意表面标志仍然能被检测到。

[0052] 如本文中所使用的术语“纤维样品的溶解部分”是指含有溶解的标准纤维和溶解试剂的一种溶液，排除所述样品中的任何不溶解识别纤维。

[0053] 如本文中所使用的术语“醋酸纤维素”是指纤维素醋酸酯，其中纤维素葡萄糖单元中的羟基基团中的氢通过乙酰化反应由乙酰基团所取代。在有些实施方案中，适宜的醋酸纤维素可能具有每个葡萄糖单元少于大约3个乙酰基团的取代程度，优选在2.2至大约2.8的范围内，并且最优选在2.4至2.7的范围内。

[0054] 如本文中所使用的术语“醋酸纤维素丝束”、“醋酸纤维丝束”、“醋酸纤维丝束带”是指连续的卷曲纤维带，其包括醋酸纤维素纤维。

[0055] 如本文中所使用的术语“制品”是指自标准纤维、纱线和/或纤维带产生的单元，其包括为了满足预期用途的功能性需求所需要的其他组件和附加物。非限制性实例包括织物和其他纺织产品、非纺织品、吸收剂产品、过滤器、滤棒、香烟滤嘴和储液器。在承认在有些实施方案中所述纤维、纱线和/或纤维带在其用于制造制品时能够发生显著的物理变化的情况下，如本文中所使用的术语“包括纤维、纱线和/或纤维带的制品”是指包括纤维、纱线和/或纤维带的制品。

[0056] 如本文中所使用的术语“过滤器”是指半渗透性的纤维材料。过滤器的非限制性实例包括滤棒，以及由滤棒制成的物品诸如香烟滤嘴。如本文中所使用的术语“滤棒”是指棒状的制品，具有任意横截面形状，由纤维带和其他的组件或附加物制成，其随后能够被用作一个完整的单元，或者被截成段以形成多数单元，用于过滤气流。滤棒能够用于过滤烟制品，例如，传统的香烟滤嘴和/或包括热不燃制品的其他烟制品的其他应用。滤棒还能够用于包括烟草和其他组分(诸如例如其他植物或植物衍生物)的新产品。滤棒能够在存在或不存在烟草的情况下用于过滤其他植物和植物衍生物。此外，滤棒能够用于过滤用于传递诸如在电子香烟中的活性组分的任何气流。

[0057] 如本文中所使用的术语“香烟滤嘴”是指香烟或者其他吸烟装置的一种组件，其去除或减少烟气流中的一种或多种成分。该术语香烟滤嘴旨在包含任意吸烟装置(包括香烟、香烟烟斗、雪茄、雪茄烟斗、烟枪、水烟枪、水烟袋、电子吸烟装置、手卷香烟、手卷雪茄和烟纸的非限制性实例)上的过滤器。

[0058] 如本文中所使用的术语“供应链信息”是指关于所述标准纤维、纱线和/或纤维带生产的信息和关于所述标准纤维、纱线和/或纤维带在其生产之后的销售的信息。供应链信息包括“供应链组件”，造诸如例如制商、加工点、生产线、生产批量、生产日期、包装、捆包、用户、用户收货地址、仓库、承运人，和/或运输路径或路线。供应链组件适用于纤维、纱线、纤维带和/或制品。

[0059] 如本文中所使用的术语“制造商”是指生产所述标准纤维、纱线和/或纤维带的实体。

[0060] 如本文中所使用的术语“加工点”是指以任意详尽程度指定的制造商的地理位置或地点，包括详细地址、洲、国家、州、省、县，或市。

[0061] 如本文中所使用的术语“生产线”是指由制造商用于生产所述标准纤维、纱线和/或纤维带的专门加工设备或设备组。

[0062] 如本文中所使用的术语“生产批量”是指使用一套特定的制造程序、方法或条件，和/或产品说明而生产的一组或一套相同或相关的商品。

[0063] 如本文中所使用的术语“用户”是指一种实体，将所述纤维、纤维带和/或纱线售卖和运送给该实体用于进一步加工为中间制品或者终产品制品；或者是购买所述纤维、纱线和/或纤维带用于转售的实体。

[0064] 如本文中所使用的术语“运送地点”是指以任意详尽程度指定用于递送所述纤维、纱线和/或纤维带的用户的地理位置，包括详细地址、洲、国家、州、省、县，或市。

[0065] 如本文中所使用的术语“捆包”是指纤维带的包装单位，通常具有立方体形，压缩为高密度，并且由包装材料包裹、容纳和保护。

[0066] 如本文中所使用的术语“仓库”是指以任意详尽程度指定用于递送所述纤维、纱线和/或纤维带的仓库的地理位置，包括详细地址、洲、国家、州、省、县，或市。

[0067] 如本文中所使用的术语“相关联”是指在一条或多条信息之间建立联系。

[0068] 如本文中所使用的术语“制造商特异示踪剂”是指由特定的制造商并入纤维、纱线和/或纤维带的特定示踪剂。术语“制造商特异示踪剂套组”是指示踪剂横截面形状和/或示踪剂横截面大小与特定的制造商相关。

[0069] 如本文中所使用的术语“纤维被制造”、“制造纤维”和“纤维制造方法”是指通过将纤维聚集在一起而纺成纤维的方法步骤。

[0070] 如本文中所使用的术语“与生产同时”是指在所述识别纤维与所述标准纤维组合之前或者之后，在生产所述标准纤维的同时表面标记识别纤维的过程。

[0071] 如本文中所使用的术语“包装识别纤维”是指将识别纤维从纺纱机上转移并包装所述识别纤维的方法步骤，例如到线轴上或者形成捆包。接着需要将所述识别纤维从包装上去除，以便将其并入纤维、纱线、纤维带，和/或包括所述标准纤维的制品中。

[0072] 如本文中所使用的术语“纤维样品”是指包括以任意物理形式存在的纤维的物品，使用成像技术对其进行分析。所述纤维样品能够包括一组纤维的一部分、纱线、纤维带，或者经制备用于图像分析的制品。

[0073] 如本文中所使用的术语“成像技术”和“图像分析技术”是指用于检测和定量电磁辐射的反射、吸收、传播和发射差异的设备和软件。成像技术包含电磁辐射水平检测和自动化形状和/或大小识别两种。

[0074] 纤维、纤维带和/或纱线包括单独的纤维。用于制造纤维的材料不是特别限定的。所述纤维能够包括例如腈纶、改性腈纶、芳纶、尼龙、涤纶、聚丙烯纤维、人造丝，或者醋酸纤维素。在一个方面，所述纤维包括醋酸纤维素、三乙酸纤维素、丙酸纤维素、丁酸纤维素、醋酸-丙酸纤维素、醋酸-丁酸纤维素、丙酸-丁酸纤维素、邻苯二甲酸醋酸纤维素、醋酸酯淀粉、丙烯腈、氯乙烯、乙烯酯、乙烯醚，以及类似物、其任意衍生物，其任意共聚物，和其任意组合。在一个方面，所述纤维包括醋酸纤维素。在一个方面，所述纤维包括天然纤维诸如例如棉花、大麻，和/或蚕丝。

[0075] 在一个方面，所述纤维、纤维带或者纱线包括标准纤维和一种或多种识别纤维。纤维通常自聚合物生产。在一个方面，一种或多种所述识别纤维包括与标准纤维相同的聚合物。在另一个方面，一种或多种所述识别纤维包括与标准纤维带不同的聚合物。在一个方面，所述示踪剂表面标志和所述重复图案代表所述纤维的编码。在其他方面，所述纤维包括

识别纤维和标准纤维，并且所述编码代表所述纤维和/或标准纤维的至少一种供应链组件。

[0076] 单独的纤维的尺寸不是特别限定的。尺寸能够用有效直径表示，并且在一个方面，所述纤维的有效直径的范围是例如从0.1μm到1000μm、1μm到500μm、1μm到100μm、1μm到30μm、10μm到1000μm、10μm到500μm、10μm到100μm、10μm到30μm。在一个方面，所述标准纤维包括醋酸纤维素，其尺寸经常以每根丝的丹尼尔(dpf)表示，其定义为9000米长的单股丝以克计的重量。在一个方面，所述纤维的尺寸范围是从0.5到1000dpf、0.5到500dpf、0.5到100、0.5到5dpf、0.5到30dpf、0.5到10dpf、1到1000dpf、1到500dpf、1到100、1到5dpf、1到30dpf、1到10dpf。在一个方面，所述纤维的dpf范围是从例如1到30dpf、1到20dpf、1到10dpf、2到30dpf、2到20dpf，或者2到10dpf。

[0077] 组成纤维带的纤维的数目不是特别限定的。在一个方面，纤维带中的纤维的数目的范围可以从10到50,000。在另一个非限定性实例中，纤维带中的纤维的数目的范围从10到40,000、10到30,000、10到20,000、10到10,000、10到1000、100到50,000、100到40,000、100到30,000、100到20,000、100到10,000、100到1000、200到50,000、200到40,000、200到30,000、200到20,000、200到10,000、200到1000、1000到50,000、1000到40,000、1000到30,000、1000到20,000、1000到10,000、5000到50,000、5000到40,000、5000到30,000、5000到20,000、5000到10,000、10,000到50,000、10,000到40,000、10,000到30,000，或者10,000到20,000。

[0078] 识别纤维能够包括一种或多种烙印纤维。所述烙印纤维呈现一种或多种示踪剂表面标志，其中所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。在一个方面，烙印纤维能够是单丝，其中所述示踪剂表面标志沿着所述单丝的长形成重复图案。在另一个方面，所述烙印纤维能够是线或纱线，其中所述示踪剂表面标志沿着所述线或纱线的长形成重复图案。所述重复图案能够表示一种编码，所述编码能够与信息诸如例如供应链信息相关联。

[0079] 在有些方面，所述重复图案包括字母数字编码、数字编码、模拟编码，或者表意编码。在有些方面，所述重复图案包括字母数字编码或者数字编码。在有些方面，所述重复图案包括数字编码。

[0080] 沿着所述烙印纤维的长的所述重复图案可以包括元数据。所述元数据在读取烙印纤维上的图案时有用。如果并入制品中的烙印纤维的长与重复图案的长近乎相同或者较短，则所述元数据能够特别有用。在一个方面，所述元数据包括读数起始位置、读数终止位置、读数方向、或者编码内数字的间隔。

[0081] 所述重复图案的数字编码不是特别限定的。在有些方面，该图案是以条形码的形式存在，要么是1-D线性形式的编码，要么是2-D矩阵形式的编码。在有些方面，所述图案可以是莫尔斯编码的可视化表示形式。在有些方面，所述数字编码包括二进制编码。在一个方面，所述重复的图案基本上是一维的。

[0082] 在一个方面，所述数字编码是二进制编码系统，每个二进制数字的两种条件或特征可以是在数字或位置中存在或不存在表面标志。在其他的方面，所述两种条件可以是数字中的两种不同表面标志中的一种。在有些方面，所述数字编码可以是x进制的位值制的二进制表示形式，其中x是2的幂(或者二进制)。在一个方面，例如，当要编码大量组合或者整数值时，可以使用十六进制(16基数)编码系统以提供一种比简单的二进制串更紧凑的标记

法。在这样的十六进制系统的一个非限制性例证中，4个二进制数字能够组成该十六进制编码的每一个数字，从而为每个十六进制数字提供16种组合或条件。X进制编码系统还能够由任意数字或空间位置中的数量x的唯一表面标志来表示。在一个非限制性实例中，5个不同色点能够形成5进制编码系统的基础。

[0083] 在所编码信息的单一字符串中可以使用多重编号或编码系统。在有些方面，所述重复图案能够包含一部分二进制编码，其序列用于表示纤维或制品的制造商，并且所述图案的另一部分是十六进制系统的二进制表示形式，用于代表所述制造商的唯一捆包号码。

[0084] 本领域技术人员认识到，对于二进制编码的数字个数的选择取决于所获取信息的复杂度和所述示踪剂表面标志的可用空间。在一个方面，二进制编码中的数字个数的范围从2到500。在其他非限定性实例中，二进制编码中的数字个数的范围从4到100、10到100、20到100、4到50、10到50，或者20到50。

[0085] 本领域技术人员还认识到，所述纤维上所述重复图案的长可能受到并入典型制品中的纤维的长的影响。在一个方面，所述重复图案的长的范围从2mm到500mm。在另一个非限制性实例中，所述重复图案的长的范围从2到200mm、2到30mm、10到200mm，或者10到30mm。

[0086] 只要该图案可以识别，则所述重复图案出现在烙印纤维上的方式不是特别限定的。所述重复图案如何并入在所述烙印纤维上的非限制性实例包括印刷、雕刻、纤维形态学修饰，或者用化学方法生产具有光学性质的图案。

[0087] 在有些方面，所述纤维进一步包括标准纤维。在有些方面，通过物理手段或者化学手段将所述烙印纤维容易地与所述标准纤维分离。为了促进烙印纤维的分离，所述烙印纤维能够包括与所述标准纤维不同的聚合物。在有些方面，所述烙印纤维基本上不溶解于溶剂中，而其中所述标准纤维溶解于那种相同的溶剂中。在有些方面，所述烙印纤维基本上不溶解于丙酮或者二氯甲烷中。在有些方面，所述烙印纤维基本上不容易受到与三乙酸甘油酯粘结的冷溶剂或者用于通过溶剂粘结所述标准纤维而形成制品的其他任何溶剂或者增塑剂的影响。在有些方面，所述烙印纤维包括腈纶、改性腈纶、芳纶、尼龙、涤纶、聚丙烯纤维、人造丝、聚丙烯腈、聚乙烯、三乙酸纤维素，或者PTFE。

[0088] 制品可以包括纤维、纱线，和/或纤维带。所述制品不是特别限定的。包括所述纤维或所述纤维带的制品的非限制性实例包括织物和其他纺织品，非纺织品、吸收剂产品、过滤器、滤棒、香烟滤嘴、储液器、纸张和/或货币。在一个方面，所述制品包括滤棒。在另一个方面，所述制品包括香烟滤嘴。制品的另外非限制性实例包括医疗用品(诸如医用胶带、绷带或者布)，用于递送蒸汽的吸湿装置，以及包括包装的医药产品。

[0089] 在一个方面，所述纤维、纱线、纤维带和/或制品具有可确定的供应链信息。所述供应链信息能够包括制造商、加工点、生产线、生产批量、生产日期、包装、捆包、仓库、用户，和/或运送地点。

[0090] 在一个方面，所述供应链信息包括供应链组件。在一个方面，至少一种供应链组件包括所述标准纤维的制造商、所述标准纤维的加工点、所述标准纤维的生产线、所述标准纤维的生产批量、所述标准纤维的生产日期、所述标准纤维的包装、所述标准纤维的仓库、所述标准纤维的用户、所述标准纤维的运送地点、包括所述标准纤维的纱线或者纤维带的制造商、所述纱线或者纤维带的加工点、所述纱线或者纤维带的生产线、所述纱线或者纤维带的生产批量、所述纱线或者纤维带的生产日期、所述纱线或者纤维带的包装、所述纱线或者

纤维带的仓库、所述纱线或者纤维带的用户、所述纱线或者纤维带的运送地点、包括所述标准纤维的制品的制造商、所述制品的加工点、所述制品的生产线、所述制品的生产批量、所述制品的生产日期、所述制品的包装、所述制品的仓库、所述制品的用户，或者所述制品的运送地点。

[0091] 在另一个方面，至少一种供应链组件包括所述纱线或纤维带的制造商。在一个方面，所述供应链组件包括所述纱线或纤维带的加工点。在一个方面，所述供应链组件包括所述纱线或纤维带的生产线。所述纱线或纤维带的生产线是在其上生产所述纱线或纤维带的生产线。在一个方面，所述供应链组件包括所述纱线或纤维带的生产批量。所述纱线或纤维带的生产批量是在其中生产所述纱线或纤维带的生产批量。在一个方面，所述供应链组件包括所述纱线或纤维带的生产日期。所述纱线或纤维带的生产日期是在其时生产所述纱线或纤维带的生产日期。在一个方面，所述供应链组件包括所述纱线或所述纤维带捆包的包装。在一个方面，所述供应链组件包括所述纱线或纤维带的仓库。所述纱线或纤维带的仓库是制造商计划将所述纤维带送至其中或者已经送至其中的仓库。在一个方面，所述供应链组件包括所述纱线或纤维带的用户。所述纱线或纤维带的用户是制造商计划将所述纱线或者纤维带送与或已经送与的用户。在一个方面，所述供应链组件包括所述纱线或纤维带的运送地点。所述纱线或纤维带的运送地点是制造商计划将所述纱线或者纤维带送至或已经送至的特定地理位置。

[0092] 下列是可能的二进制编码系统的非限制性例证，其阐明了在典型的香烟滤嘴中含有的烙印纤维上创造许多不同编码组合的能力。

[0093] 在下述实施例1的操作中，一根典型的21mm长香烟滤嘴中的卷曲的单丝纤维或线的长显示为大约25.2mm。此外，使用实施例的打印机显示可以容易地达到0.5mm的印刷标志跨距。将这样的跨距应用于25mm纤维长度将允许在每个香烟滤嘴中的烙印纤维上编码高达50比特或数字。每比特将包含二进制形式(0或者1)的信息，对应于在所述空间中存在或者不存在印刷标志。

[0094] 为了消除解码中的平移和旋转解码错误，可能想要具有编码序列的标头形式的元数据。所述标头能够提供读数起始点和读数方向信息。这样的标头将允许可靠解码具有每个香烟滤嘴一个编码这样低的编码频率的任意一个香烟滤嘴。所述标头可以采用二进制序列的形式，其被指定为不会与编码本身的字符相混淆。例如，对于二进制标记法中的十六进制系统，可以使用10比特的序列0011111010。

[0095] 对于这个实施例中可用的50比特中剩下的40比特，39比特可以用于以二进制形式表达8个十六进制字符(8x 4数字，加上每4个数字字符之间的间距)，以编码采用(####_####_####_####_####_####_####_####)形式的序列。使用这一形式，可以生成4,294,967,296个唯一编码，或者，通过使用标准的二进制编码，可以生成0到4,294,967,295的编号。这些编码或者编号能够与供应链信息诸如捆包编号相关联。

[0096] 为了进一步阐明实施例，将编号4,294,967,295转换为其十六进制的二进制形式11110111101111011110111101111011110111101111。包括标头的完整编码将是0011111010111101111011110111101111011110111101111。

[0097] 目前全球对用于香烟滤嘴的醋酸纤维丝束的需要为大约700,000,000kg每年。假定平均捆包重量为500kg，那么一年中产生的捆包总数是大约1.4M。这一实施例的印刷编码

系统的实现因而能够在捆包水平上为超过3000年的生产价值编码供应链信息。在有些方面，在每个编码中使用较少的数字，并且典型的香烟滤嘴包含示踪剂表面标志的一个以上重复图案。

[0098] 另外公开的实施方案包含包括纤维的醋酸纤维丝束带。所述纤维包括一种或多种识别纤维和标准纤维，并且所述标准纤维包括醋酸纤维素。每种所述识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述示踪剂表面标志和所述重复图案代表所述醋酸纤维丝束带的至少一种供应链组件。

[0099] 醋酸纤维丝束带的实施方案包含包括纤维的醋酸纤维丝束带，其具有如上所公开的特性的任意组合。具体而言，有识别纤维的组成、纤维的尺寸和数目、烙印纤维、表面标志、重复图案、重复图案的长度、供应链信息，以及适用于醋酸纤维丝束带的非限制性编码/关联性系统。

[0100] 在一个方面，所述至少一种供应链组件包括所述醋酸纤维丝束带的制造商、所述醋酸纤维丝束带的加工点、所述醋酸纤维丝束带的生产线、所述醋酸纤维丝束带的生产批量、所述醋酸纤维丝束带的生产日期、所述醋酸纤维丝束带的捆包、所述醋酸纤维丝束带的仓库、所述醋酸纤维丝束带的用户、或者所述醋酸纤维丝束带运送地点。在一个方面，所述至少一种供应链组件包括所述醋酸纤维丝束带的制造商和所述醋酸纤维丝束带的用户。在另一个方面，所述至少一种供应链组件包括所述醋酸纤维丝束带的制造商和所述醋酸纤维丝束带的用户。在一个方面，所述至少一种供应链组件包括所述醋酸纤维丝束带的捆包。

[0101] 进一步的实施方案包含用于制造包括纤维的醋酸纤维丝束带的方法。所述纤维包括标准纤维和识别纤维，并且所述标准纤维包括醋酸纤维素。所述方法包括：(a)获得所述识别纤维；和(b)以第一纤维生产方法生产所述标准纤维；和(c)将所述识别纤维和所述标准纤维组合到所述醋酸纤维丝束带中。每一种所述识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或一种以上示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述示踪剂表面标志和所述重复图案代表所述醋酸纤维丝束带的至少一种供应链部分。

[0102] 用于制造醋酸纤维丝束带的方法的实施方案包含包括纤维的醋酸纤维丝束带，其具有如上所公开的特性的任意组合。具体而言，有识别纤维的组成、纤维的尺寸和数目、烙印纤维、表面标志、重复图案、重复图案的长度、供应链信息，以及适用于用于制造醋酸纤维丝束带的方法的非限制性编码/关联性系统。如上所描述的醋酸纤维丝束带的实施方案的供应链特性也适用于用于制造醋酸纤维丝束带的方法。

[0103] 本领域技术人员认识到，用于制造醋酸纤维丝束带的方法的实施方案一般适用于制造纤维带或者纱线。所述识别纤维能够与标准纤维组合在纱线或者纤维带中。用于制造纱线或者纤维带的方法包含制造纤维、纤维带或者包括纤维的纱线，其具有如上所公开的特性的任意组合。

[0104] 在一个方面，所述标准纤维的至少一部分以纤维生产方法产生。在另一个方面，标准纤维从第三方接收。获得所述识别纤维至少包括下述之一：(i)以标准纤维的纤维生产方法生产至少一部分所述识别纤维，(ii)以与所述标准纤维的纤维生产方法不同的方法生产至少一部分所述识别纤维，或者(iii)从第三方接收至少一部分所述识别纤维。

[0105] 在一个方面，所述识别纤维的一部分与所述标准纤维同时生产，并且在所述纤维生产方法的下游将组成纤维带或者纱线的一部分纤维纺纱并直接组合。

[0106] 什么时候以及在哪里将所述识别纤维进行表面标记不是特别限定的。如果所述识别纤维和所述标准纤维在相同的纺纱设备上同时制造，那么能够在纤维首次物理形成的纺纱工艺起始点和包装纤维之前的任意时间应用表面标志。在有些方面，能够在所述识别纤维和所述标准纤维组合之前实施标记，或者至少在接着加工组合的纤维之前，诸如在卷曲之前。在有些方面，所述烙印纤维以单独的纺纱工艺与所述标准纤维分别制造，能够在他们与标准纤维组合之前的任意时间应用所述表面标志，包括通过第三方，或者在他们与标准纤维的组合同时。在有些方面，能够正好在组合之前或者在包装所述纤维之前的任意时间点进行标记。

[0107] 表面标记所述识别纤维的方法的非限定性实例包括印刷、雕刻、形态学修饰，和用化学方法生产具有光学性质的图案。在有些方面，可以使用商购高速打印机(诸如喷墨打印机，或者指定目的的常规打印机)进行表面标志的印刷。能够使用一种颜色的单一油墨或者使用多重油墨颜色进行印刷。在有些方面，可以通过接触设备实施雕刻，诸如使用砂面、刀片或者压花辊的设备，或者通过非接触设备，诸如激光或者其他高能量辐射源。在有些方面，能够通过接触设备实施形态学修饰，诸如使用砂面的设备，或者通过非接触设备，诸如激光或者其他高能量辐射源。这样的形态学改变的一个非限定性实例是使用能源在其形成过程中诱导所述纤维的间断性快速干燥，从而导致所述纤维光学性质的变化，诸如透明度，或者表面粗糙度的变化。

[0108] 在有些方面，以第二纤维生产方法生产烙印纤维，接着在重复图案中应用示踪剂表面标志。在有些方面，从第三方接收纤维。在重复图案中的示踪剂表面标志能够应用于纤维，以在所述烙印纤维与所述标准纤维组合在醋酸纤维丝束带中之前的任意时间生产烙印纤维。所述重复图案中的所述示踪剂表面标志应用于所述烙印纤维的方式不是特别限定的。在有些方面，所述重复图案中的所述示踪剂表面标志在生产所述标准纤维的同时印刷在所述烙印纤维上。在有些方面，所述重复图案中的所述示踪剂表面标志在生产所述标准纤维的同时激光雕刻在所述烙印纤维上。在有些方面，在卷曲所述醋酸纤维丝束带之前组合所述同时生产的烙印纤维和所述标准纤维。

[0109] 无论所述识别纤维和标准纤维在相同的或不同的设备上制造，在生产所述标准纤维(或者与其组合)的同时标记所述识别纤维是有利的，因为它降低了预-标记纤维的管理和存货的复杂性，并且在正确的时间将这些烙印纤维按照路线发送到指定的生产线，从而确保纤维产品的恰当编码。相比之下，所述识别纤维的同时标记能够通过标准计算机系统(例如PLC或DCS)容易地控制，使得编码自动改变，并且对于所生产的纤维能够基本上即刻编码想要的供应链信息。

[0110] 在另一个方面，所述识别纤维与所述标准纤维分别生产和包装，并且所述识别纤维与所述标准纤维组合以生产纤维带或者纱线。所述标准纤维还可以在与所述识别纤维组合之前被包装，或者所述识别纤维可以在包装所述纤维带或者纱线之前与所述标准纤维组合。

[0111] 用于生产所述纤维的纺纱工艺不是特别限定的。在一个方面，使用干法纺丝、溶液纺丝、熔融纺丝、静电纺丝、凝胶纺丝、多组分纺丝、熔喷法，和/或溶吹法生产所述纤维。在

另一个方面，使用干法纺丝、溶液纺丝、熔融纺丝、静电纺丝、凝胶纺丝和/或多组分纺丝生产所述纤维。在进一步的方面，所述标准纤维包括醋酸纤维素并且使用干法纺丝生产。

[0112] 在有些方面，所述重复图案中的示踪剂表面标志通过包括雕刻、印刷或者形态学修饰的方法应用。在有些方面，所述重复图案中的所述示踪剂表面标志通过一种方法应用，所述方法包括在生产所述标准纤维的同时在所述烙印纤维上的重复图案中印刷所述示踪剂表面标志，并且在卷曲所述醋酸纤维丝束带之前将所述烙印纤维和所述标准纤维组合。还在另外的方面，所述重复图案中的所述示踪剂表面标志通过一种方法应用，所述方法包括在生产所述标准纤维的同时在所述烙印纤维上的重复图案中激光雕刻所述示踪剂表面标志，并且在卷曲所述醋酸纤维丝束带之前将所述烙印纤维和所述标准纤维组合。

[0113] 图1显示了在共生产醋酸纤维丝束纤维并将其组合到醋酸纤维丝束带中的同时烙印纤维的非限制性实施方案的示意流程图。醋酸纤维丝束带112在生产环境100中生产。将醋酸纤维素纺丝溶液102添加到纤维纺纱工艺120中，其中将其添加到若干纺丝仓中，每个纺丝仓具有若干喷丝头(未显示)。离开每个纺丝仓的纤维108经常被称为末端，其聚集在一起形成被添加入卷曲机130中的带。识别纤维104穿过标记装置110，所述装置在重复图案中赋予表面标志，以产生烙印纤维106。标记装置110的非限制性实例包括打印机和激光。烙印纤维106和醋酸纤维素纤维108聚集在一起并被添加到卷曲机130中以产生卷曲的醋酸纤维丝束带112。

[0114] 还有另外的实施方案包含表征纤维样品的方法。所述纤维样品包括纤维，并且所述纤维包括标准纤维和识别纤维。每种识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述方法包括将成像技术应用于所述烙印纤维并且确定所述示踪剂表面标志的重复图案。所述示踪剂表面标志和所述重复图案代表所述纤维样品的至少一种供应链组件。

[0115] 还有另外的实施方案包含表征纤维样品的方法。所述纤维样品包括纤维，并且所述纤维包括标准纤维和识别纤维。每种识别纤维呈现至少一种独特特征。所述识别纤维包括一种或多种烙印纤维。所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征。所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。所述方法包括：(1)任选地将所述烙印纤维从所述纤维样品分离；(2)对所述烙印纤维应用成像技术；(3)确定所述示踪剂表面标志的重复图案。所述示踪剂表面标志和所述重复图案代表所述纤维样品的至少一种供应链组件。

[0116] 表征纤维样品的方法的实施方案包含表征包括纤维的纤维样品，其具有如上所公开的特征的任意组合。具体而言，有识别纤维的组成、纤维的尺寸和数目、烙印纤维、表面标志、重复图案、重复图案的长度、供应链信息，以及适用于表征纤维样品的方法的非限制性编码/关联性系统。

[0117] 为了表征所述烙印纤维的目的将制品的所述烙印纤维与所述标准纤维分离的方法能够取决于制品的性质，纤维在制品中的取向、缠绕和粘结，以及标准纤维和烙印纤维化学组成的差异。在有些方面，在典型的香烟滤嘴或者类似的溶剂粘结的消光纤维的情况中，所述烙印纤维不易受到在制品生产中使用的溶剂粘结剂的影响，所述烙印纤维能够通过手动或者借助一些其他手段定位(放大或不放大)和移除，以将所述烙印纤维与所述纤维样品

的其余部分物理性分离。在有些方面，所述烙印纤维具有与所述标准纤维不同的溶解度曲线，并且通过使用溶剂和/或条件的正确组合，所述标准纤维能够从所述烙印纤维溶解开。在有些方面，香烟滤嘴包括醋酸纤维素并且所述烙印纤维包括不溶于丙酮的聚合物，以至于丙酮能够被用于将标准纤维溶解开并且将所述烙印纤维分离。在有些方面，自所述纤维样品分离所述烙印纤维包括将所述纤维样品置于溶剂中以产生包括所述纤维样品的溶解部分和所述烙印纤维的溶液，和从所述溶液去除所述烙印纤维。

[0118] 在一个方面，所述标准纤维包括包括醋酸纤维素，并且所述纤维样品包括一部分包括纤维的制品。在有些方面，所述制品能够选自由滤棒和香烟滤嘴组成的群组。在其他方面，所述纤维样品包括一部分包括所述纤维的制品，其中所述制品选自由织物和其他纺织品、非纺织品和吸收剂产品组成的群组。

[0119] 在一个方面，所述成像技术包括使用可视波长的电磁辐射。在另一个方面，所述图像技术包括使用不可视波长的电磁辐射。可用于成像技术的仪器不是特别限定的。非限制性实例包括人类的视觉检测、显微镜、电子显微镜、共聚焦显微镜和光扫描。

[0120] 所述成像技术能够平行于所述纤维的长应用于所述纤维样品。这一方向允许，例如，所述纤维上的表面标志的图案可见。

[0121] 所述成像技术也可以应用于包括所述纤维的制品、纤维带，或者纱线。

[0122] 在一个方面，用于表征所述纤维样品的方法进一步包括(a)将所述示踪剂表面标志和/或所述示踪剂表面标志的重复图案与数据库相关联，所述数据库包括制造商特异的示踪剂；和(b)确定所述纤维样品的至少一种供应链组件。所述供应链组件包括所述标准纤维的制造商、所述标准纤维的加工点、所述标准纤维的生产线、所述标准纤维的生产批量、所述标准纤维的生产日期、所述标准纤维的包装、所述标准纤维的仓库、所述标准纤维的用户、所述标准纤维的运送地点、包括所述纤维的纱线或者纤维带的制造商、所述纱线或者纤维带的加工点、所述纱线或者纤维带的生产线、所述纱线或者纤维带的生产批量、所述纱线或者纤维带的生产日期、所述纱线或者纤维带的包装、所述纱线或者纤维带的仓库、所述纱线或者纤维带的用户、所述纱线或者纤维带的运送地点、包括所述纤维的制品的制造商、所述制品的加工点、所述制品的生产线、所述制品的生产批量、所述制品的生产日期、所述制品的包装、所述制品的仓库、所述制品的用户，或者所述制品的运送地点。在一个方面，所述关联是在独特特征和/或独特特征的组合之间进行。在另一个方面，所述关联是在独特特征、独特特征的组合，和/或每种可辨识的识别纤维的总数之间进行。在另一个方面，所述关联在独特特征、独特特征的组合、每种可辨识的识别纤维的总数，和/或所述示踪剂识别纤维总数之间进行。在一个方面，至少一种供应链组件包括包括纤维的纱线的制造商、所述纱线的加工点、所述纱线的生产线、所述纱线的生产批量、所述纱线的生产日期、所述纱线的包装、所述纱线的仓库、所述纱线的用户、所述纱线的运送地点。

[0123] 在一个方面，所述供应链信息包括所述纱线或者纤维带的制造商。在一个方面，所述供应链信息包括所述纱线或者纤维带的加工点。在一个方面，所述供应链信息包括所述纱线或者纤维带的生产线。所述纱线或纤维带的生产线是在其上生产所述纱线或纤维带的生产线。在一个方面，所述供应链信息包括所述纱线或纤维带的生产批量。所述纱线或纤维带的生产批量是在其中生产所述纱线或纤维带的生产批量。在一个方面，所述供应链信息包括所述纱线或纤维带的生产日期。所述纱线或纤维带的生产日期是在其时生产所述纱线

或纤维带的生产日期。在一个方面，所述供应链信息包括所述纱线或所述纤维带的捆包。在一个方面，所述供应链信息包括所述纱线或纤维带的用户。所述纱线或纤维带的用户是制造商计划将所述纱线或者纤维带送与或已经送与的用户。在一个方面，所述供应链信息包括所述纱线或纤维带的运送地点。所述纱线或纤维带的运送地点是制造商计划将所述纱线或者纤维带送至或已经送至的特定地理位置。

[0124] 在一个方面，所述纤维样品包括一部分纤维，包括醋酸纤维丝束带，其中所述方法进一步包括将示踪剂表面标志的重复图案与数据库相关联，所述数据库包括生产特异的示踪剂，并且其中至少一种供应链组件包括所述醋酸纤维丝束带的捆包。

[0125] 所公开的实施方案还包括制造含有具有任意所公开特征的纤维、纤维带和/或纱线的制品。所公开的实施方案还包括表征包括具有任意所公开特征的纤维、纤维带或者纱线的制品。

[0126] 图5A和5B与公开实施方案一致，阐明了环境500的非限制性实施例，描绘了实体之间的通信和运送通道。在一个实施方案中，图5A和5B的环境500可以包括一个或者多个制造商510，一个或者多个用户520、一个黑市540或者其他非法贸易网络，一个或者多个请求方，一个或多个实验室560，以及通信网络550。包括在环境500(例如，如图5A和5B所示)中的所述组件和组件的布置可以改变。因此，与公开实施方案一致，环境500可以包括在一种或多种方法实施过程中参与或辅助的其他组件。

[0127] 在有些方面，网络550可以是任意形式的网络，经配置以在环境500的组件系统之间提供通信手段(例如，生产系统512和/或实验室系统562)。例如，网络550可以是有助于通信、能交换信息等的任意形式的网络(包括基础设施)，诸如互联网、局域网、近场通讯，和/或能够在与环境500相关的组件系统之间发送和接收信息的其他合适的连接。在其他实施方案中，环境500的一种或多种组件系统可以通过专用通信链接直接通信，诸如制造商510、用户520、请求方530和/或实验室560之间的链接。

[0128] 此外，如上所述，制造商(例如制造商510)可以生成醋酸纤维素纤维和以工业化规模并入醋酸纤维素纤维的纤维产品。在有些实施方案中，所生产的醋酸纤维素纤维和纤维产品可以包括标准纤维和识别纤维。每种识别纤维呈现可视化区分所述识别纤维和所述标准纤维的一种或多种独特特征(例如，独特的横截面尺寸、独特的横截面形状、独特的光学性质，以及另外的或者可选的独特表面标志)。在有些方面，一种或多种所述的独特表面标志可以代表示踪剂表面标志，并且所述识别纤维可以包括一种或多种呈现一种或多种示踪剂表面标志的烙印纤维。在某些方面，所述烙印纤维所呈现的所述示踪剂表面标志可以形成沿着所述烙印纤维的长排列的重复图案。所述重复图案可以例如代表与所述标准纤维、所述识别纤维，和/或纤维，以及包括所述标准纤维和/或识别纤维的纤维产品相关联的至少一种供应链组件。

[0129] 在其他方面，所述重复图案可以代表与所述识别纤维和/或所述标准纤维相关联的编码(例如，如上文所描述的字母数字编码、数字编码、模拟编码，和/或表意编码)。在有些实施方案中，编码的一部分可以代表与所述标准纤维、所述识别纤维，和/或纤维，以及包括所述标准纤维和/或识别纤维的纤维产品相关联的至少一种供应链组件。

[0130] 在有些实施方案中，在醋酸纤维素纤维中包括识别纤维可以使得制造商510能够在运送至用户520之前为醋酸纤维素纤维，并从而为包括所述醋酸纤维素纤维的纤维产品

打上含有供应链信息的标签。举例来说明，与所公开实施方案一致的纤维产品可以包括但不限于醋酸纤维素丝束、散装醋酸纤维素丝束带、醋酸纤维素丝束捆包，和织物，以及包括所述醋酸纤维素纤维和/或丝束的其他制品。

[0131] 例如，在香烟生产情景中，用户520可以使用醋酸纤维丝束捆包以生产各种中间产品和/或最终阶段的产品(例如，散装丝束带、滤棒、过滤器，和/或香烟)，并且这些产品中的一部分最终能够通过他们自己的方式进入黑市(例如黑市440)。因此，因为从具有标记的识别纤维的任意黑市产品的样品可以确定供应链信息，那么有志于打击非法贸易的一方(例如请求方530)可以获得黑市产品并且提交样品用于分析，以便识别与黑市产品相关联的供应链信息。

[0132] 因此，如图5A所示，在一个实施方案中，请求方530可以给制造商510提供样品。在某些方面，制造商510可以使用上文概括的任意示例性技术分析所述样品，以识别与所述样品相关联的至少一种供应链组件。例如，所述样品可以包括标准纤维和识别纤维，其可以包括呈现一种或多种示踪剂表面标志的烙印纤维，所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案。基于所述分析，制造商510可以在识别纤维中识别呈现一种或多种示踪剂表面标志的一种或多种烙印纤维。制造商510还可以识别由所述示踪剂表面标志沿着所述烙印纤维的长形成的重复图案(例如，如上文所述，通过对所述烙印纤维应用成像技术)。

[0133] 在某些方面，制造商510可以获得相关性数据，所述相关性数据将供应链组件映射到所呈现的示踪剂表面标志，以及另外地或可选地映射到所识别的由示踪剂表面标志沿着所述烙印纤维的长形成的重复图案。基于例如所呈现示踪剂表面标志和/或所识别重复图案与所获得相关性数据之间的对比，制造商510可以识别至少一种供应链组件。在有些例子中，制造商510可以给请求方530传送识别至少一种供应链组件的信息(例如，通过网络550)。

[0134] 在如上所述的示例性实施方案中，制造商510可以分析所述样品以识别至少一种与样品相关联的供应链组件。然而，所公开的实施方案不限于由制造商510所实施的示例性分析，并且在进一步的实施方案中，用户520、请求方530，或者第三方(未显示)可以实施分析，以从所标记的纤维识别供应链信息。

[0135] 例如，如图5B所示，实验室560可以代表请求方530并且对样品实施分析，以识别与所述样品相关联的至少一种供应链组件。在有些例子中，实验室560可以代表政府实体、准政府实体，或者能够实施所述分析的私有实体，并且请求方530可以与实验室560签订合同或者雇用实验室560，以在一次性或者重复的基础上实施分析。

[0136] 但是，在其他例子中，实验室560可以由一个或者多个制造商510、用户520，和/或请求方530建立，以定期并且可靠地识别与从非法贸易的醋酸纤维素纤维或者并入所述醋酸纤维素纤维的纤维产品中获得的样品(例如，如由请求方530从黑市540获得)相关的供应链组件。在某些方面，实验室560可以根据由制造商510、用户520，和/或请求方530建立的一种或多种程序实施样品的分析。例如，一个或者多个制造商510、用户520，和/或请求方530可以共同建立标准程序和协议，用于接收和处理样品、分析样品以便以准确和可重复的方式识别供应链组件，并且给制造商510、用户520，和/或请求方530报告所识别的供应链组件部分。此外，在另外的实施方案中，实验室560也可以给各种供应链组件(例如制造商)分配所述示踪剂表面标志、由示踪剂表面标志形成的重复图案，和/或由重复图案所代表的编码

部分，以便唯一地识别这些供应链组件。在进一步的实施方案中，用户520、请求方530，或者第三方(未显示)可以给各种供应链组件(例如制造商)分配所述示踪剂表面标志、由示踪剂表面标志形成的重复图案，和/或由重复图案所表示的编码部分，以便唯一地识别这些供应链组件。

[0137] 如图5B所示，在一个实施方案中，请求方530可以给实验室560提供样品。在某些方面，实验室560可以分析所述样品以识别与样品相关联的至少一种供应链组件(例如制造商)。例如，使用如上所述的任意示例性技术，实验室560可以分析所述样品以识别呈现一种或多种独特特征的识别纤维，包括，例如一种或多种呈现一种或多种示踪剂表面标志的烙印纤维。实验室560可以进一步识别由所述示踪剂表面标志沿着所述烙印纤维的长形成的一种或多种重复图案。此外，实验室560可以获取相关性数据，并且使用如上所描述的任意示例性技术，基于所呈现示踪剂表面标志和所识别重复图案与所获取相关性数据之间的对比来识别至少一种供应链组件。

[0138] 在另外的实施方案中，实验室560可以作为一种集中设备起作用，其给各种供应链组件(例如制造商510)分配唯一的示踪剂表面标志、唯一的重复图案，和由所述重复图案表示的唯一的编码(或者部分编码)。例如，实验室560可以给制造商510分配示踪剂表面标志、由分配的示踪剂表面标志形成的重复图案，和/或由分配的重复图案代表的一部分编码。

[0139] 当其由醋酸纤维素纤维和由制造商510生产的相应纤维产品中包括的烙印纤维所呈现时，所述分配的示踪剂表面标志、分配的重复图案，和/或分配的编码部分可以唯一地代表制造商510，并且可以使得实验室560(并且另外地或者可选地，环境500中的任意其他实体)能够通过使用如上所描述的任意分析技术将制造商510识别为所述纤维或者纤维产品的来源。此外，实验室560(并且另外地或者可选地，环境500中的任意其他实体)也能够建立和维持数据记录(例如，在使用如下所概括的示例性计算机系统实施的集中式数据库中)，所述数据记录识别各种供应链组件(例如制造商510)和所分配示踪剂表面标志、重复图案，和/或编码和编码部分对应项之间的相关性。

[0140] 然而，所公开的实施方案不限于给制造商510分配示例性示踪剂表面标志、示例性重复图案，和/或示例性编码和编码部分。在进一步的实施方案中，实验室560可以分配任意另外的或者可选的示踪剂信息，和进一步的任意另外的或者可选的示踪剂表面标志、重复图案，和/或编码和编码部分的套组或者套组的组合，以唯一地识别制造商510。

[0141] 在某些方面，实验室560可以建立数据和数据记录的集中存储库(例如，使用下文所概括的任意示例性计算机系统)，所述存储库将各种供应链组件(例如制造商510)与示踪剂表面标志、由所述示踪剂表面标志形成的重复图案，和/或由所述重复图案代表的编码和编码部分对应项相关联。此外，在其他方面，实验室560可以使用所述集中存储库并生成一份或者多份报告，具体说明能够唯一地识别至少一种供应链组件(例如，制造商)的所述示踪剂表面标志、由所述示踪剂表面标志形成的重复图案，和/或由所述重复图案代表的编码。在有些例子中，实验室560在预先规定的时间间隔内，或者回应接收到的请求(例如来自请求方530、制造商510等)生成报告，并且可以给环境500中的各方和各实体提供生成的报告(例如，通过网络550)。

[0142] 在有些实施方案中，实验室560可以使用所述集中存储库，以识别与由实验室560确定(例如，使用上文概括的任意分析技术)和另外地或可选地从任意第三方或者环境500

中的其他实体获得的示踪剂表面标志和/或由所述示踪剂表面标志形成的重复图案相关联的至少一种供应链组件(例如制造商510)。此外且如下文所示,所述集中存储库可以使得实验室560能够确定提出的示踪剂表面标志、能够由所述示踪剂表面标志形成的提出的重复图案,和/或可由所述重复图案代表的提出的编码(例如,如制造商510所选)是否能够唯一地代表引入供应链中的制造商510的纤维和纤维产品。

[0143] 在某些实施方案中,实验室560可以从制造商510接收一种或多种提出的示踪剂表面标志、提出的重复图案,和/或可由提出的重复图案代表的提出的编码(或者编码部分)。例如,实验室560可以将提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分)与所建立的数据记录进行比较(例如,在所述集中存储库内),以确定这些提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分)是否能够唯一地识别制造商510(例如,提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分)没有分配给其他供应链组件,诸如另一个制造商)。如果提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分)能够唯一地代表制造商510,则实验室560可以给制造商510分配提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分),更新数据记录以反映该分配,并且为制造商510提供分配确认(例如,通过网络550在实验室560和制造商510的计算机系统之间)。

[0144] 或者,如果实验室560事先将提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分)分配给另一个制造商(或者提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分)不适合代表制造商510),那么实验室560可以给制造商510分配一种或多种替代的示踪剂表面标志、替代的重复图案,和/或能够由所述替代的重复图案代表的替代的编码(或者编码部分),更新数据记录以反映该替代的分配,并且为制造商510提供该替代的分配的确认。在其他方面,实验室560可以给制造商510提供分配提出的示踪剂表面标志、提出的重复图案,和/或提出的编码(或者编码部分)给另一个制造商的暗示,并且要求制造商510提出一种或多种另外的示踪剂表面标志、另外的重复图案,和/或能够由另外的重复图案代表的另外的编码(或者编码部分),如上文所述由实验室560进行分配。

[0145] 在某些方面,通过确认分配,制造商510可以获得和/或生产呈现分配的示踪剂表面标志的烙印纤维,其形成分配的重复图案,并且其代表分配的编码和/或编码部分。然而,在其他方面,制造商510可以进一步将分配的示踪剂表面标志、分配的重复图案、和/或可由分配的重复图案代表的分配的编码(或者编码部分)与一种或多种供应链上游组件(例如加工点、生产线、生产批量、生产日期、捆包)和/或各种供应链下游组件(例如仓库、用户、运送地点等)相关联。例如,制造商510可以进一步具体说明,与分配的重复图案相关联的另外编码或者编码部分(例如与代表制造商510的编码部分不同的那些)唯一地代表供应链中的特定用户(例如,用户520)或者由制造商510生产和运送的特定捆包。

[0146] 然而,所公开的实施方案不限于那些使得制造商510能够将用户520和/或特定捆包与分配的示踪剂表面标志、分配的重复图案、和/或可由分配的重复图案代表的分配的编码(或编码部分)相关联的技术。在进一步的实施方案中,制造商510可以指定任意另外的或者可选的示踪剂信息(例如独特特征、独特特征的组合等),连同分配的示踪剂表面标志、分配的重复图案、和/或由分配的重复图案代表的分配的编码(或编码部分)来代表其他上游

或者下游供应组件(或其组合)。

[0147] 在有些方面,实验室560或者另一个实体可以保留将制造商510与分配的示踪剂表面标志、分配的重复图案、和/或由分配的重复图案代表的分配的编码(或编码部分)联系起来的信息,而制造商510可以掌握将识别纤维、并因而将由制造商510生产的纤维产品与其他上游和下游供应链组件联系起来的机密的另外示踪剂信息(例如,独特特征、独特特征的组合、非分配的编码部分等)。在某些例子中,所述另外的示踪剂信息的机密性使得制造商510能够防止实验室560分辨出与制造商510相关联的用户(例如用户520)、运送地点、仓库,和其他内部的供应链组件(例如,加工点或生产线,以及生产批量或日期)。

[0148] 上文所述的实施方案确定与供应链特定组件相关联的示踪剂信息的特定组合,并且当其呈现于样品的识别纤维中时,使得实验室、制造商或者其他实体能够确定与样品相关联的特定供应链组件。然而,本领技术人员能够理解,所公开的实施方案不限于如上所概括的特定组合或者示踪剂信息,并且在进一步的实施方案中,特定的供应链组件可以与所述识别纤维所呈现的任意另外的或者可选的物理、化学和/或光学特征相关联,其包括但不限于独特特征和/或独特特征的组合。而且,虽然图5A和5B中没有描绘,但本领域技术人员能够理解,在实施与公开的实施方案一致的操作过程中,与环境500相关联的实体(显示或未显示)可以使用一个或多个仓库存储原材料、中间产品、最终阶段产品等。

[0149] 然而,此外,公开的实施方案不限于给供应链的各种组件(例如制造商)分配示踪剂表面标志、重复图案和/或编码和编码部分。在进一步的实施方案中,制造商510、实验室560、用户520、请求方530,或者第三方(未显示)可以给供应链的各种组件分配其他的示踪剂信息,其包括但不限于独特特征和/或独特特征的组合。

[0150] 图6与公开实施方案一致,显示由一个或多个实体所使用的计算系统600的非限制性实施例。示例性系统600的变型可以为制造商510(例如,作为制造商系统512)、用户520、请求方530、和/或实验室560(例如,作为实验室系统562)使用。在一个实施方案中,系统600可以包括一个或多个处理机621、一个或多个输入/输出(I/O)设备622,以及一个或多个存储器623。在有些实施方案中,系统600可以采用服务器、大型计算机,或者这些组件的任意组合的形式。在有些实施方案中,系统600可以采用移动计算设备的形式,诸如智能手机、平板电脑、笔记本电脑,或者这些组件的任意组合。或者,系统600可以基于存储、执行和/或实现软件指令配置为特定的设备、嵌入式系统、专用线路,以及类似物,所述软件指令执行与公开实施例一致的一种或多种操作。

[0151] 处理机621可以包括一种或多种已知的处理装置,例如移动设备微处理机或者任意各种其他的处理机。公开的实施方案不限于配置在系统600中的任意形式的处理机。

[0152] 存储器623可以包括一种或多种配置为存储指令的存储设备,由处理机624使用以执行与公开的实施方案相关的功能。例如,当由处理机621执行时,存储器623可以使用一种或多种软件指令来配置,诸如可以执行与公开的实施方案一致的一种或多种操作的程序624。公开的实施方案不限于经配置用于执行专用任务的单独的程序或者计算机。例如,存储器623可以包括执行系统600的功能的单一程序624,或者程序624可以包括数个程序。存储器623还可以存储由一个或多个程序612所使用的数据625,诸如将独特特征映射到一种或多种供应链信息组件的相关性数据。

[0153] I/O设备622可以是经配置允许由系统600接收和/或传送数据的一种或者多种设

备。I/O设备622可以包括一种或多种数字设备和/或模拟设备，其允许环境500的组件与其他机械和设备(诸如环境500的其他组件)通信。例如，I/O设备622可以包括用于显示信息、独特特征信息、供应链信息，或者给用户(诸如制造商510的职工、用户520、请求方530和/或实验室560)提供其他信息的屏幕。I/O设备622还可以包括一种或多种数字设备和/或模拟设备，其允许用户与系统600交互，诸如触摸敏感区、键盘、按钮或者麦克风。I/O设备622还可以包括本领域中已知用于与用户交互的其他组件。

[0154] 系统600的组件可以在硬件、软件，或者硬件和软件二者的组合中实现，这对于本领域技术人员是很显然的。例如，虽然系统600的一种或多种组件可以作为计算机处理指令而实现，系统600的全部或者一部分功能反而可以在专用的电子硬件中实现。

[0155] 系统600还可以与一种或多种数据库627通信连接。系统600可以通过网络550与数据库627通信连接。数据库627可以包括一种或多种存储器装置，其存储信息并且可以通过系统600使用和/或管理。举例而言，数据库627可以包括Oracle™数据库、Sybase™数据库，或者其他相关的数据库或者不相关的数据库，诸如Hadoop sequence files、HBase，或者Cassandra。

[0156] 所述数据库或者其他文件可以包括例如与独特特征相关的数据和信息，供应链信息，将所述独特特征(例如示踪剂表面标志)、由示踪剂表面标志形成的重复图案和/或与所述重复图案相关联的编码映射到供应链信息的相关性数据，指示被分配给供应链信息的独特特征(例如示踪剂表面标志)、由示踪剂表面标志形成的重复图案和/或与所述重复图案相关联的编码的数据等。例如，如上文所述，所述数据库和其他文件可以包括将供应链组件映射到纤维样品中包括的独特特征(例如示踪剂表面标志)、由示踪剂表面标志形成的重复图案和/或与所述重复图案相关联的编码的相关性数据。此外，举例而言，所述数据库和其他文件还可以包括纤维样品中包括的独特特征(例如示踪剂表面标志)、由示踪剂表面标志形成的重复图案和/或与所述重复图案相关联的编码，其如上文所概括由实验室560分配给供应链组件。

[0157] 然而，公开实施方案的系统和方法不限于单独的数据库。在一个方面，系统600可以包括数据库627。或者数据库627可以远离系统600定位。数据库627可以包括计算机组件(例如数据库管理系统、数据库服务器等)，其经配置以接收和处理针对存储在数据库627的存储设备中的数据的请求，并且提供来自数据库627的数据。

[0158] 虽然上述的描述将实验室560指定为分配各种示踪剂的实体，但在其他方面，制造商510、用户520、请求方530，或者未显示的第三方实体可以是为识别纤维分配示踪剂的那个。此外，从图5A和5B中可见，尽管说明书聚焦于醋酸纤维素丝束和与香烟滤嘴相关联的黑市，但实施方案明显地适用于任何材料制成的纤维，以及进行非法贸易的任意制品。

[0159] 如上文关于公开实施例可见和所述，图7图解了用于将供应链信息嵌入纤维的方法的非限制性实施例。

[0160] 如上文关于公开实施例可见和所述，图8图解了用于生成相关性数据的方法的非限制性实施例。例如，如图8所示，制造商510(和另外的或者可选的实验室560)可以生成供应链组件的第一结构列表，其具有一种或多种相应的特性，并且可以生成示踪剂表面标志的第二结构列表，其可获得用于应用或者包括在识别纤维中。在一个例子中，所述供应链组件可以代表一种或多种相应的特性。制造商510可以确定能够由所述示踪剂表面标志沿着

识别纤维(例如烙印纤维)的长形成的重复图案。在有些方面,制造商510可以将所述第一结构列表的元件映射到所述第二结构列表的元件,并且可以将所述第一结构列表的供应链组件映射到识别的重复图案。在另外的方面,制造商510可以存储反映所述第一和第二结构列表的元件的映射关系的相关性数据(例如,在数据库627中)。

[0161] 如上文关于公开实施例可见和所述,图9图解了用于生成相关性数据的方法的另外非限制性实施例。例如,如图9所示,实验室560(和另外的或者可选的制造商510)可以生成供应链组件的第一结构列表。在一个例子中,所述供应链组件可以代表一种或多种相应的特性。实验室560也可以确定适合应用或包括在识别纤维(例如烙印纤维)中的一种或多种示踪剂表面标志,并且可以生成第二结构列表,其包括能够由识别的示踪剂表面标志形成的潜在重复图案。在有些方面,实验室560可以生成第三结构列表,其识别可分配给所述第二结构列表的所述潜在重复图案,并且能够代表所述第一结构列表的供应链组件的潜在编码或编码部分。实验室560可以进一步将所述第一结构列表的元件映射到所述第二结构列表的元件,并且可以将所述第一结构列表的元件映射到所述第三结构列表的元件。在有些方面,实验室560可以存储反映所述供应链组件的特征与潜在重复图案和潜在编码和编码部分的映射关系的相关性数据(例如,在数据库627中)。

[0162] 如上文关于公开实施例可见和所述,图10图解了用于生产识别纤维的方法的非限制性实施例。

[0163] 如上文关于公开实施例可见和所述,图11图解了用于确定与纤维样品相关联的至少一种供应链组件的方法的非限制性实施例。

[0164] 如上文关于公开实施例可见和所述,图12图解了用于给供应链组件分配唯一地代表所述供应链组件的示踪剂表面标志、重复图案,以及编码和编码部分的方法的非限制性实施例。

[0165] 下文所列出的非限制性实施方案A1-A24。

[0166] A1:纤维包括一种或多种识别纤维,其中每种识别纤维呈现至少一种独特特征,其中所述识别纤维包括一种或多种烙印纤维,其中所述烙印纤维呈现包括一种或多种示踪剂表面标志的独特特征,其中所述示踪剂表面标志沿着所述烙印纤维的长形成重复图案,并且其中所述示踪剂表面标志和/或重复图案代表所述纤维的编码。

[0167] A2:实施方案A1的纤维,其进一步包括标准纤维,并且其中所述编码代表所述纤维或者所述标准纤维的至少一种供应链组件。

[0168] A3:实施方案A1或者A2中任意实施方案的纤维,其中所述重复图案包括字母数字编码、数字编码、模拟编码,或者表意编码。

[0169] A4:实施方案A1的纤维,其中所述重复图案包括元数据。

[0170] A5:实施方案A4的纤维,其中所述元数据包括读数起始位置、读数终止位置、读数方向、编码中数字的间距。

[0171] A6:实施方案A3至A5中任意实施方案的纤维,其中所述重复图案包括数字编码并且其中所述数字编码包括二进制编码。

[0172] A7:实施方案A6的纤维,其中二进制编码中的数字的个数从2到500、4到100、10到100、20到100、4到50、10到50,或者20到50。

[0173] A8:实施方案A1至A7中任意实施方案的纤维,其中所述重复图案的长度范围从2mm

到500mm、2到200mm、2到30mm、5mm到200mm、5mm到30mm、10到200mm，或者10到30mm。

[0174] A9：实施方案A1至A8中任意实施方案的纤维，其中所述重复图案基本上是一维的。

[0175] A10：实施方案A1至A9中任意实施方案的纤维，其中所述重复图案是印刷在所述烙印纤维上。

[0176] A11：实施方案A1至A9中任意实施方案的纤维，其中所述重复图案通过雕刻或者形态学修饰而赋予所述烙印纤维上。

[0177] A12：实施方案A2至A11中任意实施方案的纤维，其中所述标准纤维包括醋酸纤维素。

[0178] A13：实施方案A2至A12中任意实施方案的纤维，其中所述烙印纤维基本上不溶解于溶剂中，其中所述标准纤维溶解于所述溶剂中。

[0179] A14：实施方案A2或A13中任意实施方案的纤维，其中所述烙印纤维基本上不溶解于丙酮或者二氯甲烷中。

[0180] A15：实施方案A12至A14中任意实施方案的纤维，其中所述烙印纤维基本上不易受与三乙酸甘油酯粘结的溶剂的影响。

[0181] A16：实施方案A1至A15中任意实施方案的纤维，其中所述烙印纤维包括腈纶、改性腈纶、芳纶、尼龙、涤纶、聚丙烯纤维、人造丝、聚丙烯腈、聚乙烯、三乙酸纤维素或者PTFE。

[0182] A17：实施方案A2至A16中任意实施方案的纤维，其中所述至少一种供应链组件包括所述标准纤维的制造商、所述标准纤维的加工点、所述标准纤维的生产线、所述标准纤维的生产批量、所述标准纤维的生产日期、所述标准纤维的包装、所述标准纤维的仓库、所述标准纤维的用户、所述标准纤维的运送地点、包括所述纤维的纤维带的制造商、所述纤维带的加工点、所述纤维带的生产线、所述纤维带的生产批量、所述纤维带的生产日期、所述纤维带的包装、所述纤维带的仓库、所述纤维带的用户、所述纤维带的运送地点、包括所述纤维的制品的制造商、所述制品的加工点、所述制品的生产线、所述制品的生产批量、所述制品的生产日期、所述制品的包装、所述制品的仓库、所述制品的用户，或者所述制品的运送地点。

[0183] A18：包括纤维的醋酸纤维丝束带，其包括实施方案A2至A17中任意实施方案的纤维，其中所述标准纤维包括醋酸纤维素。

[0184] A19：实施方案A18的醋酸纤维丝束带，所述至少一种供应链组件包括醋酸纤维丝束带的制造商、所述醋酸纤维丝束带的加工点、所述醋酸纤维丝束带的生产线、所述醋酸纤维丝束带的生产批量、所述醋酸纤维丝束带的生产日期、所述醋酸纤维丝束带的捆包、所述醋酸纤维丝束带的仓库、所述醋酸纤维丝束带的用户、或者所述醋酸纤维丝束带的运送地点。

[0185] A20：实施方案A18或A19中任意实施方案的醋酸纤维丝束带，其中所述至少一种供应链组件包括所述醋酸纤维丝束带的捆包。

[0186] A21：一种用于制造包括实施方案A2至A17中任意实施方案的纤维的醋酸纤维丝束带的方法，其中所述方法包括：(a)获得所述识别纤维；(b)以第一纤维生产方法生产所述标准纤维；和(c)将所述识别纤维和所述标准纤维组合到醋酸纤维丝束带中。

[0187] A22：实施方案A21的方法，其中获得包括所述烙印纤维的所述识别纤维至少包括下述之一：(i)以第二纤维生产方法生产所述识别纤维部分，接着将所述重复图案中的所述

示踪剂表面标志应用于所述识别纤维，以生产所述烙印纤维部分；(ii)从第三方接收所述识别纤维部分，接着将所述重复图案中的所述示踪剂表面标志应用于所述识别纤维，以生产所述烙印纤维部分，或者(ii)从第三方接收所述烙印纤维部分。

[0188] A23：实施方案A22的方法，其中应用所述重复图案中的所述示踪剂表面标志包括雕刻、印刷，或者形态学修饰。

[0189] A24：实施方案A22的方法，其中所述应用包括在生产所述标准纤维的同时将所述重复图案中的所述示踪剂表面标志印刷在所述烙印纤维上，并且在卷曲所述醋酸纤维丝束带之前组合所述烙印纤维和所述标准纤维。

[0190] A25：实施方案A21的方法，其中所述应用包括在生产所述标准纤维的同时将所述重复图案中的所述示踪剂表面标志激光雕刻在所述烙印纤维上，并且在卷曲所述醋酸纤维丝束带之前组合所述烙印纤维和所述标准纤维。

[0191] A26：一种表征纤维样品的方法，其中所述纤维样品包括实施方案A2至A17中任意实施方案的纤维，其中所述方法包括：(1)任选地将所述烙印纤维从所述纤维样品分离；(2)对所述烙印纤维应用成像技术；和(3)确定所述示踪剂表面标志的重复图案。

[0192] A27：实施方案A26的方法，其中所述分离包括将所述纤维样品置于溶剂中以产生包括所述纤维样品的溶解部分和所述烙印纤维的溶液，和从所述溶液去除所述烙印纤维。

[0193] A28：实施方案A26或A27中任意实施方案的纤维，其中所述标准纤维包括醋酸纤维素，其中所述纤维样品包括一部分包括所述纤维的制品，并且其中所述制品选自由滤棒和香烟滤嘴组成的群组。

[0194] A29：实施方案A26或A27中任意实施方案的纤维，其中所述纤维样品包括一部分包括所述纤维的制品，并且其中所述制品选自由织物和其他纺织产品、非纺织品，以及吸收剂产品组成的群组。

[0195] A30：实施方案A26至A29中任意实施方案的纤维，其中所述成像技术选自由人类的视觉检测、显微镜、电子显微镜、共聚焦显微镜和光扫描组成的群组。

[0196] A31：实施方案A26至A29中任意实施方案的纤维，其进一步包括将所述示踪剂表面标志和所述重复图案与包括生产特异示踪剂的数据库相关联，并且确定所述至少一种供应链组件，其中所述至少一种供应链组件包括所述标准纤维的制造商、所述标准纤维的加工点、所述标准纤维的生产线、所述标准纤维的生产批量、所述标准纤维的生产日期、所述标准纤维的包装、所述标准纤维的仓库、所述标准纤维的用户、所述标准纤维的运送地点、包括所述纤维的纤维带的制造商、所述纤维带的加工点、所述纤维带的生产线、所述纤维带的生产批量、所述纤维带的生产日期、所述纤维带的包装、所述纤维带的仓库、所述纤维带的用户、所述纤维带的运送地点、包括所述纤维的制品的制造商、所述制品的加工点、所述制品的生产线、所述制品的生产批量、所述制品的生产日期、所述制品的包装、所述制品的仓库、所述制品的用户，或者所述制品的运送地点。

[0197] A32：实施方案A31的方法，其中所述纤维样品包括一部分过滤器，其中所述过滤器包括醋酸纤维丝束带，并且其中所述至少一种供应链组件包括醋酸纤维丝束带捆包。

[0198] 实施例

[0199] 实施例1

[0200] 使用ID Technologies®Ci3300喷墨打印机印刷0.28mm直径的尼龙单丝，在打印

机的图形设计工具中录入图2中的编码和设置。所使用的油墨是由ID Technologies®提供的基于丙酮的专利配方。由于如在醋酸纤维素纱线生产中的典型情况，尼龙单丝缠绕到线轴上，因此印刷的编码是连续应用的。将打印机针头置于所述纤维上方，以使得打印的条码垂直于所述纤维和所述纤维的移动方向，确保油墨接触所述纤维。通过调整打印机上的宽度设置(其控制条形码印刷之间的时间间隔)和纤维的速度(即绕线机的表面速度)，获得在所述纤维上所形成的印刷标记之间大约1mm的间距。生产大约1000m的编码或烙印纤维。

[0201] 将所编码尼龙单丝的线轴从其包装中取回并在放入卷曲机之前放入醋酸纤维素丝束生产工艺的丝束带中。所述醋酸纤维素丝束是典型的商购"Y"横截面丝束品，具有名义上的2.8单丝旦数和31,000的总旦数。使用标准生产条件，将具有编码单丝的丝束卷曲、设定条件并递送给捆包机。对于每个典型的捆包机操作，所述丝束不经压缩。

[0202] 在AF2N塞机上以300m/m的带速由所述丝束生产滤棒，从而形成具有用于烟草工业的典型丝束重量和三乙酸甘油酯增塑剂水平的120mm长的滤棒。从滤棒手工提取编码的纤维并且使用显微镜进行观察。印刷的信息保持可容易地检测和定量。图3a显示从由含有编码纤维的丝束制造的滤棒提取的纤维的拼接图像。所有类似地生成的样品的编码间距和清晰度是典型的。

[0203] 实施例2

[0204] 使用0.2mm直径的聚丙烯单丝重复实施例1。虽然，如实施例1所示，所编码的单丝成功地被并入所述丝束带并且被加工为滤棒，但印刷油墨不能很好地黏附到所述纤维底物，结果导致一定程度上弄花和弄脏，从而使得所提取的烙印纤维不能被成功地解码。尽管相信不同的油墨和/或纤维表面修饰能够改善油墨的黏附性，但是并未对聚丙烯纤维实施进一步的操作。

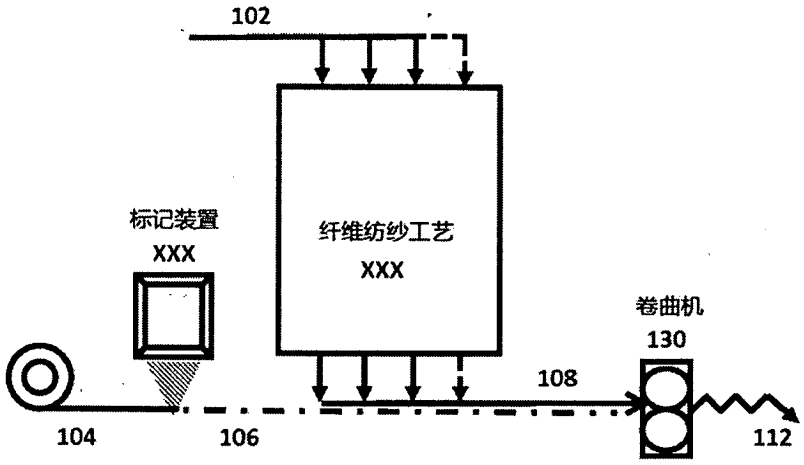
[0205] 实施例3

[0206] 使用涤纶线重复实施例1的醋酸纤维丝束带生产。从丝束中手工提取编码的线。如实施例1中所示，编码信息保持容易检测和定量。图3b显示所提取烙线的拼接图像。所有类似地生成的样品的编码间距和清晰度是典型的。

[0207] 实施例4

[0208] 使用MACSA二氧化碳激光将具有0.193mm直径的UHS(腈纶)单丝纤维样品标记图案。标记的纤维呈现于图4中。尽管滤棒不是使用图示的单丝生产，但是本领域技术人员可以预期滤棒结果与实施例1和3中的那些类似。

[0209] 本领域的技术人员通过考虑说明书和实施本文公开的实施方案，可以显而易见地想到其他的实施方案。可以理解，能够在所公开实施例的构思和范围内进行变形和修改。进一步意指，本说明书和实施例应仅视为示例性的，所公开实施方案的真正的范围和精神由所附权利要求书来说明。



同时进行烙印和醋酸纤维丝束生产的流程图

图1

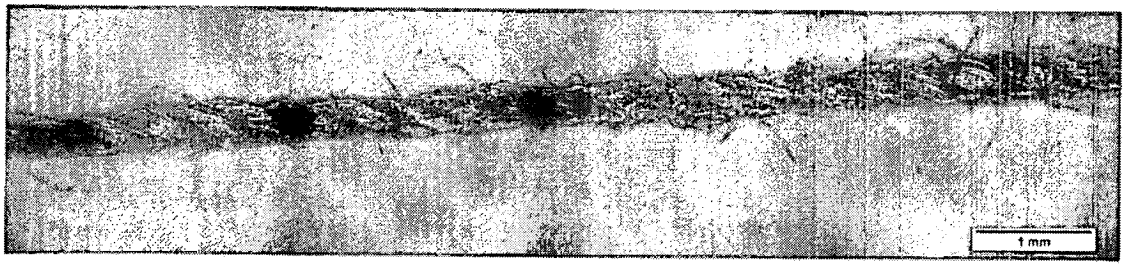
编码	
流体尺寸	正常
像素	9
延迟	10
宽度	55
间隔	0
高度	150
取向	倒转

用于烙印纤维生产的 ID Technology® Ci3300 设置

图2

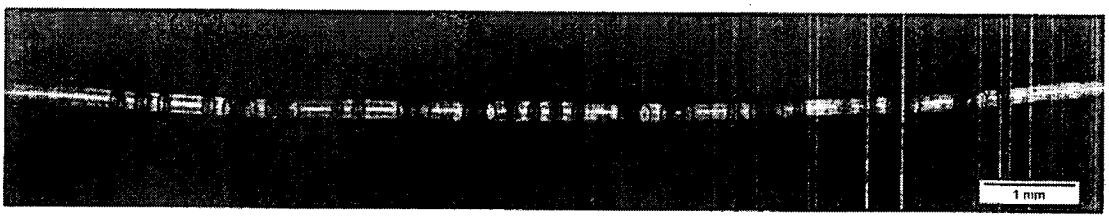
从滤棒提取的编码尼龙纤维的拼接图像

图3a



从卷曲的醋酸纤维丝束带提取的编码涤纶线的拼接图像

图3b



使用 MACSA 二氧化碳激光雕刻的腈纶单丝纤维的图像

图4

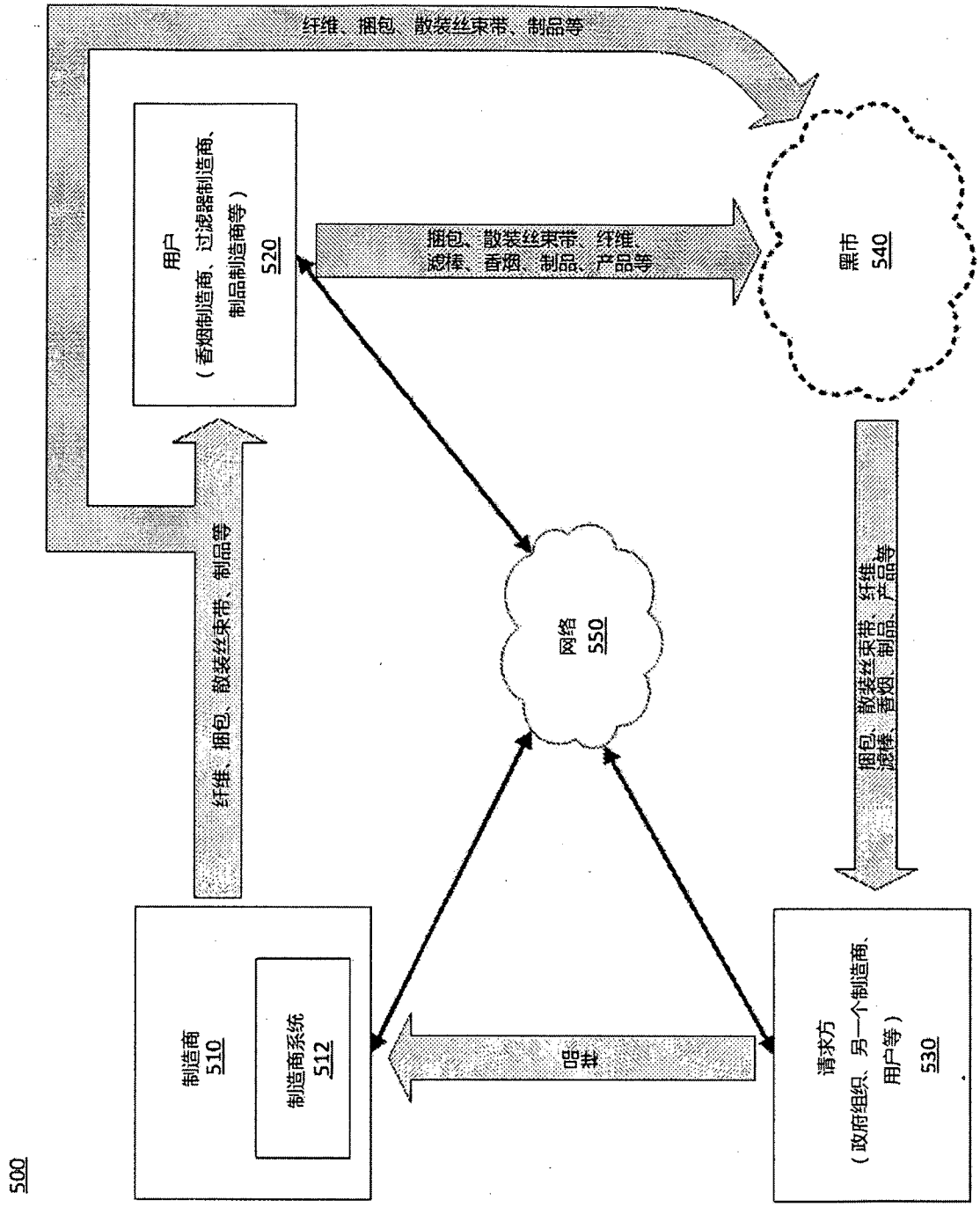

纤维、捆包、散装丝束带、制品等
用户
（香烟制造商、过滤器制造商、
制品制造商等）
520
捆包、散装丝束带、纤维、
滤棒、香烟、制品、产品等
黑市
540
网络
550
纤维、捆包、散装丝束带、制品等
捆包、散装丝束带、纤维、
滤棒、香烟、制品、产品等
制造商
510
制造商系统
512
品
请求方
（政府组织、另一个制造商、
用户等）
530
500

图5A

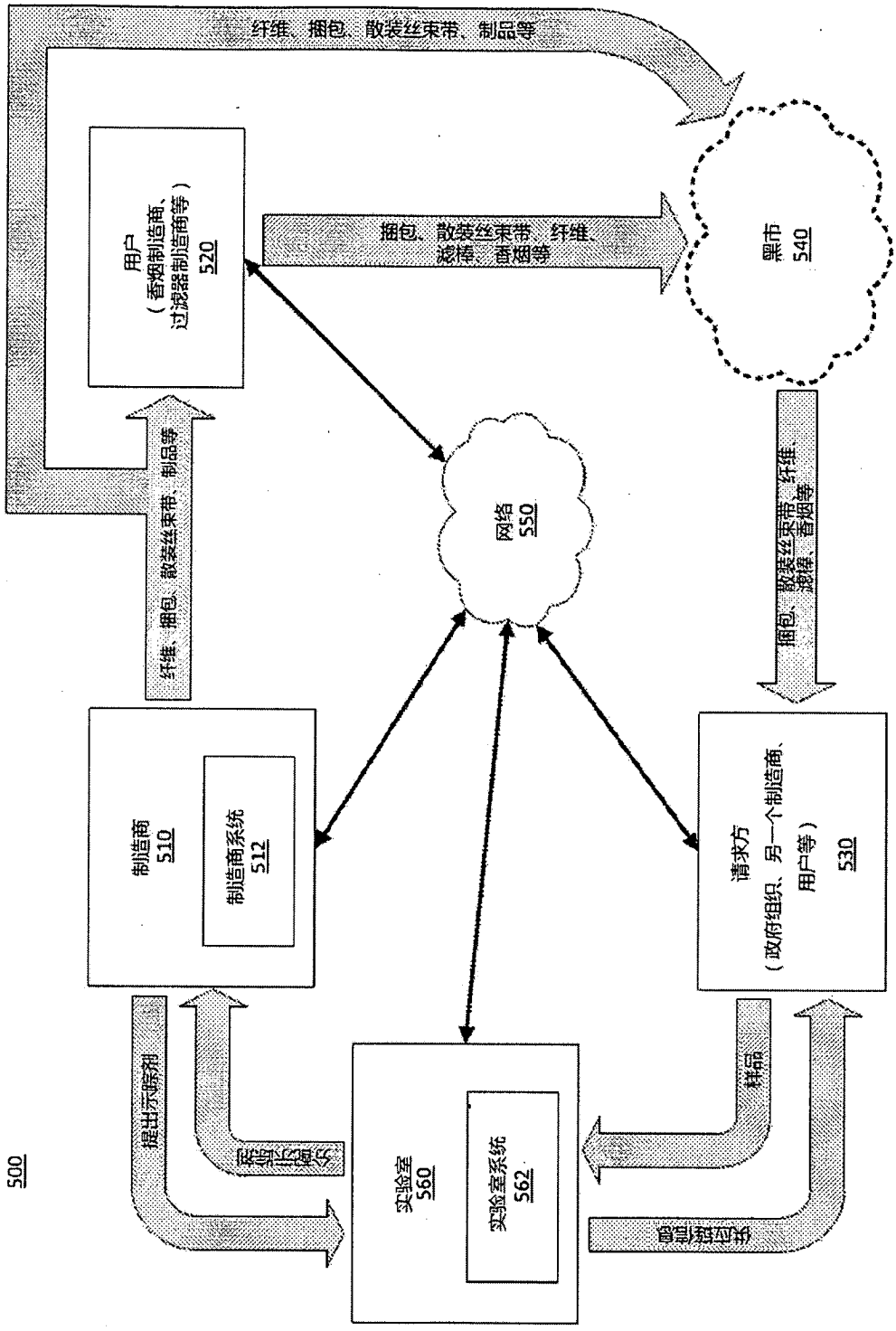

纤维、捆包、散装丝束带、制品等
用户
（香烟制造商、
过滤器制造商等）
520
捆包、散装丝束带、纤维、
滤棒、香烟等
黑市
540
网络
550
纤维、捆包、散装丝束带、制品等
捆包、散装丝束带、纤维、
滤棒、香烟等
制造商
510
制造商系统
512
请求方
（政府组织、另一个制造商、
用户等）
530
提出示踪剂
实验室
560
实验室系统
562
样品
500

图5B

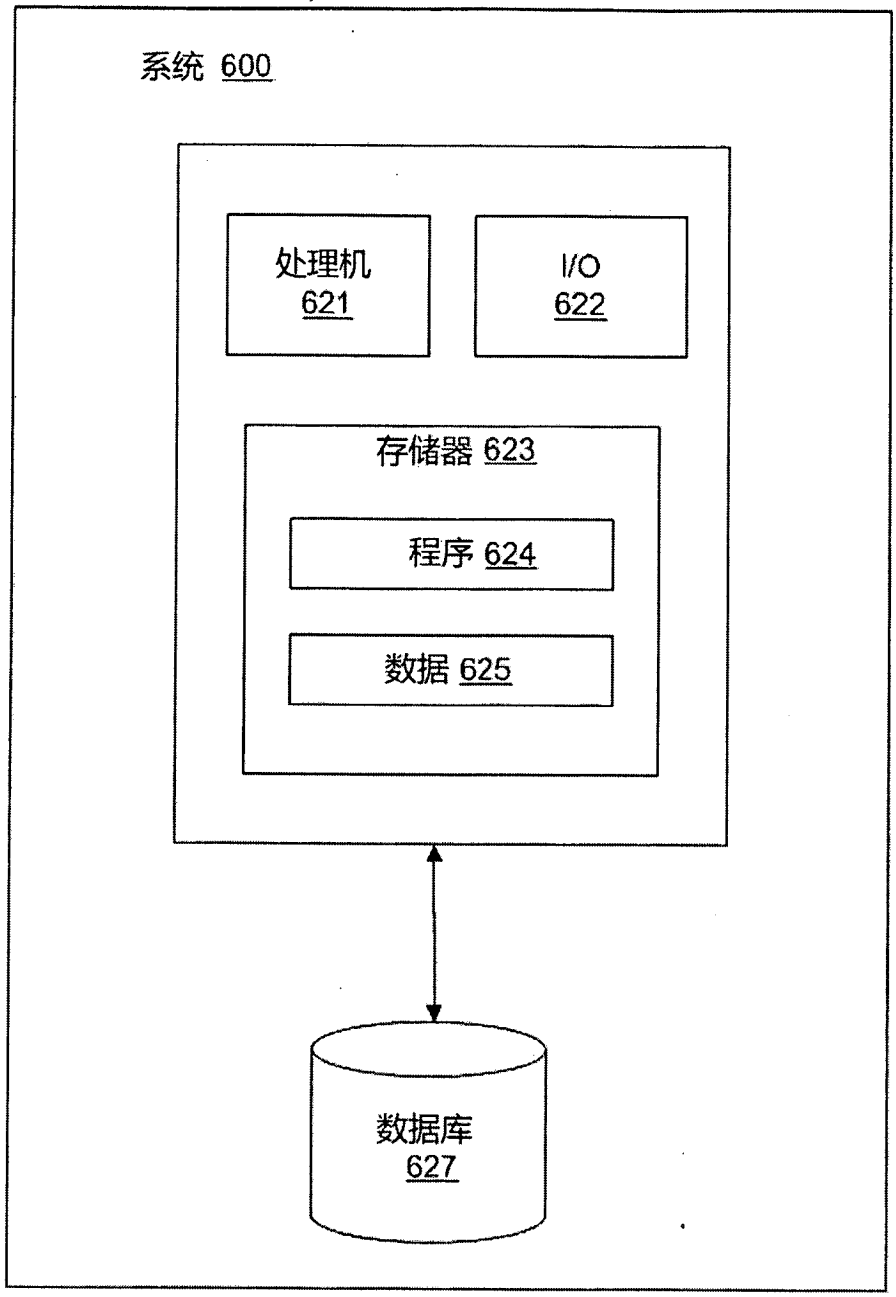


图6

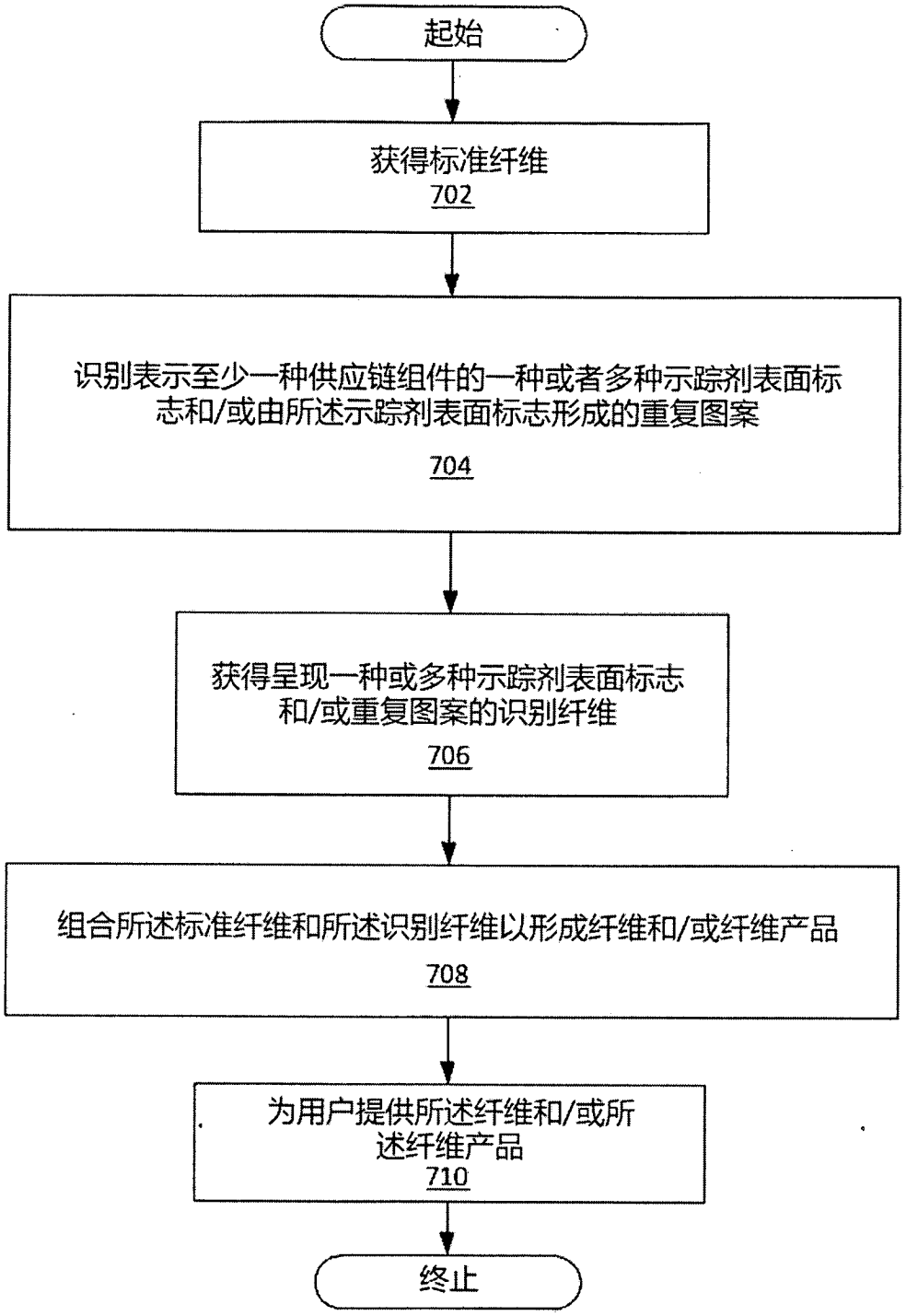

起始
获得标准纤维
702
识别表示至少一种供应链组件的一种或者多种示踪剂表面标志和/或由所述示踪剂表面标志形成的重复图案
704
获得呈现一种或多种示踪剂表面标志和/或重复图案的识别纤维
706
组合所述标准纤维和所述识别纤维以形成纤维和/或纤维产品
708
为用户提供所述纤维和/或所述纤维产品
710
终止

图7

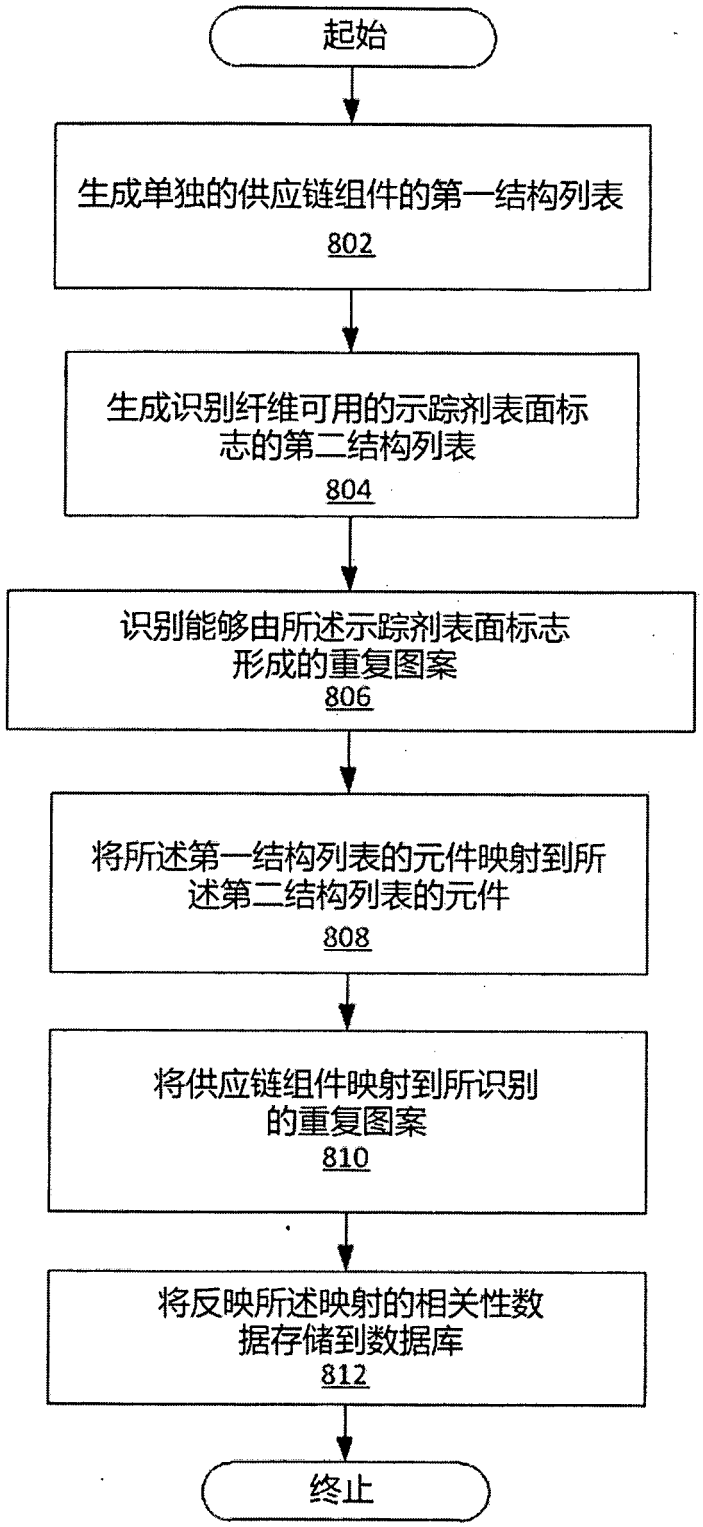

起始
生成单独的供应链组件的第一结构列表
802
生成识别纤维可用的示踪剂表面标志的第二结构列表
804
识别能够由所述示踪剂表面标志形成的重复图案
806
将所述第一结构列表的元件映射到所述第二结构列表的元件
808
将供应链组件映射到所识别的重复图案
810
将反映所述映射的相关性数据存储到数据库
812
终止

图8

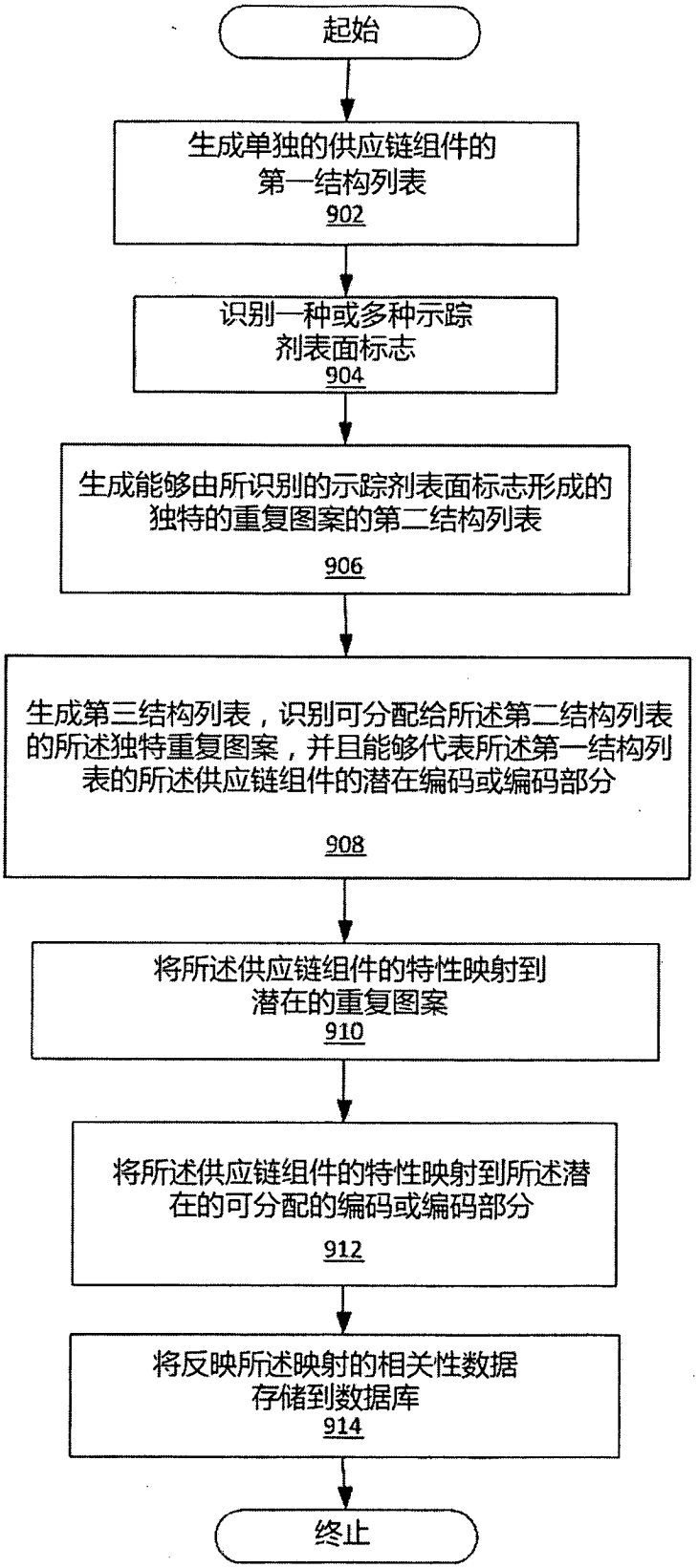

起始
生成单独的供应链组件的第一结构列表
902
识别一种或多种示踪剂表面标志
904
生成能够由所识别的示踪剂表面标志形成的独特的重复图案的第二结构列表
906
生成第三结构列表，识别可分配给所述第二结构列表的所述独特重复图案，并且能够代表所述第一结构列表的所述供应链组件的潜在编码或编码部分
908
将所述供应链组件的特性映射到潜在的重复图案
910
将所述供应链组件的特性映射到所述潜在的可分配的编码或编码部分
912
将反映所述映射的相关性数据存储到数据库
914
终止

图9

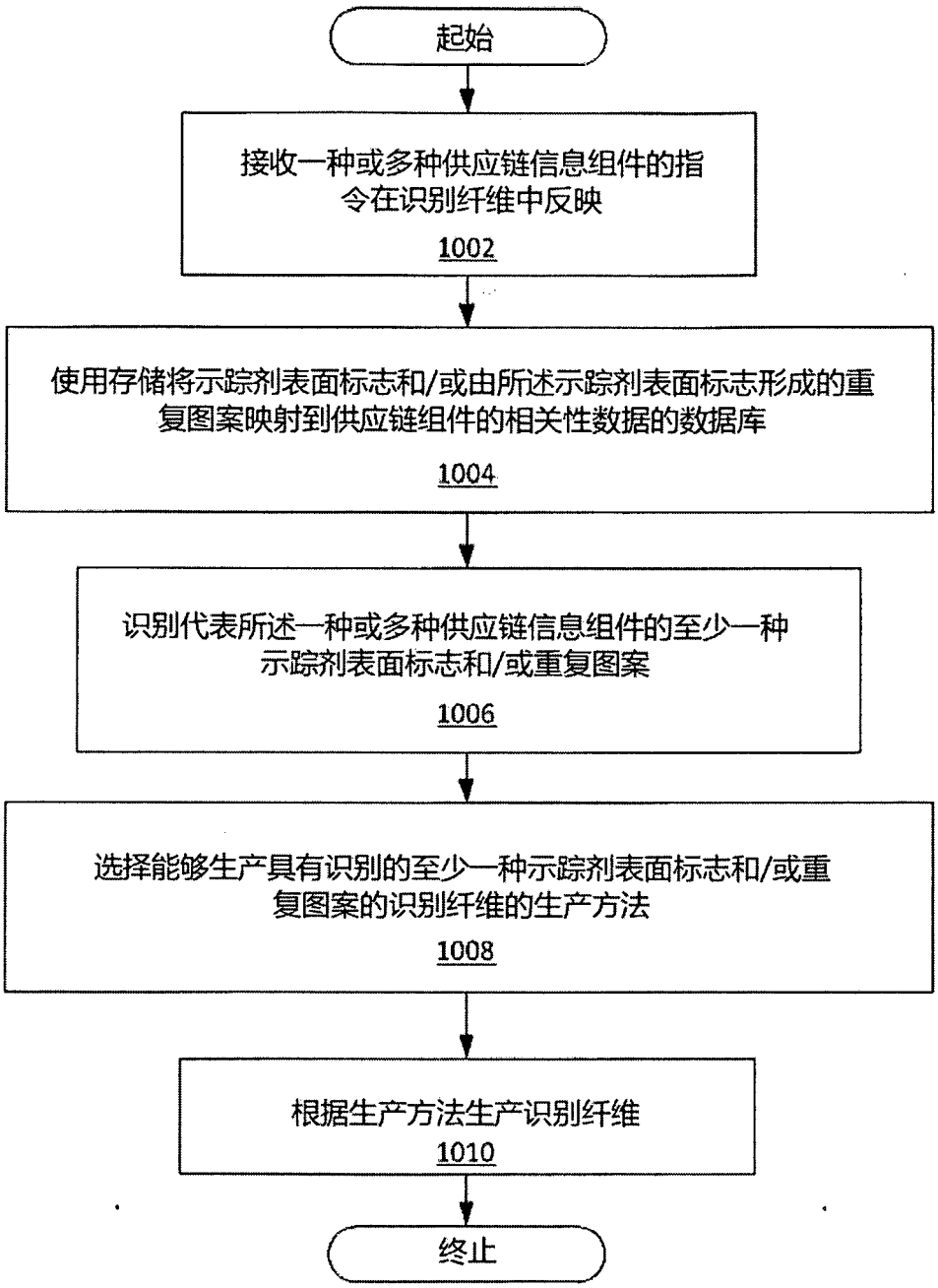

起始
接收一种或多种供应链信息组件的指令在识别纤维中反映
1002
使用存储将示踪剂表面标志和/或由所述示踪剂表面标志形成的重复图案映射到供应链组件的相关性数据的数据库
1004
识别代表所述一种或多种供应链信息组件的至少一种示踪剂表面标志和/或重复图案
1006
选择能够生产具有识别的至少一种示踪剂表面标志和/或重复图案的识别纤维的生产方法
1008
根据生产方法生产识别纤维
1010
终止

图10

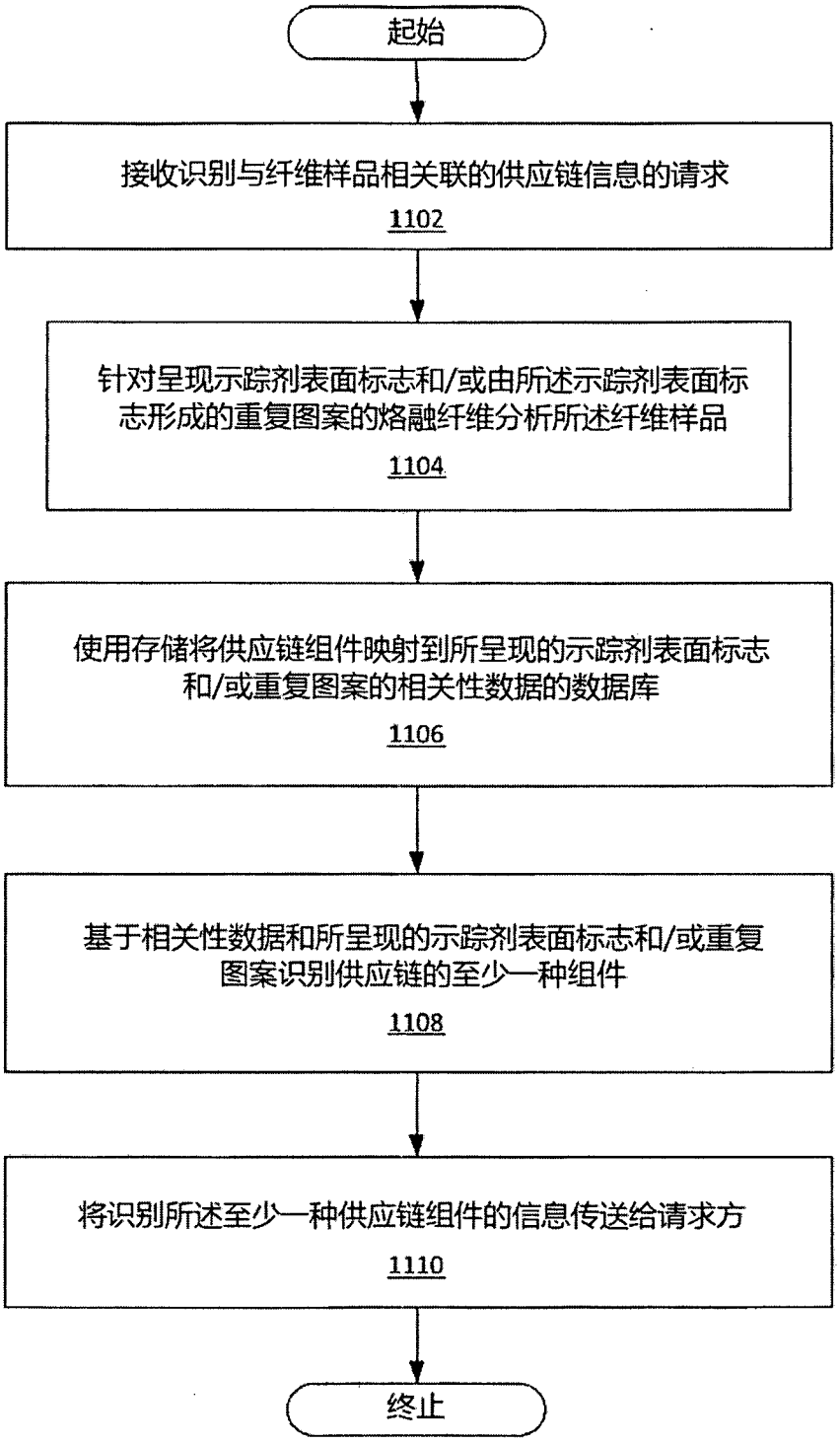

起始
接收识别与纤维样品相关联的供应链信息的请求
1102
针对呈现示踪剂表面标志和/或由所述示踪剂表面标志形成的重复图案的烙融纤维分析所述纤维样品
1104
使用存储将供应链组件映射到所呈现的示踪剂表面标志和/或重复图案的相关性数据的数据库
1106
基于相关性数据和所呈现的示踪剂表面标志和/或重复图案识别供应链的至少一种组件
1108
将识别所述至少一种供应链组件的信息传送给请求方
1110
终止

图11

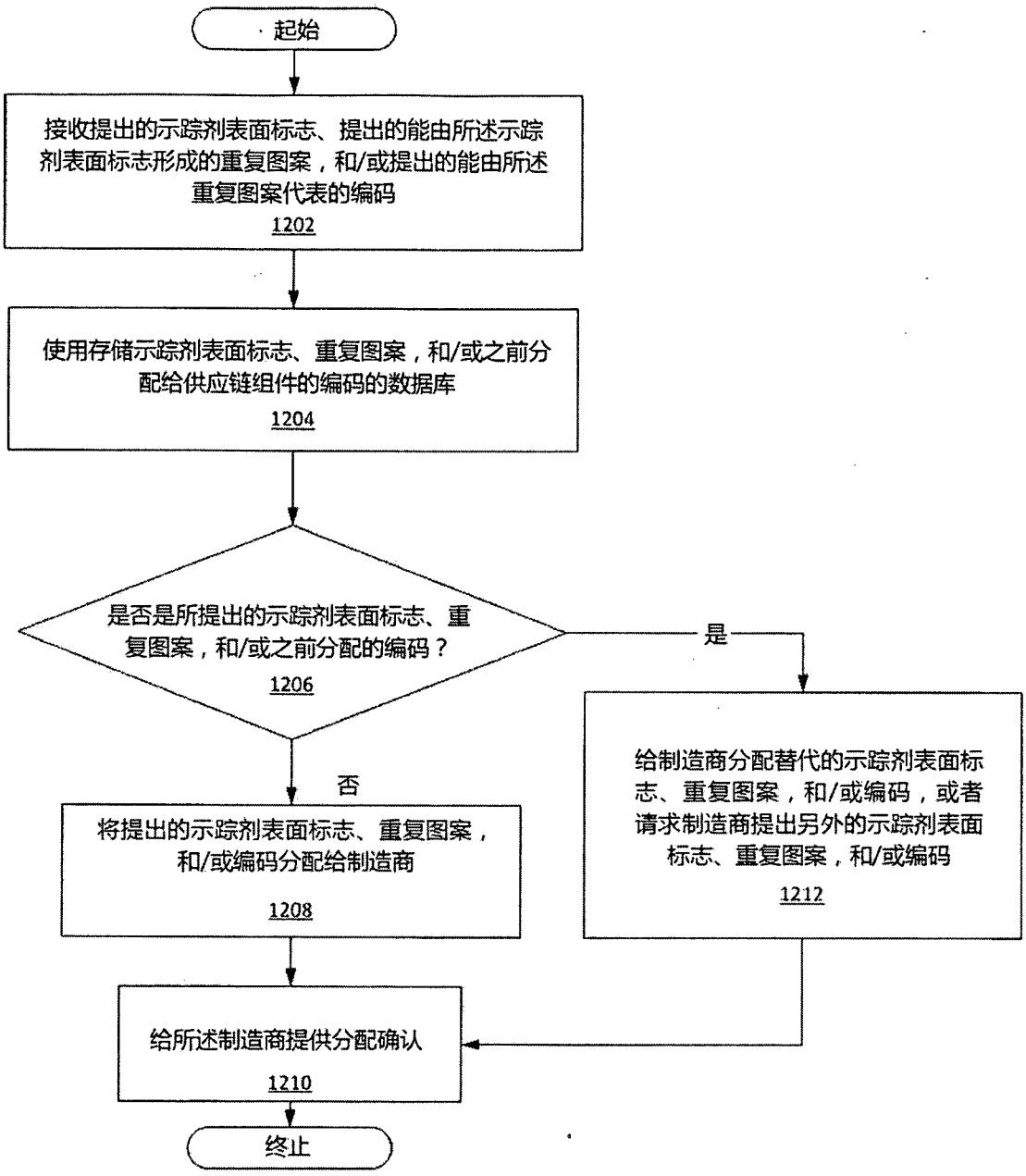

起始
接收提出的示踪剂表面标志、提出的能由所述示踪剂表面标志形成的重复图案，和/或提出的能由所述重复图案代表的编码
1202
使用存储示踪剂表面标志、重复图案，和/或之前分配给供应链组件的编码的数据库
1204
是否是所提出的示踪剂表面标志、重复图案，和/或之前分配的编码？
1206
是
否
给制造商分配替代的示踪剂表面标志、重复图案，和/或编码，或者请求制造商提出另外的示踪剂表面标志、重复图案，和/或编码
1212
将提出的示踪剂表面标志、重复图案，和/或编码分配给制造商
1208
给所述制造商提供分配确认
1210
终止

图12

Our Ref.: PT20170619-FF-P-HK

撮 录

發明名稱：具有用於編碼的表面標誌的纖維

公開的是包括一種或多種烙印纖維的纖維，所述烙印纖維沿著其長在重複圖案中呈現表面標誌。所述烙印纖維能夠被併入紗線或者纖維帶中以代表所述紗線、纖維帶和/或由所述紗線或纖維帶製成的製品的供應鏈信息。在一個特定的實施例中，烙印纖維能夠被併入醋酸纖維絲束帶中。能夠從香煙濾嘴中回收所述烙印纖維，解碼所述重複圖案，並且能夠獲得與用於製造所述香煙濾嘴的醋酸纖維絲束相關的供應鏈信息，諸如製造商、用戶、運送地點，和甚至所述醋酸纖維絲束捆包。

Abstract

Title of Invention: FIBERS WITH SURFACE MARKINGS USED FOR CODING

Disclosed are fibers comprising one or more branded fibers which exhibit surface markings in a repeated pattern along the length of the branded fibers. The branded fibers can be incorporated into yarns or fiber bands to represent supply chain information of the yarns, fiber bands, and/or articles made from the yards or fiber bands. In a specific example, branded fibers can be incorporated into an acetate tow band. The branded fibers can be recovered from a cigarette filter, the repeated pattern decoded, and supply chain information associated with the acetate tow used to make the cigarette filter, such as manufacturer, customer, ship-to location, and even the acetate tow bale, can be obtained.