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(54) Title: PREPARATION OF NOVEL SECURITY THREADS AND ITS APPLICATION FOR ANTI-COUNTERFEITING PROCESS

**Figure 2**: Schematic view of a structurally modified cellulose substrate with printed stripes or bands in two coloured with ink on single side of substrate and visible from both sides of the substrate under UV light at 365 nm wavelength

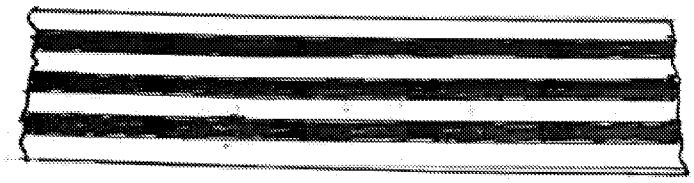

FIG. 2

(57) Abstract: The present invention relates to a security thread and its method of manufacture. Specifically, the present invention relates to a cellulose-based security thread, for security paper and other security articles. The present invention relates to a modified cellulose-based security thread having printed marks or pattern in the form of stripes or bands on one surface that are visible from that surface as well as from an opposite surface of the substrate under UV light at 365 nm wavelength. The present invention further provides a method of making such modified cellulose-based security thread as well as security documents having at least one such security thread embedded therein.

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# PREPARATION OF NOVEL SECURITY THREADS AND ITS APPLICATION FOR ANTI-COUNTERFEITING PROCESS

## FIELD OF THE INVENTION

**[0001]** The present invention relates to a security thread and its method of manufacture. Specifically, the present invention relates to a cellulose-based security thread, for preparing security paper and other security articles.

## BACKGROUND OF THE INVENTION

**[0002]** Background description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

**[0003]** Security papers such as bonds, cheques, stock certificates, currency, financial papers, passports, bank notes and stamp papers, etc., suffer from severe issues of counterfeiting and hence need special protection. Several technologies are available to provide anti-counterfeit features to such paper products that vary from use of holograms, watermarks, incorporation of security threads, etc. However, new technologies and new or enhanced anti-counterfeit features are required to stay ahead of counterfeiters, who use modern reprographic devices and specialized scanning equipment combined with commercially available high resolution printers to reproduce/simulate/counterfeit the end product.

**[0004]** It is widely known that security strips or threads which are made from a transparent film provided with a continuous reflective metal layer, vacuum deposited aluminium on polyester film being the commonest example.

**[0005]** The security feature in the security paper should not be widely available and difficult to reproduce. Security threads or filaments included in prior security papers have typically been made of a metallic, colored, transparent, optical, or magnetic material. These materials can provide effective anti-copying functions, as well as permitting documents to be checked for authenticity by machine or visual inspection. The filaments can be embedded into the Security paper during the manufacture thereof, or added to less expensive paper after the paper has been manufactured.

**[0006]** US 4,897,300A discloses the use of luminescent compounds for guaranteeing the authenticity of security papers, where it discloses a security thread comprising a tear-proof carrier material (e.g., polyester film) printed with luminescent colors that are invisible in normal lighting, but visible when exposed to ultraviolet radiation. The luminescent colors are provided along the carrier material in successive and overlapping portions, with overlapping areas showing mixed luminescence.

**[0007]** US 4,897,300A discusses a security thread which necessarily requires the use of adhesives to bond the thread into or onto a security document such as paper.

**[0008]** WO 2004/025028A1 discloses fibers that have a plurality of colored fluorescent stripes or regions printed on front and rear sides of the fiber. The stripes or regions are printed in at least two different colors with ultraviolet fluorescent pigments or inks and are only visible under ultraviolet light. As such, the overlapping of these stripes is deemed disadvantageous. The invention of WO 2004/025028A1 necessarily requires that the printed regions are registered such that regions on the front and rear sides are registered with one another and in the same color. Such a requirement of registration, which is extremely difficult if not impossible to achieve, introduces several constraints such as limiting the flexibility of manufacturing routes and the need for stringent matching of registrations, which thereby enhances the rejection rates of the products.

**[0009]** GB-A-1127043 describes security devices, such as security threads, comprising magnetic material. Such devices allow banknotes and other documents to be authenticated on high speed used note sorting machines and other devices by verification of the presence of the magnetic component.

**[0010]** GB-A-1585533 describes other security devices which combine a machine verifiable layer of magnetic material with another layer of a non-magnetic metal or luminescent substance, such other layer being in itself machine-detectable.

**[0011]** EP-B-0319157 describes security paper containing a security thread which is predominantly metallized but has clear regions, at least some of which are wholly surrounded by metal, forming a repeating pattern, e.g., in the form of the characters of an alphabet.

**[0012]** US 4,652,015 describes a paper with a security device with isolated characters of metal.PCT application WO92/11142 discloses a security device where central region of the

security device has a metallic appearance with clear regions forming characters; on either side of this central strip in the width direction.

**[0013]** EP-B-0319157 described a device from a metal which is itself magnetic, such that the size of characters and ratio of character height thread width of the Clear text product is maintained, while providing direct compatibility with existing magnetic thread detectors.

**[0014]** US 5,227,223 discloses a process for electroless deposition of metal on to a pattern of catalytic material printed on to a moving web of polymeric film so as to form electronic circuits on the film or electrical components or micro-engineering components.

**[0015]** GB1095286 mentioned a microprinted security threads composed of a polymeric film such as polyester, which may be metalised or coloured and may include micro printed lettering denoting a title or message. The lettering can be produced by printing onto the substrate or by de-metallising a metallic layer on the substrate.

**[0016]** GB1552853 and GB1604463 disclose to use a security thread comprising a thin layer of aluminium on a plastic support which is exposed on one side of the sheet at intervals along the length of the thread, the region of exposure being referred to as a window. Paper for use in producing such banknotes can be made using the method disclosed in EP0059056.

**[0017]** GB 2213098 discloses a partially metallized film Strip, used as a Security thread, which has metal-free portions in the form of a pattern, design, indicia, etc. to provide a continuous metal path along the length of the Strip.

**[0018]** JP 216795/1988 teaches a security strip having a metallized pattern on the Surface of a transparent film.

**[0019]** US 5,876,068, on the other hand, discloses a security element comprising a transparent plastic film having an opaque coating extending over the element with recesses corresponding to patterns to be introduced and in areas congruent with the recesses, at least one of coloring substances and luminescent Substances which cause the patterns to differ from the security element and from the opaque coating by color contrast under Suitable light conditions.

**[0020]** Various compositions can be applied to a cellulosic substance to make it relatively transparent. For example, US 5,418,205, US 6,103,355, and US 6,143,120 describe the application of solvent less transparent zing compositions to a cellulosic substrate to transparentize a portion of the Substrate.

**[0021]** It is also known that security paper can be produced by transparentizing selected areas of the paper. For example, US 5,989,389 provides a method of producing visible, continuous streaks and/or delimited fields in paper.

**[0022]** Further known are security documents that can be manufactured by applying a transparentizing resin to at least a portion of a substantially unfinished porous absorbent sheet to define a transparent region, pattern, or Series of streaks as disclosed in US 5,928,471.

**[0023]** US 09/300,118 relates to the application of the transparentizing composition of the present invention to a cellulosic substrate in a predetermined pattern, so as to create a relatively transparent graphical image, such as a watermark, for security documents.

**[0024]** US2003/0082348 A1 relates to the application of transparentizing composition applied to form thin lines in a variety of configurations on one or both sides of the substrate. The transparentizing composition is comprised of a radiation-curable composition, or a composition selected so as to cure upon contact with the Substrate.

**[0025]** US 5,631,039 discloses the preparation of security thread where a magnetic metal is deposited on a film of polymeric substrate in a pattern such that when the security thread is produced from the film by cutting the film the magnetic metal on the security thread has a specific pattern and provides both a visually discernible security feature and a magnetically detectable security feature.

**[0026]** US 5,465,301 discloses the preparation of a security thread for use in security articles, includes a substrate having a coating on one or both sides containing a thermo chromic material selected from pigments and dyestuffs which changes from coloured to colourless when the temperature of the pigment or dyestuff is changed to the activation temperature.

**[0027]** US 2002/0058138 A1 relates to a preparation of security thread having a partially metallized film for a Security thread having a dyed region and a transparent region alternately at an each regular interval on a major Surface thereof, in the form of a figure, character or pattern.

**[0028]** US 8,287,993 B2 discloses preparation of paper based security threads having printed marks on one surface that are visible from that surface and from an opposing Surface of the security thread by applying a clear or pigment-free, non-yellowing varnish to paper substrate. The varnish serves a further purpose in partially transparentizing the tissue paper substrate.

**[0029]** US 8,512,518 B2 relates to a security thread having windowed thread with the high contrast single-tone water mark technique. Here inventor made use of the recesses created to

cover the thread in the areas where it is visible, which exhibit a greater accumulation of fibers and are therefore opaque areas in the final paper, to insert therein the electrotype or high contrast single-tone watermarks.

**[0030]** US 8573651 B2 relates to the preparation of security thread comprising a string-like and light permeable substrate having front and back sides, at least one metal thin film layer formed in a pattern of either character or figure or both on one side of the substrate, and a colored resin layer patterned same as the metal thin film layer on the metal thin film layer.

**[0031]** US 5,449,200 discloses the security thread includes a resinous substrate sheet on which indicia are printed. Paper sheets are laminated on either side of the resinous substrate sheet using a suitable adhesive. In the laminated security paper, the indicia printed on the substrate sheet are undetectable when viewed in reflected light, but become apparent when viewed transmitted light within the visible spectrum.

**[0032]** US 4,183,989 relates to the security thread having at least two machine verifiable security features, one magnetically coded or printed and second with luminescent material.

**[0033]** There is, therefore, a need to develop security threads having enhanced unique features that are effective in preventing forgery and illegal copying and can overcome deficiencies associated with the known arts. The security industry needs to further protect security papers by providing security features that are difficult to counterfeit and yet remain amenable to flexible and cost-effective manufacturing and to easy authentication by users and issuing authorities. The present invention relates to providing an alternative type of security thread where process of manufacturing of thread is simple, flexible and cost effective and yet difficult to counterfeit.

## OBJECTS OF THE INVENTION

**[0034]** An object of the present invention is to provide security thread where process of manufacturing of thread is simple, flexible and cost effective and yet difficult to counterfeit.

**[0035]** Another object of the present invention is to provide security thread which can be manufactured with a biodegradable substrate, without the application of a transparentizing composition or metallization or vacuum deposition or support lamination or magnetization of substrate and is yet easy to authenticate.

**[0036]** Another object of the present invention is to provide a security thread, wherein the substrate material used is inherently transparent.

**[0037]** Yet another object of the present invention is to provide security thread by cost effective and environmentally friendly procedure.

**[0038]** Another object of the present invention is to provide security thread that offers the advantage of single-sided printing which allows for perfect or near perfect registration between printed marks on opposite sides of the substrate.

## SUMMARY OF THE INVENTION

**[0039]** This summary is provided to introduce a selection of concepts in a simplified form that are further described below in Detailed Description section. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

**[0040]** The present invention relates to a security thread and its method of manufacture. Specifically, the present invention relates to a cellulose-based security thread, for preparing security paper and other security articles.

**[0041]** In another aspect, the present invention relates to a security thread which can be manufactured with a biodegradable substrate, without the application of a transparentizing composition or metallization or vacuum deposition or support lamination or magnetization of substrate and is yet easy to authenticate.

**[0042]** In another aspect, the present invention relates to a security thread, wherein the substrate material used is inherently transparent.

**[0043]** In another aspect, the present invention relates to a security thread manufactured by cost effective and environmentally friendly procedure.

**[0044]** In another aspect, the present invention relates to a security thread where process of manufacturing of thread is simple, flexible and cost effective and yet difficult to counterfeit.

**[0045]** In another aspect, the present invention relates to a structurally modified cellulose-based security thread having printed marks or patterns, on one surface that are visible from that surface as well as from an opposite surface of the substrate under UV light at 365 nm wavelength.

**[0046]** In a preferred embodiment, the present invention relates to a security thread, wherein the substrate material used for preparing the security thread is structurally modified cellulose.

**[0047]** In another preferred embodiment, the present invention relates to a security thread, wherein the substrate material used in the invention, i.e., structurally modified cellulose is completely biodegradable giving environmental benefit.

**[0048]** In yet another preferred embodiment, the present invention relates to a security thread, wherein the substrate material used in the invention, i.e., structurally modified cellulose is inherently transparent in nature.

**[0049]** In another aspect, the present invention relates to a security thread, wherein the security thread is in the form of fibers (e.g., tissue paper strips).

**[0050]** In another aspect, the present invention relates to a structurally modified cellulose-based security thread, wherein printed marks or pattern are in the form of parallel stripes or bands that are printed in two or more colors using UV fluorescent inks.

**[0051]** In another aspect, the present invention relates to a security thread wherein the printing of marks or patterns is carried out in two or more stages sequentially depends on the number of colours used.

**[0052]** In yet another aspect, the present invention relates to a security thread wherein the printed marks or patterns are visible from both sides of the substrate under UV light at 365 nm wavelength.

**[0053]** In a preferred embodiment, the printed marks or pattern in the form of stripes or bands are visible only under ultraviolet (UV) light at the 365 nm wavelength.

**[0054]** In another aspect, the present invention relates to a security thread wherein the printing of marks or patterns, in the form of stripes or bands, is on the single side of the substrate.

**[0055]** In another aspect, the present invention relates to a security thread that offers the advantage of single-sided printing which allows for perfect or near perfect registration between printed marks on opposite sides of the substrate.

**[0056]** In another aspect, the present invention relates to a security thread, wherein the security threads are prepared as final product by cutting the fibers to a desired length and width according to the requirement, using proper slitter machine.

**[0057]** In a preferred embodiment, the thickness of the security threads can be varied by varying the thickness of the structurally modified cellulose substrate. Structurally modified cellulose is available in the form of a film, with varying thickness parameters. According to the requirement of thickness of security threads, the substrate, structurally modified cellulose can be chosen accordingly.

**[0058]** In another aspect, the present invention provides a method of manufacture of security devices and security documents having at least one such security thread embedded therein.

**[0059]** In a preferred embodiment, the present invention provides a security thread having enhanced security, useful in the preparation of security articles such as banknotes, cheques and the like. The security feature of the present invention is more difficult to counterfeit than the present banknotes containing windowed thread.

**[0060]** In another aspect, the present invention relates to a security thread which can provide significant cost savings as compared to conventional security paper. The substrate for conventional security paper may be synthetic polymer or paper and is prepared by metallization, vapour deposition, applying transparentizing agent, with lamination or via magnetization to substrate.

**[0061]** Other features and advantages of the invention will be apparent to one of ordinary skill will be apparent from the description and accompanying drawings, or may be learnt by the practice of the invention. Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. All publications, patent applications, patents and other references mentioned herein are incorporated by reference in their entirety. In case of conflict, the present specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and not intended to be limiting.

## BRIEF DESCRIPTION OF DRAWINGS THE INVENTION

**[0062]** The following drawings form part of the present specification and are included to further illustrate aspects of the present disclosure. The disclosure may be better understood by reference to the drawings in combination with the detailed description of the specific embodiments presented herein.

**Figure 1**: is a schematic view of a structurally modified cellulose substrate

**Figure 2:** is a schematic view of a structurally modified cellulose substrate with printed stripes or bands in two coloured with ink on single side of substrate and visible from both sides of the substrate under UV light at 365 nm wavelength.

**Figure 3**: is a schematic view of a security threads in the cut forms to a desired length and width.

**Figure 4:** is a schematic view of a security document having security threads embedded therein which is visible in UV light only at 365 nm wavelength

## DETAILED DESCRIPTION

**[0063]** The following is a detailed description of embodiments of the disclosure. The embodiments are in such detail as to clearly communicate the disclosure. However, the amount of detail offered is not intended to limit the anticipated variations of embodiments; on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present disclosure as defined by the appended claims.

**[0064]** All publications herein are incorporated by reference to the same extent as if each individual publication or patent application were specifically and individually indicated to be incorporated by reference. Where a definition or use of a term in an incorporated reference is inconsistent or contrary to the definition of that term provided herein, the definition of that term provided herein applies and the definition of that term in the reference does not apply.

**[0065]** Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

**[0066]** In some embodiments, the numbers expressing quantities of ingredients, properties such as concentration, reaction conditions, and so forth, used to describe and claim certain embodiments of the invention are to be understood as being modified in some instances by the term "about."Accordingly, in some embodiments, the numerical parameters set forth in the written description and attached claims are approximations that can vary depending upon the desired properties sought to be obtained by a particular embodiment. In some embodiments, the

numerical parameters should be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of some embodiments of the invention are approximations, the numerical values set forth in the specific examples are reported as precisely as practicable. The numerical values presented in some embodiments of the invention may contain certain errors necessarily resulting from the standard deviation found in their respective testing measurements.

**[0067]** As used in the description herein and throughout the claims that follow, the meaning of "a," "an," and "the" includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

**[0068]** Unless the context requires otherwise, throughout the specification which follow, the word "comprise" and variations thereof, such as, "comprises" and "comprising" are to be construed in an open, inclusive sense that is as "including, but not limited to."

**[0069]** The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each separate value falling within the range. Unless otherwise indicated herein, each individual value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g. "such as") provided with respect to certain embodiments herein is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the invention.

**[0070]** Groupings of alternative elements or embodiments of the invention disclosed herein are not to be construed as limitations. Each group member can be referred to and claimed individually or in any combination with other members of the group or other elements found herein. One or more members of a group can be included in, or deleted from, a group for reasons of convenience and/or patentability. When any such inclusion or deletion occurs, the specification is herein deemed to contain the group as modified thus fulfilling the written description of all Markush groups used in the appended claims.

**[0071]** The description that follows, and the embodiments described therein, is provided by way of illustration of an example, or examples, of particular embodiments of the principles and aspects of the present disclosure. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the disclosure.

**[0072]** It should also be appreciated that the present disclosure can be implemented in numerous ways, including as a system, a method or a device. In this specification, these implementations, or any other form that the invention may take, may be referred to as processes. In general, the order of the steps of the disclosed processes may be altered within the scope of the invention.

**[0073]** The headings and abstract of the invention provided herein are for convenience only and do not interpret the scope or meaning of the embodiments.

**[0074]** The following discussion provides many example embodiments of the inventive subject matter. Although each embodiment represents a single combination of inventive elements, the inventive subject matter is considered to include all possible combinations of the disclosed elements. Thus if one embodiment comprises elements A, B, and C, and a second embodiment comprises elements B and D, then the inventive subject matter is also considered to include other remaining combinations of A, B, C, or D, even if not explicitly disclosed.

**[0075]** Various terms as used herein are shown below. To the extent a term used in a claim is not defined below, it should be given the broadest definition persons in the pertinent art have given that term as reflected in printed publications and issued patents at the time of filing..

**[0076]** The present invention relates to a security thread and its method of manufacture. Specifically, the present invention relates to a cellulose-based security thread, for preparing security paper and other security articles.

**[0077]** In one embodiment, the present invention relates to a security thread which can be manufactured with a biodegradable substrate, without the application of a transparentizing composition or metallization or vacuum deposition or support lamination or magnetization of substrate and is yet easy to authenticate.

**[0078]** In another embodiment, the present invention relates to a security thread, wherein the substrate material used is inherently transparent.

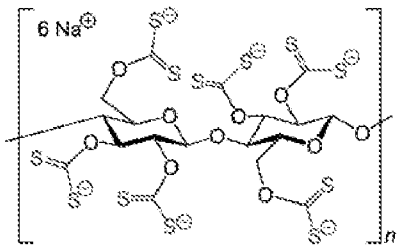
**[0079]** In yet another embodiment, the present invention relates to a security thread manufactured by cost effective and environmentally friendly procedure.

**[0080]** In one embodiment, the present invention relates to a security thread where process of manufacturing of thread is simple, flexible and cost effective and yet difficult to counterfeit.

**[0081]** In another embodiment, the present invention relates to a structurally modified cellulose-based security thread having printed marks or pattern on one surface that are visible from that surface as well as from an opposite surface of the substrate under UV light at 365 nm wavelength.

**[0082]** In a preferred embodiment, the present invention relates to a security thread, wherein the substrate material used for preparing the security thread is structurally modified cellulose.

**[0083]** In another embodiment, the substrate material used for preparing the security thread is structurally modified cellulose and has the following structure:




Structurally modified cellulose used in the present invention is a natural polymeric chains compound, also known as regenerated cellulose, with molecular weight ranging between 130 – 150 g/mol and CAS no. 9005-81-6. This substrate is commercially available and was purchased prior to use.

**[0084]** In another preferred embodiment, the present invention relates to a security thread, wherein the substrate material used in the invention, i.e., structurally modified cellulose is completely biodegradable giving environmental benefit.

**[0085]** In yet another preferred embodiment, the present invention relates to a security thread, wherein the substrate material used in the invention, i.e., structurally modified cellulose is inherently transparent in nature.

**[0086]** In another embodiment, the present invention relates to a security thread, wherein the security thread is in the form of fibers (e.g., tissue paper strips).

**[0087]** In another embodiment, the present invention relates to a structurally modified cellulose-based security thread, wherein printed marks or pattern are in the form of parallel stripes or bands.

**[0088]** In another embodiment, the marks or pattern in the form of stripes or bands used in the practice of the present invention are preferably printed using solvent-based security inks.

**[0089]** In another embodiment, the security inks used for security threads include, but are not limited to, UV visible fluorescent inks, IR visible fluorescent inks, thermo-chromic inks, photochromic inks, heat reactive-irreversible inks, optically variable inks, and solvent/chemical reactive inks.

**[0090]** In a preferred embodiment, the security inks used for security threads is solvent-based security ink which is a no-bleed UV visible fluorescent ink that demonstrates fade and abrasion resistance.

**[0091]** In another embodiment, suitable UV visible fluorescent inks include, but are not limited to, energy curable UV visible fluorescent inks and heat/air curable UV visible fluorescent inks.

**[0092]** In another embodiment, the present invention relates to a structurally modified cellulose-based security thread , wherein printed marks or pattern are in the form of parallel stripes or bands that are printed in two or more colors using UV fluorescent inks.

**[0093]** In yet another embodiment, the UV visible fluorescent colors used in the manufacture of these preferred embodiments of the inventive security threads are invisible in normal light conditions thereby not impacting upon the appearance of the host security paper in any manner.

**[0094]** In one embodiment, the security thread is an elongated security thread and the printed marks or pattern are continuous stripes or bands that alternate in color along the length of the security thread.

**[0095]** In another embodiment, the printed marks or indicia are letters, numbers and/or symbols that may alternate with colored stripes or bands along the length of the elongated security thread.

**[0096]** In another embodiment, the present invention relates to a security thread wherein the printing of marks or patterns is carried out in two or more stages sequentially depends on the number of colours used.

**[0097]** The printed marks or pattern in the form of stripes or bands are printed on the single side of the substrate but are visible from the both sides of the substrate under UV light at 365 nm wavelength.

**[0098]** In a preferred embodiment, the printed marks or pattern in the form of stripes or bands are visible only under ultraviolet (UV) light at the 365 nm wavelength.

**[0099]** In another embodiment, the present invention relates to a security thread that offers the advantage of single-sided printing which allows for perfect or near perfect registration between printed marks on opposite sides of the substrate.

**[00100]** In another embodiment, the present invention relates to a security thread, wherein the security threads are prepared as final product by cutting the fibers to a desired length and width according to the requirement, using proper slitter machine.

**[00101]** In a preferred embodiment, the thickness of the security threads can be varied by varying the thickness of the structurally modified cellulose substrate. Structurally modified cellulose is available in the form of a film, with varying thickness parameters. According to the requirement of thickness of security threads, the substrate, structurally modified cellulose can be chosen accordingly.

**[00102]** In another embodiment, the present invention provides a method of manufacture of security articles and security documents having at least one such security thread embedded therein.

**[00103]** In a preferred embodiment, the present invention provides a security thread having enhanced security, useful in the preparation of security articles such as banknotes, cheques and the like. The security feature of the present invention is more difficult to counterfeit than the present banknotes containing windowed thread.

**[00104]** In one embodiment of the present invention, the structurally modified cellulose-based security threads of the present invention, which are suitable for use within security papers such as bank notes, passports, stamp papers, high security documents, and the like, offer the advantage that they may be added to security papers during manufacture without the need for additional equipment or modifications to existing equipment.

**[00105]** In a preferred embodiment, the inventive modified cellulose-based security threads are compliant when wet, which aids in handling, and bond naturally to papermaking fibers.

**[00106]** In another embodiment, the present invention relates to a security thread which can provide significant cost savings as compared to conventional security paper. The substrate for conventional security paper may be synthetic polymer or paper and are prepared by metallization, vapour deposition, applying transparentizing agent, with lamination or magnetization to substrate.

**[00107]** In one embodiment, the security threads in the form of fibers (i.e., strips) are particularly useful in the present invention. The size, length, width and thickness of these threads are not in any way limited or restricted.

**[00108]** In a preferred embodiment, modified cellulose substrates used for manufacture of security threads are devoid of optical brighteners and have a thickness ranging from about 15 to about 50 microns, preferably from about 20 to about 35 microns.

**[00109]** In one embodiment, the printed marks used in the practice of this invention may adopt any form and pattern including any type and combination of symbol, design, shape or other graphic indicia that may be visually detected and possibly machine detected or machine read.

**[00110]** In another embodiment, the marks or pattern in the form of stripes or bands may be printed on the modified cellulose substrate using any printing method including, but not limited to, rotogravure, letterpress, intaglio, lithography, and flexography.

**[00111]** In one embodiment, the printed substrate of the present invention may be cut into desired shapes or forms (e.g., fibers and/or planchettes) using conventional methods and techniques.

**[00112]** In one preferred embodiment, the printed substrate is bias cut resulting in strips with a long axis and a short axis. In another preferred embodiment, the longer axis of each fiber ranges from about 1 mm to about 10 mm (more preferably, from about 4 mm to about 8 mm), while the shorter axis of each fiber ranges from about 0.1 mm to about 1.0 mm (more preferably, from about 0.2 mm to about 0.4 mm).

**[00113]** Figure 1 depicts a structurally modified cellulose substrate for a preferred embodiment of the inventive security thread

**[00114]** Figure2, refers to the structurally modified cellulose substrate having marks in the form of alternating printed stripes or bands of two or more colors (e.g., red, yellow, green, blue, orange, violet, blue/green, green/yellow) that extend along the length of the substrate, the printed

stripes or bands being visible from both sides of the substrate only under UV light at 365 nm wavelength.

**[00115]** In one embodiment, printing is carried out on any one surface of the modified cellulose substrate using UV visible fluorescent inks so as to achieve a predetermined sequence of parallel stripes or bands of colors having widths ranging from about 0.1 mm to about 5.0 mm (more preferably, from about 0.75 to about 1.5 mm), each color being applied in a separate printing station, the color stripes being appropriately registered along the length of the substrate so as not to leave any significant unprinted areas or overlapping areas.

**[00116]** In a more preferred embodiment, the inventive security thread is a fiber that comprises a bleached, machine glazed, high wet strength modified cellulose substrate having stripes or bands printed on one surface in two different UV fluorescing colors that alternate along the length of the substrate. The alternating, colored stripes or bands are printed in register with each other such that there are no unprinted gaps between the bands or stripes and no overlap of colors.

**[00117]** Figure 3 refers to view of a security threads in the cut forms to a desired length and width.

**[00118]** Figure4 refers to the document or banknote where the inventive security threads are embedded therein.

**[00119]** In one embodiment of the present invention, the security threads may be incorporated into security papers during manufacture by techniques commonly employed in the security papermaking industry.

**[00120]** In another embodiment, the security threads may be mixed with the stock suspension fed to the papermaking machine so that the devices are randomly distributed among the normal papermaking fibers forming the security paper. The security threads may also be introduced in a dilute suspension in water to a cylinder mold machine, or similar papermaking machine of known type, along with an appropriate suspension of papermaking fibers in such a way that the security threads only appear in designated bands within the security paper.

**[00121]** In another embodiment, the printed marks or pattern in the form of stripes or bands on the security thread in the finished paper are visible from both faces of the paper and in a preferred embodiment are visible only under UV light at 365 nm wavelength so as not to disturb in any way the appearance of the paper before and after the paper is printed.

**[00122]** In another embodiment, the security thread of the present invention provides significant cost savings as compared to conventional security paper where substrate may be synthetic polymer or paper and are prepared by metallization or vapour deposition or application of transparentizing agent or lamination or magnetization of the substrate.

**[00123]** Thus present invention provides a security threads that differs from known security threads as it uses structurally modified substrate, inherently transparent, totally biodegradable, printed on single side, invisible during normal sunlight but visible under UV light at 365 nm wavelength and does not uses any plastic / polymers, metallization, vapour deposition, transparentizing agent, lamination or magnetization of the substrate. This yields the cost effective and environmentally friendly security thread for security paper.

**[00124]** While the foregoing describes various embodiments of the disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof. The scope of the invention is determined by the claims that follow. The invention is not limited to the described embodiments, versions or examples, which are included to enable a person having ordinary skill in the art to make and use the invention when combined with information and knowledge available to the person having ordinary skill in the art.

## ADVANTAGES OF THE PRESENT INVENTION

**[00125]** The present invention provides security threads that remain amenable to flexible and cost-effective manufacturing and to easy authentication by users and issuing authorities.

**[00126]** The present invention provides security thread with security features that are difficult to counterfeit.

**[00127]** The present invention provides a security thread where process of manufacturing of thread is simple, flexible and cost effective and yet difficult to counterfeit.

**[00128]** The present invention provides a security thread manufactured with a biodegradable substrate, without the application of a transparentizing composition or metallization or vacuum deposition or support lamination or magnetization of substrate and yet easy to authenticate

**[00129]** The present invention provides a method of manufacturing safety thread, which offers significant cost saving over the conventional methods.

**[00130]** The present invention provides security threads that are compliant when wet, which aids in handling and making them bond naturally to papermaking fibers.

**[00131]** The present invention provides security threads that offer the advantage of single-sided printing which allows for perfect or near perfect registration between printed marks on opposite sides of the substrate.

**We Claim**:

1. A structurally modified cellulose-based security thread having printed marks or pattern on one surface that are visible from that surface as well as from an opposite surface of the substrate under UV light at 365 nm wavelength.

2. A security thread as claimed in Claim 1, wherein the structurally modified cellulose is completely biodegradable, devoid of optical brighteners and inherently transparent.

3. A security thread as claimed in Claim 1, wherein the structurally modified cellulose has a thickness ranging from about 15 to about 50 microns.

4. A security thread as claimed in Claim 1, wherein the structurally modified cellulose has a thickness ranging from about 20 to about 35 microns.

5. A security thread as claimed in Claim 1, wherein the security thread is in the form of fibers like tissue paper strips.

6. A security thread as claimed in Claim 1, wherein printed marks or patterns are in the form of stripes or bands.

7. A security thread as claimed in Claim 1, wherein the marks or pattern in the form of stripes or bands printed using solvent-based security inks.

8. A security thread as claimed in Claim 1, wherein solvent-based security ink, which is a no-bleed UV visible fluorescent ink demonstrates fade and abrasion resistance.

9. A security thread as claimed in Claim 1, wherein printed marks or pattern are in the form of parallel stripes or bands that are printed in two or more colors using UV fluorescent inks.

10. A security thread as claimed in Claim 1, wherein the security thread is an elongated security thread and the printed marks or pattern are continuous stripes or bands that alternate in color along the length of the security thread.

11. A security thread as claimed in Claim 1, wherein the printing of marks or patterns is carried out in two or more stages sequentially depends on the number of colours used.

12. A security thread as claimed in Claim 1, wherein the security threads are prepared as final product by cutting the fibers to a desired length and width according to the requirement, using proper slitter machine.

13. A security thread as claimed in Claim 1, wherein the printed substrate is bias cut resulting in strips with a long axis ranging from about 1 mm to about 10 mm and a short axis ranging from 0.1 mm to about 1.0 mm.

14. A security thread as claimed in Claim 1, wherein the printed marks may adopt any form and pattern including any type and combination of symbol, design, shape or other graphic indicia that may be visually detected and possibly machine detected or machine read.

15. A security thread as claimed in Claim 1, wherein the printed marks or pattern in the finished paper are visible from both faces of the paper only under UV light at 365 nm wavelength so as not to disturb in any way the appearance of the paper before and after the paper is printed.

16. A security document comprising security thread as claimed in claims 1-15.

17. A method of manufacture of security articles and security documents having at least one security thread as claimed in Claim 1, embedded therein.

18. A method of manufacture of security articles and security documents as claimed in Claim 17, wherein the security thread may be added to security papers during manufacture without the need for additional equipment or modifications to existing equipment.

19. A method of manufacturing a security document as claimed in claim 16, the method comprising, mixing the security threads with a stock suspension of papermaking fibers fed to a papermaking machine so that the security threads are randomly distributed among the papermaking fibers, and forming the security document so that the security threads are incorporated randomly in the paper.

20. A security document manufactured by the method of claim 19.

21. A method of making security thread, which comprises:

providing a modified cellulose substrate which is biodegradable and transparent in nature;

printing marks on only one surface of the modified cellulose substrate using ultraviolet fluorescent inks;

and cutting the printed modified cellulose substrate into any desired shape or form.

22. The method of claim 21, wherein the modified cellulose substrate has a thickness ranging from about 10 to about 50 microns.

23. A security thread manufactured by the method of claim 22.

**Figure 1:** Schematic view of a structurally modified cellulose substrate

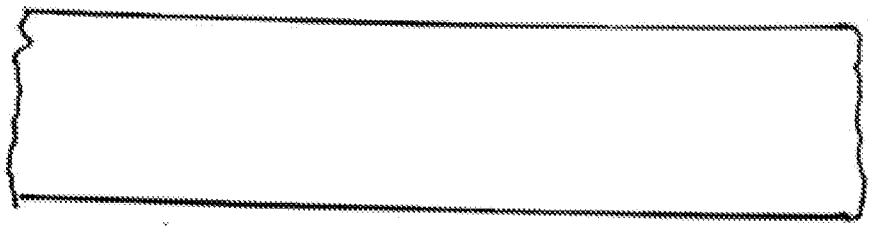


FIG. 1

**Figure 2**: Schematic view of a structurally modified cellulose substrate with printed stripes or bands in two coloured with ink on single side of substrate and visible from both sides of the substrate under UV light at 365 nm wavelength

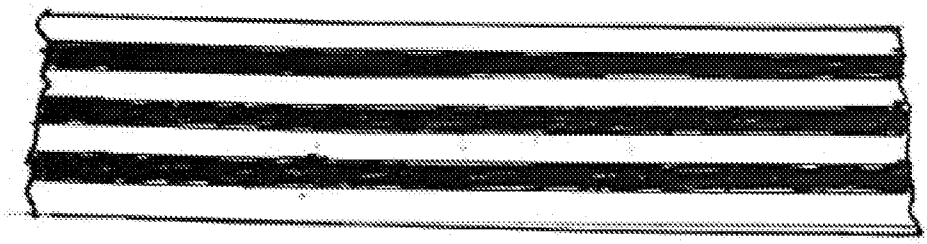


FIG. 2

**Figure 3:** Schematic view of a security threads in the cut forms to a desired length and width

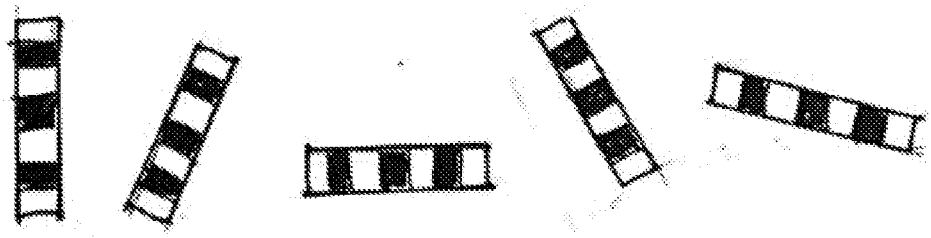


FIG. 3

**Figure 4:** Schematic view of a security document having security threads embedded therein which is visible in UV light only at 365 nm wavelength

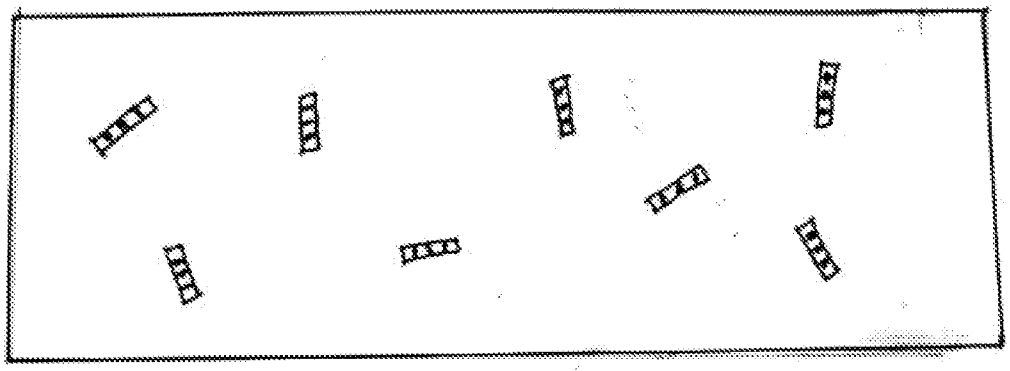


FIG. 4

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2019/051882

A. CLASSIFICATION OF SUBJECT MATTER
B42D25/355,B42D25/40 Version=2019.01

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)

B42D

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)

TotalPatent One, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| Y | EP 1631705 B1 (LANDQART) 13 October 2010 page 2, line 5; page 5, lines 26-28; claims 7-8 | 1-23 |
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 30-07-2019 | 30-07-2019 |
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