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(54) **Security sheet, particularly of the type that includes an electrically conducting element**

(57) The present invention relates to a security sheet, usable in particular in the paper industry, which includes an electrically conductive element which, by virtue of detection devices, allows precise detection and easy monitoring and is therefore particularly adapted as an anti-forgery system in the production of security documents, such as currency bills, checks, and personal identification documents.

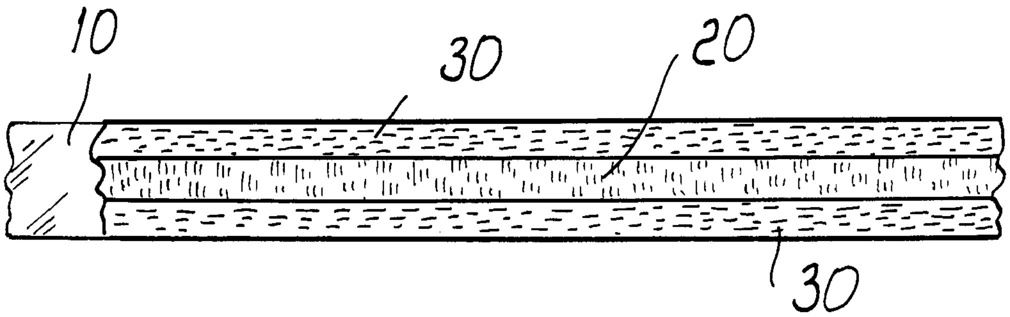

Fig. 2

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Description

The present invention relates to a security sheet, particularly of the type that includes an electrically conducting element.

In particular, the present invention relates to a security sheet that includes an electrically conducting element that can be detected by virtue of means for detecting electrical conductivity. Said security sheet, by allowing precise detection and simple monitoring, is particularly useful in the production of security documents such as currency bills, checks, identification documents, and credit cards.

Among electrically conducting elements conducting polymers are known which can be roughly classified into two different groups: filled conducting polymers in which a polymer is made conductive by the addition of a conductive filler, such as for example carbon black, graphite, carbon fiber, metal powder, etcetera, and intrinsically conducting polymers that are made conductive through a chemical process.

Filled conducting polymers are known since a long time; they present however certain problems derived from the presence of the powder itself in the polymer structure.

Intrinsically conductive polymers (ICPs) are a class of molecules that was created when it was discovered that polyacetylene could be made to conduct electricity by "doping" (H. Shirakawa, E.J. Louis, A.G. Mac Diarmid, C.K. Chiang, A.J. Heeger, J. Chem. Soc., Chem. Commun., 1977).

ICPs are conjugated polymers that can be obtained from the respective monomers by virtue of normal polymerization reactions combined with, or followed by, chemical "doping" processes, and have particular properties that consist, in particular, in electrical conductivity. Known ICPs include polyaniline, which has high conductivity and high environmental stability. In accordance with procedures for doping polyaniline bases described in the literature (Y. Cao, P. Smith and A.J. Heeger, Sinth. Met. 48, 1992), the mixtures of polyanilines with conventional polymers or with their respective copolymers (R.W. Gumbs, Sinth. Met. 64, 1994) are soluble in the commonest organic solvents and are sufficiently stable in the melted state; therefore, their workability with techniques used for conventional plastic polymers is easy and does not entail difficulties.

Another specific characteristic of polyaniline is that during the production process it is possible to preset and control, by means of the oxidation and protonation state, the electrical properties of the polymer that is produced (E.M. Geniès, A. Boyle, M. Capkowski, C. Tsintavis, Sinth. Met. 36 (1990); A.G. MacDiarmid, A.J. Epstein, Faraday Discuss. Chem. Soc. 88, 1989).

Furthermore, in blends of polyaniline with the most common polymer matrices, the percolation threshold is reached for very low polyaniline contents, on the order of 1% or even less (C.Y. Yang, Y. Cao, P. Smith, A.J. Heeger, Sinth. Met. 53, 1993). Conductivity increases continuously as the concentration of polyaniline in the polymer matrix increases, starting from the percolation threshold, until it reaches values that are higher by several orders of magnitude (C. O. Yoon, M. Reghn, D. Moses, A.J. Heeger, Y. Cao, Sinth. Met. 63, 1994). The low percolation threshold and the continuous increase in conductivity starting from the threshold are particularly important characteristics, since they allow to produce, in a reproducible and controlled manner, conducting composites having electrical properties whose values can vary and can be preset over a wide range, and they also allow to obtain, for said blends, excellent mechanical properties that are very similar to those of the polymer that acts as matrix.

Recent studies on the response of conducting polyanilines to microwaves have shown their metallic nature (A.G. Mac Diarmid et al., Phys. Rev. B. Condens Matter, 49, 1994). The magnetic properties of some aniline copolymers have been described in applications no. EP 0 545 819 and EP-A-0 680 989.

It is known that security devices based on the properties of metals have been used in security documents and particularly in currency bills in various forms and manners. For example, CH-PS 472 081 describes how to provide currency bills with metal security threads. Anti-forgery systems for currency bills are also known which insert a surface-metallized plastic strip or thread in the bill paper. Metallization has been restricted, in practice, to aluminum, since in this case the process for the evaporation and deposition of the metal on the plastics is easy and relatively inexpensive, whereas other metals require the use of sophisticated and expensive techniques and facilities, since it is necessary to work in high vacuum.

This limitation entails a severe drawback from the security point of view, since plastic films coated with aluminum having a thickness that is fully similar to that of the threads that are inserted in currency bills are commonly commercially available and have a wide range of uses for everyday requirements. Therefore, the validity of this type of security device is very low. Furthermore, due to the stretching that the strip undergoes during the process for inserting it in the paper, and due to the stresses to which the currency bill can be subjected during its life, the aluminum layer that coats the strip may crack, interrupting electrical conduction and losing detectability.

It is also known that the inclusion of metallic fibers in a sheet of paper composed of cellulose fibers entails problems due to the difficulty in dispersing the metallic fibers in the fibrous mix because of their high relative density. Another drawback is that once the metallic fibers have been inserted in the paper, they tend, under the effect of mechanical stresses and most of all of repeated folding, as in the case of bill paper, to cause micro-cracks in the paper and are sometimes expelled from the fibrous structure. Furthermore, the process for producing said fibers is not simple, since their diameter cannot in practice be greater than approximately ten microns and this of course entails the use of highly sophisticated, complicated, and expensive techniques.

Metallic pigments of various kinds are also known which can be included in printing ink varnishes. In particular, copperplate-printing inks containing metallic pigments constituted by iron particles in the form of microspheres have been used to print security documents and currency bills.

However, the use of these pigments in copperplate-printing inks entails drawbacks; their considerable abrasiveness affects the life of the PVC rollers that remove from the printing plate the excess ink that is present outside the engravings after the inking step. Furthermore, since the copperplate printing unit requires a system for treating the waste, which is constituted by a watery sludge of excess ink, the presence of iron pigments causes early wear of the components of the facility, particularly the pumps and the critical parts of the piping.

The iron pigment can react with the acid components of the varnish of the ink and, in the presence of condensation water, can produce gaseous hydrogen inside the container.

A principal aim of the present invention is to avoid or substantially reduce the above described drawbacks.

It is an object of the present invention to provide a security sheet whose properties can be easily detected and monitored so as to make it particularly difficult to forge.

It is another object to provide a sheet made of cellulose fibers (paper) that includes an anti-forgery system that has the form of a security thread and allows precise detection and simple monitoring by using detector devices.

Another object is to provide an ink that is adapted for the copperplate printing of valued paper and security documents, constitutes a sophisticated anti-forgery system and is not abrasive for printing machine rollers.

It is still another object to provide an ink which, once printed, is easily detectable with the use of conventional detector means and at the same time ensures a high level of security for the sheets to which it is applied.

With the foregoing and other objects in view, which will become apparent hereinafter, there is provided, in accordance with the present invention, a security sheet comprising a supporting matrix and an intrinsically conductive polymer.

The expression "support matrix", or "substrate", refers to matrices that are conventionally used as basic material in the production of security sheets and documents, i.e., of documents that include an anti-forgery system.

The expression "security sheets" refers to sheets used as base to produce currency bills, checks, shares, identification documents such as ID cards, passports, credit cards, restricted-area passes, and all documents used in everyday life that require an anti-forgery system.

According to an aspect of the present invention, said support matrix is a structure made of natural or synthetic fibers preferably chosen from the group including cellulose fibers and synthetic fibers, and is preferably constituted by synthetic polymers.

According to a preferred embodiment of the present invention, said support matrix consists of paper based of cellulose fibers, for example of the type that is commonly used in the production of currency bills.

The security sheet according to the present invention can also comprise additives, such as for example fillers, impregnating agents, and other agents known in the art of making paper and derived products.

According to another aspect of the invention, said support matrix is a thermoplastic polymer, preferably chosen from the group comprising polyester, polyvinyl chloride, polyvinyl acetate, polyethylene, ABS, polystyrene, polycarbonate, polymethyl methacrylate, polyethylene glycol, and mixtures thereof, polyester being the most preferred one.

Preferably, said intrinsically conductive polymer is chosen from the group comprising polyaniline, polypyrrole, polythiophene, polyphenylene vinylidene, polydiphenylamine, in substituted and unsubstituted forms, polyaniline being the most preferred one.

More preferably, the intrinsically conductive polymers of the invention are polymers or copolymers whose relative molecular mass is such that they can form films or fibers, derived from the polymerization of substituted or unsubstituted anilines, in positions and with radicals of a known type, as described for example for polyaniline in WO 92/22911.

The intrinsically conductive polymers used in the invention also advantageously have a relative molecular mass of more than 10,000.

According to one embodiment, said intrinsically conductive polymers are present in the form of a blend with a conventional thermoplastic polymer.

Intrinsically conductive polymers produce, together with thermoplastic polymers, blends that have high conductivity even at low concentrations of the conducting polymer-dopant species. The high conductivity of the polymer blend that comprises the intrinsically conductive polymers according to the invention indicates that said conductive polymers are advantageously present as a continuous phase rather than as a phase of disperse particles.

Furthermore, the thermoplastic polymer/intrinsically conductive polymer blend has good mechanical and workability properties that can be likened to those of the thermoplastic polymer.

The amount of conductive polymer that is present is preferably between 0.1% and 40% by weight, more preferably between 0.5% and 20% by weight, even more preferably between 1% and 5% by weight, with respect to the weight of the thermoplastic polymer.

The conductivity of said thermoplastic polymer/intrinsically conductive polymer blend can be advantageously varied over a wide range and is advantageously between 10^{-8} and 10 $S.cm^{-1}$, more preferably between 10^{-5} $S.cm^{-1}$ and 10 $S.cm^{-1}$, and even more preferably between 10^{-3} $S.cm^{-1}$ and 1 $S.cm^{-1}$, as a function of the amount of intrinsically conductive polymer which is present in the blend.

According to the present invention, the use of intrinsically conductive polymers allows to provide different conductivity values and therefore allows to provide unequivocal information for detection of the document and selective recognition thereof according to the specific conductivity value of the polymer included therein, by using conventional detector device that are described hereinafter.

According to one embodiment, the sheet according to the present invention comprises a support matrix made of cellulose fibers and a security thread which is constituted by a intrinsically conductive polymer/thermoplastic polymer blend of the type described above, included in said support matrix.

The security thread according to the present embodiment has conductive properties and high resistance to mechanical traction, and can be detected, as regards electrical conductivity, by virtue of conventional means used for detecting metallic threads inserted in paper, as described for example in EP-0 057 972.

Generally, said thread has a thickness between 10 and 50 microns.

In this manner, one obtains a security thread or strip that does not have a metallic appearance and therefore, differently from what occurs for metallized threads, does not clearly indicate its conductive properties to the ordinary user.

Furthermore, when the intrinsically conductive polymer is constituted by polyaniline, said security thread is transparent or semitransparent and allows, by applying printing ink, to produce symbols, images and the like that can be perceived against the light.

The transparency of the thread varies according to the content of polyaniline and of the thermoplastic polymer used as host-matrix. Higher transparency values are obtained with polymethyl methacrylate and polystyrene.

In particular, the use of a blend with a polyaniline content between 0.1% and 40% by weight with respect to the matrix of thermoplastic polymer advantageously allows to obtain transparency values in the range between 25% and 95%, whereas by using polyaniline values between 0.5% and 20% one obtains transparency values between 60% and 85%.

According to another embodiment, the security thread or strip comprises a support matrix made of thermoplastic polymeric material, which advantageously consists of polyester, on which a continuous or discontinuous layer of an intrinsically conductive polymer of the above described type is deposited. Preferably, said intrinsically conductive polymer is in the form of a dispersion in a compatible vehicle.

Said vehicle is constituted by a medium or binder in which the intrinsically conductive polymer can be dissolved or dispersed and is advantageously a polymer, preferably of the acrylic type; the concentration of said intrinsically conductive polymer being preferably between 1% and 40% by weight with respect to the weight of the binder.

In particular, the non-conductive thermoplastic polymeric material has a continuous or discontinuous covering layer that is constituted by an intrinsically conductive polymer, preferably polyaniline dispersed on a binder, with a thickness between 1 and 10 μm, more preferably between 1.5 and 5 μm. At this covering layer, one advantageously has transparency values between 25% and 95%, more preferably between 60% and 85%.

By way of an example, mention is made of the product Incoblend 991762/43 by Zipperling Kessler & Co. of Ahrensburg, in which the intrinsically conductive polyaniline (Versicon™ - 40-45% concentration) is in dispersed form in an acrylic polymer (lacquer). This product is used in various solvents at concentrations, with respect to the solids content, between 5% and 7.5%, so as to obtain deposits that have a surface resistance between 10^3 and 10^5 ohm and a specific conductivity between 5 and 30 S/cm. Furthermore, by applying a layer of approximately 2 microns it is possible to obtain a transparency value close to 80%.

The deposition of an intrinsically conductive polymer dispersed in an appropriate vehicle on a support matrix can be achieved by spreading with conventional means, for example by spraying, followed by evaporation of the solvent, or by means of a printing process.

Advantageously, said security thread or strip can be produced with various controlled conductivity values, so as to allow its selective recognition on the basis of the specific conductivity value of the intrinsically conductive polymer deposited on said strip.

The conductivity values vary generally over a wide range between 10^{-8} and 10 $S.cm^{-1}$. By way of example, by using polyaniline the conductivity values are between 10^{-5} $S.cm^{-1}$ and 5 $S.cm^{-1}$, preferably between 10^{-3} $S.cm^{-1}$ and 1 $S.cm^{-1}$, as a function of the amount of intrinsically conductive polymer that is present.

When said conductive polymer is constituted by polyaniline, it has a green coloring that can be modified by adding dyes or fluorescent substances without compromising the transparency and conductivity of the film.

Furthermore, on said strip/thread it is advantageously possible to apply continuous or discontinuous deposits of magnetic materials, such as iron oxide, or other material that can be detected by means of a magnet-resistor unit, such as iron powder. An application of this type is described for example in EP 0 310 707.

Advantageously, these materials are applied in such a manner as to leave continuous regions exposed along the strip of thermoplastic polymer, so as to allow to detect conductivity and a characteristic that is visible against the light. Furthermore, said strip/thread can include regions that are covered by a printing ink so as to form portions (symbols or images) that can be detected visually against the light.

Further characteristics and advantages will become apparent from the description of three preferred but not exclusive embodiments of security threads or strips included in the sheet according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic top view of a thread provided to the security paper of the present invention;
figure 2 is another schematic top view of a security thread according to the present invention;
figure 3 is a further schematic top view of a thread provided to the security paper of the invention.

With reference to the above decribed figures, figure 1 is a view of a security thread constitued by a support matrix made of nonconductive transparent polymeric material (polyester) 1, on the surface whereof there is a continuous layer of intrinsically conductive polymer (polyaniline) 2 and a magnetic material 3 deposited thereon so as to form transversal bands.

Figure 2 is a view of a security thread constitued by a support matrix made of nonconductive transparent polymeric material (polyester) 10, on the surface whereof there is a continuous layer of intrinsically conductive polymer (polyaniline or polypyrrole) 20, and a magnetic material 30 deposited thereon so as to form two longitudinal bands.

In the two-digit numbering that is used, the first digit corresponds to the single-digit numbering used in figure 1 in order to indicate corresponding components.

Figure 3 illustrates a security thread that is constitued by a support matrix made of nonconductive transparent polymeric material (polyester) 100, on the surface of which there is a coloured layer of intrinsically conductive polymer (polyaniline) 200, applied by a printing method, for example rotogravure, so as to form in the regions not covered by the coloured layer images like symbols 100', or letters 100", allowing thus to detect a characteristic that is visible against the light. On said layer a magnetic material 300 is applied so as to form two longitudinal bands.

In the three-digit numbering that is used, the first digit corresponds to the single-digit numbering used in figure 1 and to the first digit of the two-digit numbering used in figure 2 in order to indicate corresponding components.

According to another embodiment, said intrinsically conductive polymers or blends thereof with thermoplastic polymers are present in the form of fibers dispersed in the support matrix, which is advantageously constituted by paper.

Said fibers are preferably between 1 and 20 mm long and their diameter advantageously varies between 3 and 30 μm.

Said intrinsically conductive polymers and their blends with thermoplastic polymers have a relative density that is advantageously between 1.4 and 1.5 g/ml, which corresponds to a fraction of the relative density of metals.

A significant advantage with respect to the use of metallic fibers is constituted by the fact that these values are similar to those of the cellulose fibers used in the production of paper, facilitating the uniform and easy dispersion of said conductive fibers in the mix without having to provide particular technical refinements.

It has been observed that said fibers constituted by blends of intrinsically conductive polymers and thermoplastic polymers have the main properties of metallic fibers, such as electrical conductivity and the ability to absorb electromagnetic waves. Furthermore, when polyaniline is used in a blend with thermoplastic polymers (for example polystyrene, polycarbonate, methyl methacrylate...), other properties, such as coloring and transparency, have been observed which make the fibers detectable by using commonly employed detection methods.

In particular, it is possible to detect microwave absorption ability with a device that is commonly used in detection technology (according to the ASTM D4935-89 standard method) and comprises a source of electromagnetic waves, to which the sheet according to the invention is exposed through a tube that acts as waveguide, and a detector that measures the amount of radiation transmitted by the sheet, which is preferably made of cellulose. Electrical conductivity can be measured by measuring surface resistivity with a device that has two electrodes that rest, according to a specific geometrical arrangement, on the surface of the sheet (according to the ASTM D4496-87 method).

Said intrinsically conductive polymer, which is advantageously in fiber form, can be treated, with particular reference to polyaniline blended with at least one thermoplastic polymer, so as to vary the optical properties, modifying its transparency, color, and fluorescence. Furthermore, by varying the amount of doping of the conductive polymer and therefore its electrical properties, it is possible to vary the response of the microwave absorption signal that can be detected for document identification.

The sheet according to the invention therefore has a high security value, allowing to assign an unequivocal identification for its recognition by means of an adapted device, differently from techniques that entail the use of metallic fibers, which produce a standard response for a given content of fibers in the paper.

Furthermore, the intrinsically conductive polymer can be advantageously deposited in a controlled manner, i.e., in preset and limited regions of the sheet, with preset concentrations.

According to an aspect of the present invention, said intrinsically conductive polymer in fiber form is included on the surface of the support matrix, preferably so as to form straight bands or stripes.

The inclusion of the conductive polymer fibers in regions of the surface of the sheet is performed by means of methods that are known in the art, for example by depositing said fibers from an aqueous disperse system on a portion of the sheet in the wet section of conventional paper-making machine.

According to a particular embodiment of the invention, particles of a film of intrinsically conductive polymer blended with a thermoplastic polymer are deposited on the surface of the support matrix, for example in a circular or hexagonal shape (so-called "planchettes"). In order to facilitate the dispersion of said particles in the water and their subsequent adhesion to the sheet, it is possible to apply a synthetic lacquer, preferably of the vinyl type, to the film of conductive polymer from which said particles are obtained; said lacquer increases the wettability of said particles and develops, during the drying of the sheet, a sufficient heat-sealing property, as described for example in EP-A-0 544 917. Since the particles have the properties of electrical conduction and microwave absorption, detection is possible with conventional means of the previously described type.

According to another aspect of the present invention, an intrinsically conductive polymer in powder form is embedded in said support matrix, which is advantageously constituted by cellulose fibers.

Advantageously, the intrinsically conductive polymeric component in powder form is blended with fillers of the type used commonly in the paper-making process. Preferably, the sheet of paper comprising the intrinsically conductive polymer is interposed, by virtue of conventional methods, between two sheets of paper that do not contain the conductive polymer.

According to another aspect of the present invention, said intrinsically conductive polymer is included as powder in a printing ink for detection with conventional means. For this purpose, one preferably uses polyaniline in powder form, dispersed in varnishes of inks commonly used in printing processes, such as for example copperplate printing, which is a technique of prevailing importance in the printing of security documents and in particular of currency bills.

According to yet another embodiment, said intrinsically conductive polymer, which is preferably constituted by polyaniline, is blended in solution or in the melted state with conventional polymers and receives the addition of dyes that allow to give the resulting conductive powder a wide range of colorings and fluorescence characteristics.

Said conductive polymer, which is advantageously constituted by polyaniline, preferably blended with dyes, is dispersed in powder form in the varnishes of printing inks at concentrations preferably between 1% and 30% by weight with respect to said ink. The particle size of the powder of said conductive polymer is preferably in the range between 0.5 and 10 μm, more preferably between 1 and 2.5 μm.

The following examples are provided as further illustration of the present invention and must not be understood to limit the scope of the invention as defined in the accompanying claims.

Example 1

Films of polymeric blends constituted by blends of conductive polyaniline and conventional thermoplastic polymers (polystyrene, polyethylene, polyesters, nylon, and the like) are prepared by using conventional extrusion techniques, starting from the dissolved or melted polymeric composite. The polyaniline fraction in the composite varies between 1% and 40% and the composite correspondingly assumes values between 10^{-8} and 10 $S.cm^{-1}$. A film with a thickness of 25 μm, obtained from a blend that contains a 2% fraction of conductive polyaniline, has a surface resistivity of 5.10^2 ohm/square and has remarkable transparency (65%). The transparency and color of the film vary according to the polyaniline content and as a function of the thermoplastic polymer used as matrix. Higher transparency values (70-85%) are obtained with polymethyl methacrylate and polystyrene. The film thus obtained is cut into a strip that is 1.2 mm wide and said strip is embedded in a paper sheet with conventional methods.

Example 2

A 20-μm film or thread of polyester is covered with layers of varying thickness of conductive composite (example 1), according to the data listed in Tables 1, 2, and 3. The conductive composite was applied by spreading lacquers containing polyaniline with a vehicle, followed by evaporation of the solvent.

Two types of disperse systems (lacquers) of Versicon™ polyaniline in an acrylic binder, produced by the company Zipperling Kessler & Co under the trade names Incoblend Lacquer 910002 and 9100016/43, were used.

The application of layers of 2 and 3 microns of Incoblend Lacquer 910002 has yielded highly encouraging results, obtaining significant surface resistance values on the order of 10^4 ohm together with good transparency of the film and good adhesion; furthermore, no interruptions were found after a 50% elongation of the support polyester film. The polyester film covered by the layer of conductive polymer was cut into a strip 1.2 mm wide, which was included in a currency bill paper with conventional methods.

TABLE 1

TYPE	910016/43	910002
Thickness	2 microns	< 1 micron
Plasticity	breakage < 10%	50% elongation without fractures
Adhesion	insufficient	OK
Surface Resistance	1100 kohm	860 kohm
Densitometric value	180	125

TABLE 2

TYPE	910016/43	910002
Thickness	7 microns	2 microns
Plasticity	breakage < 10%	50% elongation without fractures
Adhesion	insufficient	OK
Surface Resistance	290 kohm	83 kohm
Densitometric value	420	490

TABLE 3

TYPE	910016/43	910002
Thickness	10 microns	3 microns
Plasticity	breakage < 10%	50% elongation without fractures
Adhesion	insufficient	OK
Surface Resistance	260 kohm	56 kohm
Densitometric value	600	670

Example 3

A wire with a diameter of 20 µm, having a conductivity of 1.10^{-1} $S.cm^{-1}$, is obtained from a solution of a blend that contains 2% polyaniline in polymethyl methacrylate. The wire is cut so as to obtain fibers that are approximately 5 mm long. The fibers are then dispersed in a mix of cellulose fibers until a 5% concentration by weight is obtained. A sheet of paper having an average surface resistivity on the order of 10^8 ohm/square is formed from the mix thus obtained.

Example 4

A powder of a conductive polymer based on polyaniline is finely ground until an average particle size of approximately 1 µm is obtained. The relative density of the powder is 1.4 g/cu cm and the conductivity is 10 $S.cm^{-1}$. The powder is then dispersed, by using techniques that are commonly used in the production of printing inks, in a varnish for copperplate-printing inks, in such amounts as to constitute 20% by weight with respect to the produced ink. A typical varnish for copperplate-printing inks in paste form contains: 20% to 40% of unsaturated oleo-resinous compounds that can polymerize due to oxidation reactions; 10% to 40% extenders such as calcium carbonate, barium sulfate, titanium oxide, aluminum silicates; 15% to 30% organic solvents constituted by a mixture of hydrocarbon mineral oils with a boiling range up to 300°C, glycol ethers, and small amounts of specific additives.

Example 5

The conductive polymer powder of Example 4 is dispersed in varnishes used to produce letterpress, lithography, screen-printing, and rotogravure inks so as to thus obtain the respective inks.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. Security sheet comprising a support matrix and an intrinsically conductive polymer.

2. Sheet according to claim 1, characterized in that said intrinsically conductive polymer is chosen from the group comprising polyaniline, polypyrrole, polythiophene, polyphenylene vinylidene, polydiphenylamine, in substituted and unsubstituted form, and mixtures thereof.

3. Sheet according to claim 2, characterized in that said intrinsically conductive polymer is polyaniline.

4. Sheet according to any one of claims 1 to 3, characterized in that said intrinsically conductive polymer is blended with a thermoplastic polymer.

5. Sheet according to any one of claims 1 to 4, characterized in that said support matrix is a fiber structure.

6. Sheet according to claim 5, characterized in that said fiber structure is chosen from the group comprising cellulose fibers, synthetic polymer fibers, and mixtures thereof.

7. Sheet according to claim 6, characterized in that said support matrix is constituted by cellulose fibers.

8. Sheet according to any one of claims 1 to 4, characterized in that said support matrix is a thermoplastic polymer.

9. Sheet according to claim 8, characterized in that said thermoplastic polymer is chosen from the group comprising polyester, polyethylene, polyvinyl acetate, polyvinyl chloride, ABS, and mixtures thereof.

10. Sheet according to any one of claims 1 to 9, characterized in that said intrinsically conductive polymer is shaped as a security thread.

11. Security sheet, comprising a support matrix made of cellulose fibers and a security thread including a blend of a thermoplastic polymer with an intrinsically conductive polymer.

12. Sheet according to claim 11, characterized in that said thermoplastic polymer consists of polyester.

13. Sheet according to claim 11 or 12, characterized in that said intrinsically conductive polymer is polyaniline.

14. Sheet according to claim 13, characterized in that said polyaniline is present, in said blend, in an amount between 0.1% and 40% by weight with respect to the weight of the thermoplastic polymer.

15. Sheet according to claim 11, characterized in that said blend has conductivity values between 10^{-8} and 10 $S.cm^{-1}$.

16. Sheet according to claim 11, characterized in that said blend has transparency values between 25% and 95%.

17. Security sheet comprising a support matrix made of cellulose fibers and a security thread including a polyester layer on which there is a layer of intrinsically conductive polymer blended with a compatible binder.

18. Sheet according to claim 17, characterized in that said intrinsically conductive polymer is polyaniline.

19. Sheet according to claim 17 or 18, characterized in that said binder is of the acrylic type.

20. Sheet according to any one of claims 17 to 19, characterized in that said intrinsically conductive polymer is present in a layer whose thickness is between 1 and 10 microns.

21. Sheet according to any one of claims 17 to 20, characterized in that said intrinsically conductive polymer is present in an amount between 1% and 40% by weight with respect to said binder.

22. Sheet according to any one of claims 17 to 21, characterized in that said security thread has transparency values between 25% and 95%.

23. Sheet according to any one of claims 11 to 22, characterized in that said security thread also comprises a magnetic material.

24. Sheet according to claim 23, characterized in that said magnetic material is applied discontinuously.

25. Sheet according to any one of claims 11 to 24, characterized in that said thread comprises regions that are covered with printing ink so as to form portions that can be perceived visually against the light.

26. Sheet according to any one of claims 11 to 25, characterized in that said security thread has a thickness between 10 and 50 µm.

27. Sheet according to any one of claims 1 to 9, characterized in that said intrinsically conductive polymer is in the form of fibers dispersed in said support matrix.

28. Sheet according to claim 27, characterized in that said intrinsically conductive polymer fibers are localized in limited regions of the surface of said support matrix.

29. Sheet according to claim 27, characterized in that said intrisically conductive polymer fibers have a length between 1 and 20 mm and a diameter between 3 and 30 µm.

30. Sheet according to any one of claims 1 to 9, characterized in that said conductive polymer is applied to the support as security ink by means of a printing method.

31. Sheet according to claim 30, characterized in that said intrinsically conductive polymer included in a security ink is applied to the support by copperplate printing.

32. Sheet according to any one of claims 1 to 9, characterized in that said support matrix is made of polyester and said electrically conductive polymer is applied by screen printing.

33. Use of an intrinsically conductive polymer to produce a security sheet having conductive properties that can be detected by virtue of electrical conductivity detection means.

34. Use according to claim 33, characterized in that said intrinsically conductive polymer is chosen from the group that comprises polyaniline, polythiophene, polypyrrole, polyphenylene vinylidene, polydiphenylamine, in substituted or unsubstituted form, and blends thereof.

35. Use according to claim 34, characterized in that said intrinsically conductive polymer is polyaniline.

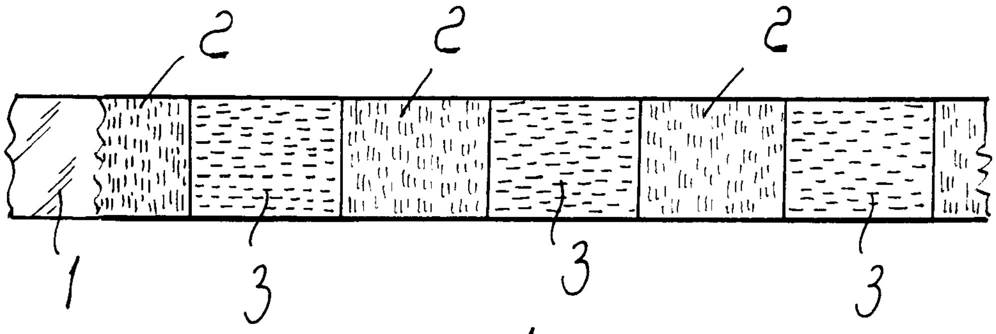

Fig.1

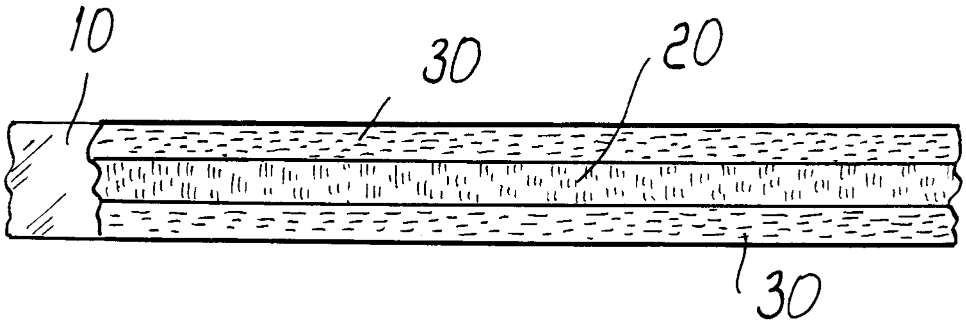

Fig. 2

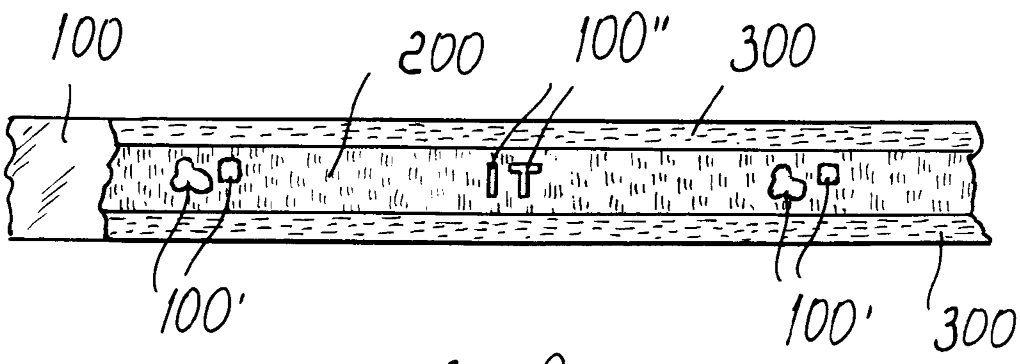

Fig.3