

Feature substances and safety features and processes for their integration in the pulp web as well as processes for testing

The invention relates to feature substances and safety features and a process for their integration in the pulp web of documents, security documents, bank notes, packages and products as well as a process for the testing of such integrated electrically conductive feature substances and safety features according to the preambles of claims 1, 13, 32 and 53

The pulp webs for documents, security documents, bank notes, packages and for products are encoded with feature substances to increase the unforgeability. Light-active feature substances used until now are currently available on the free market so that counterfeiters are able to reproduce the safety features made with them.

In order to establish technological barriers for counterfeiters in this situation, complicated solutions were developed using light-active feature substances in which - as described in DE 196 53 423 - human-visually undetectable, light-absorbing feature substances are additionally used. In this way, for instance printing images with striking flaws develop during a test under the influence of infrared light.

To increase the unforgeability feature substances in a defined distribution are applied on the paper web in order to make the genuineness of a document machine-readable. According to DE 197 14 519 human-visually undetectable feature substances are used which overlap a visual printing image in the form of markings designed as lines. The used feature substance shall be detectable by a machine on the basis of a physical property. Among other things, the electrical conductivity is mentioned as such a physical property, however, such a human-visually undetectable feature substance is not revealed.

One safety feature currently broadly used in bank notes is represented by a foil structure consisting of at least one carrier foil and a metallization applied on the carrier foil. A so-called safety thread is embedded in the paper web either completely or with windows. Originally, such a safety thread including the detectable demetallized points in the form of marks or letters was only used for the human-visual testing. In order to improve the unforgeability an additional testing of



the electrical conductivity of the metallization was considered. Until now a realisation of this intention failed in so far as the bank notes are exposed to a high mechanical stress as regards their use, for instance by being buckled and folded by the user but also by being bent in cash dispensers and counters. On the other hand, the foil structure is exposed to a considerably tension already during the technological process of papermaking. due to being tensed and bent. As a result of this fine hair cracks arbitrarily distributed in the metallization occur which make any measuring result uncertain and non-reproducible. However, in order to overcome the counterfeiting of this safety feature not only the presence of a metallization must be detected in the testing apparatuses of automated tellers but the genuineness must be detected on the basis of a certain measuring value of the conductivity. This problem will also not be basically solved if – as proposed in DE 43 44 553 and EP 659 587 - printing inks with a metallic effect will be used instead of high-vacuum metallizing.

Since the electrical conductivity is one of the most essential properties of metals, it seems to be obvious that counterfeiters assume the electrical conductivity of a metallization. At the moment enough technological equipment is inexpensively available in order to include correct metallizations, including their pictorial designs, as a counterfeit of a safety feature in documents, security documents, bank notes, packages and products. However, since the electrical conductivity is a test parameter that can be easily and quickly detected there is no wish at the moment to dispense with this safety feature. In addition, it is also disadvantageous that the human-visually visible metallization is almost not variable as regards its properties since it shall serve to the majority of the users as a constant safety feature that can always be detected in the same way. Finally, a relatively big number of people knows the secrets of this human-visually detectable safety feature in connection with its production and testing so that a high risk potential is involved as regards the size and incomprehensibility of this group of people.

Hence, it is an objective of this invention to suggest an electrically conductive feature substance in which the aforementioned disadvantages do not appear. It is also the objective of this invention to suggest such feature substances that contribute to an increased unforgeability since it became necessary to create another, easily variable safety feature which draws less attention to itself than the human-visually detectable metallization, or to suggest a safety feature at alternating points at which it is not assumed and is only detectable by a very precisely working testing technology.

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These safety-enhancing features and elements are integrated in the pulp web directly or in connection with other safety features to be included in the pulp web, such as safety threads.

The problem as disclosed by the invention is solved by the marks and features of claim 1 as well as by its special embodiments shown in the sub-claims. In addition to the claims, the features of the invention will also appear from the descriptions and drawings where the individual features represent patentable embodiments, either each for itself or several ones in the form of sub-combinations for which protection is claimed.

The solution of the invention has the advantage to provide feature substances and safety features in connection with security paper with hidden, detectable features which are human-visually undetectable and the homogeneous or partial presence of which must be tested. At the same time there is, surprisingly, the advantage of a continuously running, time-saving and cost-effective process for the inclusion of feature substances and safety features in paper webs.

The invention will be described by the following examples and figures.

Fig. 1 – Diagrammatic side view and top view of the long sieve of a paper machine to indicate the process of the partial integration of the feature substances in the form of lines,

Fig. 2 – Diagrammatic side view and top view of a cylindrical sieve of a paper machine to indicate the same process,

Fig.3 – Diagrammatic side view and top view of a cylindrical sieve of a paper machine with a connected water mark embossing roller,

Fig. 3a – Diagrammatic top view on a sheet stock during the test including the signal image of the sheet stock with the homogeneously included feature substance and embossed water mark,

Fig.4 – Diagrammatic side view of a cylindrical sieve of a paper machine with pulp inlet for a homogeneous integration of the feature substance,

Fig.5 – Diagrammatic side view of a cylindrical sieve of a paper machine with headbox for the homogeneous integration of the feature substance,

Fig. 6 - Signal image when scanning a bank note with a sensor with homogeneous feature material distribution and with a safety thread,

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Fig. 7 – Signal image when scanning a banknote with a sensor with homogeneous feature substance distribution and one water mark,

Fig. 7a – Signal linkage of the sensors,

Fig. 8 – Diagrammatic side view of a water mark embossing roller with a feature substance transfer roller,

Fig. 8a – Signal image of an electrically conductive water mark in conventional paper,

Fig. 9 – Diagrammatic view of a partial feature substance application on the pulp web or feature substance integration in the pulp web 6, respectively,

Fig. 10 – Signal images of the partial feature substance detection,

Fig. 11 – Foil structure with a carrier foil, one metallization and another layer of an electrically conductive polymer,

Fig. 12 – Another foil structure with a carrier foil, one metallization and another layer of the electrically conductive polymer,

Fig. 13 – A foil structure with two carrier foils and one metallization, where each of the carrier foils carries another layer of the electrically conductive polymer,

Fig. 14 – A foil structure with two carrier foils, one metallization and another layer of the electrically conductive polymer.

Fig. 1 illustrates a diagrammatic side view and top view of a paper machine with a long sieve 1, a head box 3, outlet pipes 17, a control unit 18 for the outlet pipes 17, an automatic valve 19 in each outlet pipe 17, a pump 20 for the feature substance cycle and a store tank 26 for the partial integration. Furthermore, test zones containing feature substances 14 are illustrated.

Fig. 2 illustrates a diagrammatic side view and top view of the cylindrical sieve 2 of a paper machine with a pulp inlet 4, the partial test zones 14, the outlet pipe 17, the control unit 18 for the outlet pipes 17, the automatic valve 19 in each outlet pipe 17, the pump 20 for the feature substance cycle and the store tank 26 for the feature substance for the partial integration.

Fig. 3 illustrates a diagrammatic view of the cylindrical sieve 2 of a paper machine with a connected water mark embossing roller 5, the feature substance homogeneously distributed in the paper 6, the pulp inlet 4 and the embossing segment 25 of the water mark embossing roller 5.

Fig. 3a illustrates the diagrammatic top view of a sheet stock during the test including the signal image 23 of the sheet stock with a homogeneously included feature substance and embossed water mark and with optical sensors 13 for the activation of a number of capacitive scanner

sensors 11. Below the sheet stock a diagrammatic time scale with times 1 – 16 is illustrated. The signal image shows the voltage U of the capacitive scanner sensors 11 as a function of the time with times 10 – 13.

Fig. 4 illustrates the diagrammatic side view of the cylindrical sieve with the pulp inlet 4 for the homogeneous integration of the feature substance and a machine chest 8.

Fig. 5 illustrates a diagrammatic view of the long sieve 1 of a paper machine with the pulp inlet 3, the machine chest 8 and the feature substance 6 homogeneously distributed in the paper.

Fig. 6 illustrates the signal image 23 in the form of $U = f(t)$ when scanning a bank note with a scanner sensor 11 with a homogeneously distributed feature substance distribution and with a safety thread 15 and the optical sensors 13 for the activation of the capacitive scanner sensors 11.

Fig. 7 illustrates the signal image in the form of a diagram of voltage U as a function of the channel number during scanning of the optical scanner sensors 10 and the capacitive scanner sensors 11 across a bank note with a homogeneous feature substance distribution 6 and with an electrically conductive embossing area 24. In a diagrammatic view the sensor channels 1 - 14 are illustrated.

Fig. 7a illustrates the signal linkage of the optical scanner sensors 10, capacitive scanner sensors 11 and optical sensors 13 for the activation of the capacitive scanner sensors 11 during the testing of sheets with partial test zones 14.

Fig. 8 illustrates the diagrammatic side view of a water mark embossing roller 5 with embossing segments 25 and with a feature substance transfer roller 7, an electrically conductive test zone 9 in the form of a water mark, a feature substance store tank 16 and a proofing roller 27.

Fig. 8a illustrates the signal image in the form of a diagram of voltage U as a function of the channel number during the testing of an electrically conductive test zone 9 in paper not provided with feature substance.

Fig. 9 illustrates in a diagrammatic view after a partial feature substance integration in the pulp web 6 according to Fig. 8, the testing with the capacitive scanner sensors 11, the optical sensors 13 to their activation and with the different partial test zones 14a, 14b, 14c.

Fig. 10 illustrates the signal images 23 of the partial feature substance detection according to the arrangements in Fig. 9.

Fig. 11 illustrates a foil structure with a carrier foil 28, a metallization 29 and another layer and 30 of the electrically conductive polymer.

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Fig. 12 illustrates another foil structure with the carrier foil 28, a metallization 29 and the additional layer 30 of the electrically conductive polymer.

Fig. 13 illustrates a foil structure with two carrier foils 28; 28' and a metallization 29, where each of the carrier foils 28; 28' carries another layer 30 of the electrically conductive polymer.

Fig. 14 illustrates a foil structure with two carrier foils 28;28', a metallization 29 and another layer 30 of the electrically conductive polymer.

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Example 1:

Fig. 1 and 2 illustrate in which way a partial application of a feature substance is realised by dosing devices exactly positioned above the pulp web 6. The precondition for an even supply of the dosing devices with the feature substance is a constant circulation of the pulp by pumps 20 in the whole pipe system including the store tank 26 for the feature substance for the partial integration. By means of an arrangement of dosing devices each consisting of an outlet pipe 17 with an automatic valve 19 the feature substance is partially applied on the paper web or integrated in it, respectively. Depending on the control continuous test zones 14a, discontinuous test zones 14b or punctual test zones 14c are produced in the form of lines. See also **Fig. 9**. By cutting the pulp web 6 into sheet stock partial test zones 14 with the feature substance are produced. They can extend across the full sheet width or sheet length or they can appear in sections in the sheet length or sheet width. The width of the lines or line sections must be adjusted to the resolution of the scanner sensors 10; 11. Preferably, a line width of 2 mm will be chosen.

Fig. 4 and 5 illustrate the preparation of a homogeneous pulp mixed with feature substance or the production of special paper with electrically conductive polymers or electrically conductive pigments on the long sieve 1 and on the cylindrical sieve 2. For this purpose the pulp is mixed with the feature substance in the machine chest 8 and kept in the condition of a homogeneous suspension being constantly stirred. For a solid feature substance an allowance of 10 % is preferably prepared. The quantity may vary depending on the way of detection.

When using electrically conductive polymers there is the advantage that these polymers have a good compatibility to the other ingredients of the pulp. Hence, the integration in the pulp is much

more uncomplicated as compared to solid feature substances since the electrically conductive polymers are also available in a liquid form. The needed concentrations allow an almost transparent electrically conductive marking.

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Example 2:

Fig. 3 and 8 illustrate another two possibilities of the integration of feature substances in the pulp web 6. By a pulp density modification a coding is produced in the otherwise homogeneously distributed feature substance. This is done by embossing in the embossing area 24 due to which a pulp density modification takes place and, hence, a change of the electrical conductivity.

The other possibility includes a partial application of the feature substance. A print is produced on the pulp web 6 by means of the embossing roller 5 and the feature substance transfer roller 7. The print of the embossing segments 25 corresponds to the pictorial representation of the electrically conductive test zone in the form of the water mark 9.

Example 3:

Fig. 1 and 2 illustrate also, in addition to the process of the integration of the feature substance, that the test zones 14 in the pulp web 6 are controlled concerning the homogeneous or partial presence of the feature substance. The test result gained influences the automatic valves 19 in the outlet pipes 17 via the control unit 18.

As described before, **Fig. 3a, 6, 7, 7a, 8a, 9 and 10** illustrate the test procedure in various applications with the corresponding signal image.

The process for the testing of paper 6 with an integrated electrically conductive feature substance, for instance in the form of an electrically conductive polymer, is explained as follows by means of **Fig. 3a**. It is diagrammatically illustrated that the paper 6 with an embossed water mark passes an arrangement of optical sensors 13. They activate another arrangement of capacitive scanner sensors 11 extended across the full width of the pulp web 6. The time scale with times 1 – 16 illustrates the time curve during which the paper 6 passes the arrangement of the optical sensors 13 and the capacitive scanner sensors 11. During the passage of the paper 6 the capacitive scanner sensors 11 give off a voltage corresponding to the change of the electrical conductivity on the pulp web 6. Accordingly, a recording test apparatus shows a signal image that shows

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voltage U as a function of time. The times 10 – 13 on the time axis t correspond to the times at which the water mark passes the arrangement of the capacitive scanner sensors 11.

To reduce the stray coupling of the sensor channels the control channels with even numbers 21 and those with odd numbers 22 are alternately controlled by a processor. The scanning frequency is 200 Hz.

Fig. 6 illustrates in a similar presentation the signal image when paper 6 in the form of a bank note with a homogeneous feature substance distribution and with a safety thread passes the above described test arrangement. The signal image 23 shows a voltage U as a function of time t .

For the ranges of the bank note with a homogeneous distribution of the feature substance the signal image 23 shows a constant voltage on a relatively low yet analysable level. At that time when the safety thread 15 passes the test arrangement with a higher conductivity a voltage peak is registered which clearly distinguishes from the remaining voltage curve. In this way the presence of the safety thread 15 may be detected.

Fig. 7 illustrates by means of a water mark in the embossing area 24 how the testing of the electrical conductivity of the paper 6 is carried out as a reference test to the testing of the pictorial design of the water mark.

The paper 6 with the water mark runs – in the direction of the arrow – successively through an arrangement of optical scanner sensors 10 and another arrangement of capacitive scanner sensors 11. The signal image belonging to it illustrates the concurring voltage curve of the optical scanner sensors 10 and the capacitive scanner sensors 11, here shown as a function of the channel number.

As illustrated in Fig. 7a, also in this case the sensor channels are alternately controlled as described above.

Fig. 9 and 10 illustrate the testing of the feature substance applied on the paper 6 in the form of lines as well as the signal images 23 produced.

In Fig. 9a the paper 6 includes a test zone 14a with a continuous, line-shaped application of the feature substance. When running through the test arrangement including the optical sensors 13

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and the capacitive scanner sensors 11, a continuous voltage curve $U = f(t)$ in the signal image 23 is produced.

In Fig. 9b the application of the feature substance in the test zone 14b is interrupted in an equally distant way. During the test a signal image 23 is produced with regular jumps in the voltage curve $U = f(t)$.

In Fig. 9c the application in the test zone 14c is interrupted in an unequally distant way. This is also reflected in the resulting signal image 23.

Example 4:

In the following the application of the electrically conductive feature substance in a foil structure to be included in the pulp web 6 is illustrated in Fig. 11 and 14.

The foil structure of a safety feature to be included in a paper web includes a carrier foil 28; 28', for instance of propylene with a thickness of preferably 40 μm . The metallization 29 applied on the carrier foil 28; 28', for instance by vapour-deposition or sputtering, has an additional thickness of 2 mm.

The metallization 29 includes demetallized areas, for instance in the form of letters or numbers, which are human-visually detectable to the user by transmitted light. The demetallization extends in sections to the margin of the carrier foil 28; 28'. On its other side the carrier foil 28; 28' has another layer 30 of an electrically conductive polymer. The electrically conductive polymer, for instance a PEDT/PSS (Polyethylenedioxythiophenepolystyrolsulphonate) according to the formulation CPP105, is applied in a thickness of 1 μm to 2 μm on the carrier foil 28; 28'. By the addition of the additional layer 30 there is a thickness increase to be completely neglected. The foil structure with the feature substance of the invention included in a paper web as a safety feature does not impair, by its slightly changed thickness, the documents or bank notes produced from the paper web, even not in a pile of a considerable height. The paper is also not weakened on the embedding place of the safety feature by an increased thickness.

The metallization 29 applied, for instance, by vapour-deposition or sputtering on the carrier foil 28; 28' has only the thickness of some atom layers and is, hence, relatively brittle depending on the surface structure of the carrier foil. Being folded, bent or buckled, hair cracks appear arbitrarily which make the intended measuring of the conductivity of given sections of the

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metallization 29 impossible. Whereas the additional layer 30 is flexible and elastic and has a much higher extensibility as compared to the metallization 29 depending on the surface structure of the carrier foil 28; 28'. If, for instance, a bank note is bent, buckled or folded there is also no interruption of the additional layer 30. The test apparatuses in automatic tellers, for instance, record for the given section of the safety feature a measuring value of the conductivity from the given state-of-the-art metallization 29 including any possibly existing hair cracks and from the relatively high-ohm additional layer 30 connected in parallel to the metallization 29.

Example 5:

Fig.11 illustrates a preferred embodiment of the foil structure with the feature substance of the invention for a safety feature, for instance in a bank note. **Fig. 11** illustrates the carrier foil 28, on one side of which the metallization is applied. The other side of the carrier foil 28 carries the additional layer 30 of the electrically conductive polymer.

The additional layer 30 is applied on the carrier foil 28 on the basis of the common technological processes, for instance by calendering. A compound foil is produced on which the metallization 29 is applied afterwards, for instance by vapour-deposition.

Of course, it is also possible to apply the additional layer 30 of the electrically conductive polymer on the metallization 29 after the vapour-deposition of the carrier foil. In such a foil structure the additional layer 30 has a certain protective effect for the metallization 29 .

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Example 6:

Fig. 12 illustrates another preferred embodiment of the foil structure with the feature substance of the invention. The carrier foil **28** is illustrated with the metallization **29**. The additional layer **30** of *PEDT/PSS* lies between the carrier foil **28** and the metallization **29** as a bonding agent between the carrier foil **28** and the metallization **29**. The arrangement of the additional layer **30** as a bonding agent is not limited to an improvement of the bond between the carrier foil **28** and the metallization **29**. The additional layer **30** can be used between any other foils or layers for the improvement of the bond. However, as a bonding agent between the carrier foil **28** and the metallization **29** there is the advantage that the relatively brittle metallization **29** on the much more elastic additional layer **30** is able to resist higher mechanical stresses than with a direct vapour-deposition of the carrier-foil **28**.

Example 7:

Fig. 13 illustrates a foil structure for a safety feature with the feature substance of the invention using a carrier foil **28**, on which the metallization **29** is applied. The metallization **29** is covered by another carrier foil **28'**. This is made, for instance, for the protection of the metallization **29**, if it is exposed to a higher stress in the case of a window thread with a partial embedding in the paper web. Increased stresses during the technological process of paper making are another reason for the use of another carrier foil **28'**. At least one of the carrier foils **28**; **28'** is provided with the additional layer **30** of the electrically conductive polymer.

Example 8:

In **Fig. 13** both carrier foils **28**; **28'** carry the additional layer **30**, whereas in **Fig. 14** an embodiment is illustrated in which only one of the carrier foils **28** carries the additional layer **30** of the electrically conductive polymer

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The invention is not limited to the feature substance of the invention being used as an additional layer 30 in a foil structure. The feature substance of the invention can be included as a safety feature in the paper web in an any configuration.

Example 9:

It is another preferred embodiment to provide the chosen printing inks with the electrically conductive polymer for the purpose of testing.

The electrical conductivity of the polymer may be produced by different physical processes. One of these processes is based on the fact that the electrically conductive polymer base a special polymer mesh structure allowing, to a certain extent, an electron displacement and is, hence, electrically conductive.

Another physical process is based on the fact that certain, finely distributed substances are added to a polymer so that an electrical conductivity is produced. If a substance with a varnish-like consistency is selected for the electrically conductive polymer, it is possible to include different additives in the structure of the polymer in a fine distribution. According to the invention these substances may be electrically conductive and cause an electrical conductivity of the polymer; they may also be of another nature, however, for instance they can contain feature pigments.

It serves the improvement of unforgeability to provide additional safety features in addition to the feature of the electrical conductivity and to combine them in a suitable way. For instance, in addition to the electrical conductivity of the polymer, human-visually detectable feature pigments as well as those that are only detectable with suitable test apparatuses such as special light sources and optical sensors. Moreover, the invention extends also to the combination of the electrical conductivity with those additives that have magnetic properties. Particularly advantageous in the meaning of the invention is a combination of the electrical conductivity with optical and magnetic feature substances. As a preferred application the additives with magnetic properties can be hidden by the addition of human-visually detectable feature pigments. Hence, it remains uncertain to a potential counterfeiter whether a magnetically effective substance is existing, in particular because the used quantities are low and the magnetic effects can't be simply detected.

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Besides the mere presence of the optically effective additives in the electrically conductive polymer the invention also extends to the optically effective additives being arranged in the electrically conductive polymer such that an optical encoding is produced, for instance an ink pattern that can be detected by the test apparatuses. The same applies to the magnetically effective additives by the arrangement of which a magnetic encoding is produced, for instance in the form of a magnetic bar code.

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We claim

1. Process for the integration of electrically conductive feature substances in pulp webs (6) for documents, security documents and bank notes, **in which** the feature substance is included in or applied on the pulp web (6), and for this the feature substance is transported from a store tank (26) in outlet pipes (17) or, for the production of water marks in the pulp, from a store tank (16) via feature substance transfer rollers (7) on embossing segments (25) of a water mark embossing roller (5) to the pulp web (6).
2. Process as claimed in claim 1 **in which** an electrically conductive, transparent polymer is used as a feature substance.
3. Process as claimed in claim 1 **in which** an electrically conductive pigment with a carrier media is used as a feature substance.
4. Process as claimed in claim 1 **in which** a combination of electrically conductive, transparent polymers and electrically conductive pigments is used as a feature substance.
5. Process as claimed in one or several of the preceding claims **in which** the feature substance is combined with the pulp web (6) as a
 - dispersion
 - suspension
 - solution or
 - in the form of a monomer together with a polymerisation agent.
6. Process as claimed in one or several of the preceding claims **in which** the feature substance is included in the pulp web (6) partially or homogeneously.
7. Process as claimed in one or several of the preceding claims **in which** the feature substance is applied on the pulp web (6) partially or homogeneously.





8. Process as claimed in one or several of the preceding claims **in which** the feature substance is preferably mixed in a machine chest (8) homogeneously with the pulp.
9. Process as claimed in one or several of the preceding claims **in which** the feature substance is fed from a store tank (26) with pumps (20) into outlet pipes (17) which are equipped with a valve (19) and a control unit (18).
10. Process as claimed in one or several of the preceding claims **in which** the outlet pipe (17) is designed such that the feature substance drops on the pulp web (6) in an equally distant way or enables a continuous outflow of the feature substance in order to apply it on the pulp web in the form of lines.
11. Process as claimed in one or several of the preceding claims **in which** the feature substance is partially transferred as an image of an embossing segment (25) of the water mark embossing roller (5) or as one part of the image of the embossing segment (25) so that either the whole or one part of the water mark in the embossing area (24) is provided with the electrically conductive feature substance.
12. Process as claimed in one or several of the preceding claims **in which** the pulp web (6) provided with the electrically conductive feature substance is monitored by a testing and controlling equipment to control the homogeneous or partial presence of the feature substance and in which the feature substance addition is regulated through the controlling equipment.
13. Electrically conductive feature substance for safety features to be included in the paper webs for the testing of documents, security documents, bank notes, packages and products **in which** the electrically conductive feature substance is combined in the form of an electrically conductive polymer, as described in claim 5, with a foil of the safety feature to be included in the pulp web.





14. Electrically conductive feature substance as claimed in claim 13 **in which** the electrically conductive polymer is at least partially applied, preferably as a printing image, on the safety feature to be included in the pulp web.
15. Electrically conductive feature substance as claimed in claim 13 **in which** a foil structure serving as a safety feature consisting of at least one carrier foil (28) and one metallization (29) applied on the carrier foil (28) with a demetallization in sections up to the edge of the carrier foil (28) is provided with another layer (30) of the electrically conductive polymer and the foil structure is partially or fully embedded in the pulp web.
16. Electrically conductive feature substance as claimed in claim 13 **in which** the additional layer (30) is used as a bonding agent between the carrier foils (28) as well as between the carrier foils (28) and the metallization (29) of the foil structure serving as a safety feature, and as a bonding agent between the foil structure and the pulp web.
17. Electrically conductive feature substance as claimed in claim 13 **in which** on one side of the carrier foil (28) the metallization (29) and on the other side an additional layer (30) of the electrically conductive polymer is applied
18. Electrically conductive feature substance as claimed in one or several of claims 13 to 17 **in which** on one side of the carrier foil (28) the metallization (29) and on the metallization (29) the additional layer (30) of the electrically conductive polymer is applied
19. Electrically conductive feature substance as claimed in one or several of claims 13 to 18 **in which** the metallization (29) applied on one side of the carrier foil (28) is covered by a second carrier foil (28) and on at least one of these carrier foils (28) the additional layer (39) of the electrically conductive polymer is applied.
20. Electrically conductive feature substance as claimed in one or several of claims 13 to 19 **in which** the additional layer (30) of the electrically conductive polymer is provided with a higher extensibility rate than the metallization (29) applied on the carrier foils (28;2).





21. Electrically conductive feature substance as claimed in one or several of claims 13 to 20 **in which** the feature substance is an electrically conductive printing ink containing a polymer.
22. Electrically conductive feature substance as claimed in one or several of claims 13 to 21 **in which** the feature substance is an electrically conductive polymer the specific surface resistance of which is adjustable by the way of application, by the way of integration and/or by its composition and/or its specific formulation.
23. Electrically conductive feature substance as claimed in one or several of claims 13 to 22 **in which** the feature substance is an electrically conductive polymer the resistance of which lies in the range of 20 to 40 kohm/sq.
24. Electrically conductive feature substance as claimed in one or several of claims 13 to 23, **in which** the feature substance is an electrically conductive polymer that has a mesh structure causing the electrical conductivity.
25. Electrically conductive feature substance as claimed in one or several of claims 13 to 24 **in which** the feature substance is an electrically conductive polymer the electrical conductivity of which is caused by the additives
26. Electrically conductive feature substance as claimed in one or several of claims 13 to 25 **in which** the feature substance is an electrically conductive polymer to which at least one human-visually perceptible pigment is added as an additive.
27. Electrically conductive feature substance as claimed in one or several of claims 13 to 26 **in which** the feature substance is an electrically conductive polymer the feature pigments of which are active or may be activated and are detectable with an optical testing equipment.



28. Electrically conductive feature substance as claimed in one or several of claims 13 to 27 **in which** the feature substance is an electrically conductive polymer the additives of which have magnetic properties.
29. Electrically conductive feature substance as claimed in one or several of claims 13 to 28 **in which** the feature substance is an electrically conductive polymer the feature pigments of which make the additives with magnetic properties unrecognisable.
30. Electrically conductive feature substance as claimed in one or several of claims 13 to 29 **in which** the safety feature to be included in the pulp web is provided with an optical coding in addition to the electrically conductive polymer.
31. Electrically conductive feature substance as claimed in one or several of claims 13 to 30 **in which** the safety feature to be included in the pulp web is provided with a magnetic coding in addition to the electrically conductive polymer.
32. Electrically conductive feature substance for safety features to be included in paper webs for the testing of documents, security documents, bank notes, packages and products **in which** the feature substance is an electrically conductive polymer, as described in claim 5, combined with a carrier material as a liquid applying substance in the form of the solution, the dispersion or suspension or in the form of a monomer together with a polymerisation agent.
33. Electrically conductive feature substance as claimed in claim 32 in which this one consists of 3,4-ethylenedioxythiophene (EDT) and is preferably a PEDT/PSS (Polyethylenedioxythiophenepolystyrolsulphonate).
34. Electrically conductive feature substance as claimed in claim 33 in which PEDT/PSS is preferably applied according to the formulation CPP105.



35. Electrically conductive feature substance as claimed in claim 32 **in which** a monomer, for instance a 3,4-ethylenedioxythiophene is combined on a carrier material together with a polymerisation agent, for instance ferric-III-toluenesulphonate solution in n-butanol.
36. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the electrically conductive polymer is transferred on the carrier material by means of generally known transfer processes.
37. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the electrically conductive polymer is applied on the carrier material by means of a printing, spray or dipping process.
38. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the carrier material is the paper web itself or a foil to be included in the paper web.
39. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the carrier material is a bonding agent or primer existing on a base,
40. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the carrier material is a package or a product.
41. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the carrier material is a human-visually detectable safety feature
42. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the electrically conductive polymer is transparent
43. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the electrically conductive polymer is almost transparent.
44. Electrically conductive feature substance as claimed in any one of claims 32 to 35 **in which** the electrically conductive polymer has a metallic appearance.



45. Electrically conductive feature substance as claimed in any one of claims 32 to 35 in **which** the electrically conductive polymer is opaque by transmitted light.
46. Electrically conductive feature substance as claimed in any one of claims 32 to 35 in **which** the electrically conductive polymer does not stand out from its surroundings in a used condition.
47. Electrically conductive feature substance as claimed in any one of claims 32 to 35 in **which** the electrically conductive polymer stands out from its surroundings in a used condition.
48. Electrically conductive feature substance as claimed in any one of claims 32 to 35 in **which** the electrically conductive polymer is applied on the carrier material as at least one coherent area.
49. Electrically conductive feature substance as claimed in any one of claims 32 to 35 in **which** the electrically conductive polymer is applied on the carrier material as an area which is divided by at least one interruption.
50. Electrically conductive feature substance as claimed in any one of claims 32 to 35 in **which** the electrically conductive polymer is applied on the carrier material as at least one line.
51. Electrically conductive feature substance as claimed in any one of claims 32 to 35 in **which** the electrically conductive polymer is punctually applied on the carrier material.
52. Electrically conductive feature substance as claimed in any one of claims 13 to 51 in **which** the electrically conductive feature substance is combined in the form of an electrically conductive polymer prior to its combination with the paper web with at least one foil, one hardenable varnish film, one reflection layer and one protective layer.



* C L M S *

53. Process for the testing of electrically conductive feature substances integrated in the pulp web of documents, security documents, packages and products **in which** the feature substance is detected on the basis of its data of the electrical conductivity and/or other physical values and/or chemical properties to achieve a multiple testing.
54. Process as claimed in claim 53 **in which** a scanner sensor (10;11) is activated by means of optical, magnetic and/or mechanical sensors (13) and the scanner sensor (10;11) consists of a multitude of scanner channels scanning the electrical conductivity.
55. Process for testing as claimed in claim 53 **in which** the electrical conductivity is scanned across the full width of the pulp web (6) by means of capacitive scanner sensors (11).
56. Process for testing as claimed in claim 53 **in which** for the reduction of the stray coupling the scanner channels are controlled such that in the first scanning process the sensor channels with even numbers (21) are controlled and in the second scanning process the sensor channels with odd numbers (22) where the scanning frequency is preferably 200 kHz.
57. Process for testing as claimed in claim 53 **in which** the distance between the transmitting electrodes and the receiving electrodes of the capacitive scanner sensor (11) is switched over according to the test structures and test level.
58. Process for testing as claimed in claim 53 **in which** the optical properties which the electrically conductive feature substance has are used as a reference value to the electrical conductivity as a double testing of this feature.
59. Process for testing as claimed in claim 53 **in which** a holding-down device opposing to the scanner sensor (10;11) in the form of a roller or sliding rail optimises the transport of the pulp web (6).
60. Process for testing as claimed in claim 53 **in which** the pulp web (6) is tested on both sides by means of sensor electrodes one functional electrode side of which is positioned



above the pulp web (6) and the other functional electrode side of which is positioned below the pulp web (6) to be tested.

61. Process for testing as claimed in claim 53 in which the adherence to the production parameter is tested by a multitude of scanner sensors (10;11) arranged across the full width of the pulp web (6).
62. Process for testing as claimed in claim 53 in which a control circuit downstream of the scanner sensors (10;11) regulates the feature substance addition.

Feature substances and safety features and processes for their integration in the pulp web as well as processes for testing

The invention relates to feature substances and safety features, a process for their integration in the pulp web of documents, security documents, bank notes, packages and products as well as a process for testing. It is the objective of the invention to contemplate feature substances contributing to an increased unforgeability and being only detectable by means of a very precisely working testing technology. The feature substance as disclosed by the invention is transported from a store tank via outlet pipes to the pulp web or, for the production of water marks, on embossing segments of a water mark embossing roller to the pulp web. The electrically conductive feature substance is combined as an electrically conductive polymer with a foil of the safety feature to be included in the pulp web or combined as a liquid application substance with the carrier material. The feature substance is detected according to its electrical conductivity, its physical values or chemical properties in a multiple testing.

See Fig. 1



"I, a translator of the Arabic and English languages who was officially appointed and sworn in by the President of the Regional Court of Dresden (Saxony, Germany) do hereby certify: The above English translation of the German original is true and complete." Dresden, December 11, 2000

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C. Gentsch

