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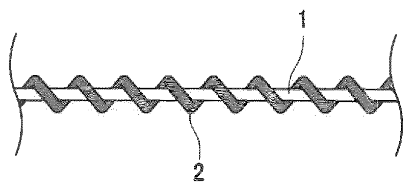
(54) **WORK GLOVE**

(57) Disclosed is a work glove which is wholly or partly knitted with a composite yarn comprising a filament yarn and a conductive fiber, the glove being **characterized in that** the recovery rate from stretch of the filament yarn included in the composite yarn is 0 to 10%.

F I G. 1A



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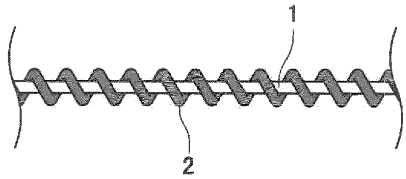

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Description

Technical Field

[0001] The present invention relates to composite yarns used in the fields requiring conductivity and low dust emission, such as a semiconductor fabrication process, a painting process or a clean room work, to methods for producing composite yarns, to work gloves and fabrics obtained from composite yarns, and to methods for producing such work gloves and fabrics.

Background Art

[0002] In a field such as a semiconductor fabrication process, a painting process or a clean room work, work gloves having conductivity are used. In such work gloves, conductive fibers obtained by incorporating carbon into polyester fibers or nylon fibers are used. Alternatively, in such work gloves, there are also used, for example, composite yarns obtained by braiding conductive fibers with a filament yarn such as a woolly nylon or a woolly polyester wherein the conductive fibers are obtained by dyeing acrylic fibers with copper sulfide or by coating acrylic fibers with polypyrrole. Further, there are also used, for example, work gloves modified by coating the fingertip portions and the palm portions of such gloves as described above with a polyurethane resin, a synthetic rubber or the like for the purpose of preventing slipping.

[0003] For example, JP2009-102779A discloses a glove in which conductive threads obtained by forming a metallic coating layer on the surface of synthetic fibers are stitched onto finger and thumb portions and a back portion. Japanese Utility Model Registration No. 3042096 describes a conductive fiber clothing material in which a yarn material made of an electromagnetic wave fiber obtained from a material mainly composed of platinum and including as mixed therein minerals such as silica and alumina and a yarn material made of a copper ionic fiber are interwoven so as to be entangled with each other, and further describes a glove, a fabric and the like made of the conductive fiber clothing material. JP2006-63456A discloses a glove in which a conductive yarn is used. Japanese Utility Model Registration Publication No. H6-54720 discloses the use of a conductive yarn having an electric resistance of 10^9 Ω/cm or less in the finger-forming portions of a glove. In any of the above-described gloves, a certain level of conductivity and a certain level of low dust emission are attained.

[0004] However, in each of the above-described heretofore known gloves, a composite fiber obtained by braiding a conductive fiber as they are with a filament yarn is used. Due to the physical properties of the conductive fibers, such gloves cannot attain such stretching properties that offer sufficient feeling of fitting at the time of wearing the gloves. Conductive fibers are expensive, and hence the composite yarns and gloves obtained with the conductive fibers unfortunately offer a problem of cost increase.

[0005] For the purpose of preventing or suppressing static electricity, or reducing costs, there have beet proposed a composite yarn obtained by covering with a conductive fiber a filament yarn made of a fiber such as woolly nylon fiber or a woolly polyester fiber, and a glove comprising the composite yarn. The covering as referred to herein means a method for obtaining a composite yarn by winding at a predetermined interval a yarn to be a winding yarn around the outer periphery of a yarn to be a core yarn. As compared to the cases where composite yarns are obtained, for example, by doubling and twisting, the yarn length needed by the covering is shorter, and hence a merit in cost can be expected. As compared to doubling and twisting machines, covering machines are widely available in the market and widely used, and hence the covering is effective from the viewpoint of the productivity.

[0006] However, when work is performed by wearing a glove made of such a composite yarn, unfortunately the conductive fiber in the glove is detached due to the friction and abrasion during working. Consequently, for example, in the semiconductor fabrication process, troubles such as insulation breakdown of semiconductor substrates due to the detached conductive fiber occur as the case may be.

[0007] The cause for the detachment of the conductive fiber in the glove is inferred as follows. In the conventional gloves for use in a countermeasure against static electricity, for the purpose of enhancing the fit of the gloves, usually, a crimp processed filament yarn (for example, woolly nylon yarn) having a recovery rate from stretch of 20% to 50% as measured according to Japanese Industrial Standard L 1013 is used as a core yarn, and a conductive fiber is used as a winding yarn. In the case where such a filament yarn is used, when a composite yarn is obtained by covering or when a glove is produced from the composite yarn, the involved process requires working to be performed while a tension is being applied to the yarn. This tension is removed after the working. Thus, as the filament yarn gets back to the original condition, the covering conductive fiber smaller in recovery protrudes outward from the surface of the composite yarn. And, the conductive fiber protruding outward conceivably tends to be detached due to friction and abrasion. In particular, when the diameter of conductive fiber is smaller than the diameter of the filament yarn, the phenomenon of the outward protrusion of the Conductive fiber from the surface of the composite yarn is more remarkable.

Summary of Invention

Technical Problem

[0008] Accordingly, for the purpose of preventing the detachment of the conductive fiber due to the friction and abrasion at the time of working, it is necessary to suppress the outward protrusion of the conductive fiber, smaller in recovery, even after the tension is removed following the covering or the production of a glove.

[0009] In view of the above-described problems, a technical problem to be solved by the present invention is to provide a composite yarn in which the detachment of the conductive fiber is prevented over a long period of time and which has both conductivity and low dust emission, and a work glove and a fabric obtained from the composite yarn.

Solution to Problem

[0010] The present inventor performed a continuous diligent study in order to solve the above-described problems, and consequently has found that the recovery (restoration) of the conductive fiber and the recovery (restoration) of the filament yarn to be combined with the conductive fiber to form a composite yarn are brought close together. Consequently, the present inventor perfected the present invention by discovering that a composite yarn in which the detachment of the conductive fiber is prevented and a work glove and a fabric obtained from the composite yarn can be obtained. It is to be noted that the filament yarn is to be a covering yarn wound around a conductive fiber serving as a core yarn, to be a core yarn around which a conductive fiber is wound as a covering yarn, to be a yarn attached to a conductive fiber serving as a core yarn, and to be a yarn doubled and twisted with a conductive fiber to form a doubled and twisted yarn.

[0011] Specifically, the gist of the present invention is the following (1) to (16).

(1) A work glove wholly or partly knitted with a composite yarn comprising a filament yarn(s) and a conductive fiber, the glove being characterized in that the recovery rate from stretch of the whole of the filament yarn(s) included in the composite yarn is 0 to 10%.

(2) The work glove according to (1), characterized in that the filament yarn is a core yarn, and the conductive fiber is a covering yarn wound around the core yarn.

(3) The work glove according to (1), characterized in that the filament yarn is the core yarn, the conductive fiber is a yarn attached to the core yarn, and the core yarn and the attached yarn are covered with a covering yarn.

(4) The work glove according to (1), characterized in that the conductive fiber is a core yarn, and the filament yarn is a covering yarn wound around the core yarn.

(5) The work glove according to (1), characterized in that the composite yarn is a yarn obtained by doubling and twisting the filament yarn and the conductive fiber.

(6) The work glove according to any one of (1) to (5), characterized in that the conductive fiber is of a form of a doubled and twisted yarn.

(7) The work glove according to any one of (1) to (6), characterized in that the fingertip portions, the palm portion or the whole surface of the work glove is covered with a synthetic rubber or a resin.

(8) A method for producing a work glove, characterized by comprising: decreasing the recovery rate from stretch of a crimp processed yarn; preparing a filament yarn comprising at least in part thereof the crimp processed yarn decreased in the recovery rate from stretch and having a total recovery rate from stretch of 0 to 10%; preparing a composite yarn by using the filament yarn and a conductive fiber; and knitting the composite yarn into the work glove.

(9) A composite yarn comprising a filament yarn(s) and a conductive fiber, characterized in that the recovery rate from stretch of the whole of the filament yarn(s) included in the composite yarn is 0 to 10%.

(10) The composite yarn according to (9), characterized in that the filament yarn is a core yarn, and the conductive fiber is a covering yarn wound around the core yarn.

(11) The composite yarn according to (9), characterized in that the filament yarn is a core yarn, and the conductive fiber is a yarn attached to the core yarn, and the core yarn and the attached yarn are covered with a covering yarn.

(12) The composite yarn according to (9), characterized in that the conductive fiber is a core yarn, and the filament yarn is a covering yarn wound around the core yarn.

(13) The composite yarn according to (9), characterized in that the filament yarn and the conductive fiber are doubled and twisted.

(14) The composite yarn according to any one of (9) to (13), characterized in that the conductive fiber is of a form of a doubled and twisted yarn.

(15) A method for producing a composite yarn characterized by comprising: decreasing the recovery rate from stretch of a crimp processed yarn; preparing a filament yarn comprising at least in part thereof the crimp processed yarn decreased in the recovery rate from stretch and having a total recovery rate from stretch of 0 to 10%; and preparing the composite yarn by using the filament yarn and a conductive fiber.

(16) A fabric characterized in that the whole or part of the fabric is formed of the composite yarn according to any one of (9) to (15).

Advantageous Effects of Invention

[0012] In the present invention, the recovery rate from stretch of the filament yarn forming the composite yarn in combination with the conductive fiber, as measured according to Japanese Industrial Standard L 1013, is specified to be 0 to 10%. Consequently, the recovery (restoration) of the conductive fiber and the recovery (restoration) of the filament yarn combined with the conductive fiber to form the composite yarn can be made to almost coincide with other. Accordingly, in any of the case where the conductive fiber is used as the core yarn, the case where conductive fiber is used as the covering yarn and the case where the conductive fiber is used as the yarn to be attached to the core yarn, the outward protrusion of the conductive fiber, smaller in recovery, is prevented when the tension is removed after covering. As a result, the detachment of the conductive fiber due to friction or abrasion can be suppressed. Moreover, even in a practical use over a long period of time, the detachment of the conductive fiber can be effectively suppressed. Thus, it becomes possible to obtain a composite yarn having both conductivity and low dust emission, and a work glove and a fabric obtained from the composite yarn.

Brief Description of Drawings

[0013]

[FIG. 1] FIG. 1 is a schematic diagram illustrating the contrast between a case of a composite yarn in which a core yarn is a filament yarn and a covering yarn is a conductive fiber and a case where a tension applied to the composite yarn is removed.

[FIG. 2] FIG. 2 is a schematic diagram illustrating the contrast between a case of a composite yarn in which a core yarn being a filament yarn and an attached yarn being a conductive fiber are covered with another filament yarn and a case where a tension applied to the composite yarn is removed.

[FIG. 3] FIG. 3 is a schematic diagram illustrating the contrast between a of a composite yarn in which a core yarn formed of a bundle of paralleled filament yarns is covered with a conductive fiber and a case where a tension applied to the composite yarn is removed.

[FIG. 4] FIG. 4 is a schematic diagram illustrating the contrast between a case of a composite yarn in which a conductive fiber being a core yarn is covered with a filament yarn and a case where a tension applied to the composite yarn is removed.

[FIG. 5] FIG. 5 is a schematic diagram illustrating the contrast between a case of a composite yarn in which a core yarn formed of a bundle of parallel conductive fibers is covered with a filament yarn and a case where a tension applied to the composite yarn is removed.

[FIG. 6] FIG. 6 is a schematic diagram illustrating a work glove of the present invention wherein the palm portion of the glove is covered with a resin.

[FIG. 7] FIG. 7 is a schematic diagram illustrating a condition that, when the recovery rate from stretch of a filament yarn is measured, a simple 6 with a load 7 of (0.176 mN $\times$ 20 $\times$ displayed Tex number) and a load 8 of (8.82 mN $\times$ 20 $\times$ displayed Tex number) applied thereto is allowed to move downward into water 9.

Description of Embodiments

[0014] The work glove of the present invention is wholly or partly knitted with a composite yearn. The composite yarn includes a conductive fiber and yarns (specifically, such as a covering yarn to be wound around the conductive fiber as a core yarn, a core yarn around which the conductive fiber as a covering yarn is wound, a yarn to be attached to the conductive fiber as a core yarn, and a yarn to be doubled and twisted with the conductive fiber to yield a doubled and twisted yarn) to be combined with the conductive fiber.

[0015] The conductive fiber used in the present invention is preferably a filament yarn (namely, a long fiber) from the viewpoint of low dust emission.

[0016] Examples of of the conductive fiber include: metal fibers (for example, metal fibers of 20 to 50 μm in diameter) such as stainless steel fiber; fibers obtained by polymerizing pyrrole or the like on the surface of synthetic fibers such as acrylic fiber; fibers obtained by coating the surface of acrylic fiber with copper sulfide or the like; and fibers obtained by incorporating carbon into polyester fiber or nylon fiber.

[0017] From the viewpoint of the improvement of the feeling in the form of a glove or the demands related to the countermeasure against static electricity in the form of a glove, preferable among these are fibers obtained by coating the surface of synthetic fibers such as acrylic fiber with copper sulfide and fibers obtained by incorporating carbon into polyester fiber or nylon fiber.

[0018] From the viewpoint of reducing the emitted amount of dust and the detached amount of the conductive fiber, the conductive fiber is preferably a doubled and twisted yarn. In such a case, the conductive fiber may be obtained by doubling and twisting a conductive fiber and a nonconductive fiber, or may be obtained by doubling and twisting two conductive fibers, wherein these conductive fibers may be the same or different in type. Among these, the Conductive fiber obtained by doubling and twisting a conductive fiber and a nonconductive fiber is preferable because even the detachment of such a fiber does not cause insulation breakdown and thus the safety is ensured.

[0019] When the conductive fiber is a doubled and twisted yarn composed of a conductive fiber and a nonconductive fiber, the conductive fiber is preferably a fiber obtained by doubling and twisting a filament yarn having a recovery rate from stretch of 0 to 10% as measured according to Japanese Industrial Standard L 1013 and a conductive fiber, and more preferably a fiber obtained by doubling and twisting a filament yarn having a recovery rate from stretch of 0 to 7% and a conductive fiber. When the recovery rate from stretch of the filament yarn to be doubled twisted with a conductive fiber exceeds 10%, unpreferably the emitted amount of dust and the detached amount of the conductive fiber may be increased. Substantially, there is no such a filament that has a recovery rate from stretch of less than 0%.

[0020] The recovery rate from stretch in the present invention is a quantity used as an index for the recovery (restoration) of a yarn, and the measurement method thereof is described below in Examples.

[0021] When a doubled and twisted yarn is obtained by doubling and twisting a conductive fiber and a filament yarn, preferable is a doubled and twisted yarn obtained with a twist of 50 to 700 turns per 1 meter, and more preferable is a doubled and twisted yarn obtained with a twist of 100 to 500 turns/m. When the number of twist is less than 50 turns/m, the flexibility as a yarn is poor, and further, such a doubled and twisted yarn cannot be satisfactorily doubled and twisted with a doubling and twisting machine, and the productivity may be degraded. On the other hand, when the number of twist exceeds 700 turns/m, the thus obtained doubled and twisted yarn may become unpractically too hard.

[0022] The yarn to be with a conductive fiber to form a composite yarn is required to be a filament yarn, namely, a long fiber, from the viewpoint of preventing the yarn from protruding of the ends of the yarn from the composite yarn. The filament yarn may be a yarn obtained by using the following fibers each alone or in combinations of two or more thereof: fibers formed of polymers such as polyester, acrylic polymer, reinforces polyethylene, aramid and nylon.

[0023] When the filament yarn is used as a core yarn or an attached yarn of a composite yarn, the fineness of the filament yarn per one yarn is preferably 50d to 450d and more preferably 50d to 200d. When the fineness is less than 50d, the sense of stability and the strength of the yarn in the case where the yarn is used as a core yarn or an attaches yarn may be poor. On the other hand, when the fineness exceeds 450d, the yarn becomes too hard, and hence the texture and the sense of touch in the form of a composite yarn may be poor.

[0024] When the filament yarn is used as a covering yarn for a composite yarn, the fineness of a filament of the yarn is preferably 2d to 5d and more preferably 1.3d to 2.9d. When the fineness is less than 2d, the emitted amount of dust and the detached amount of the filament yarn may be increased. On the other hand, when the fineness exceeds 5d, the texture may be degraded.

[0025] The recovery rate from stretch of the filament yarn is usually about 20 to 50% in the case where the filament yarn is a yarn obtained, for example, by crimping processing. In the present invention, it is necessary to bring close together the recovery rate from stretch of the conductive fiber and the recovery rate from stretch of the filament yarn to be combined with the conductive fiber to form a composite yarn. It is essential to suppress in this way the detachment of conductive fiber in the case where the conductive fiber is included in the composite yarn. The recovery rate from stretch of the Conductive fiber is usually about 1 to 5%, and hence the recovery rate from stretch of the filament yarn to be combined is required to be 0 to 10%, and is preferably 0.1 to 10% and more preferably 1 to 7%. When the filament yarn is composed of a plurality of yarns different from each other in recovery rate from stretch, the recovery rate from stretch of the whole of the filament yarns is required to satisfy the above-described range.

[0026] In general, for the purpose of making the recovery (restoration) of the conductive fiber approximately coincide with the recovery (restoration) of another yarn to be used in combination (namely, to be combined with the conductive fiber), for example, it is considered that the conductive fiber has only to be subjected to a crimping processing. However, when the conductive fiber is a fiber dyed with copper or a conductive fiber incorporating carbon, it is difficult to perform a crimping processing to provide the conductive fiber with stretching properties, because of the properties of the material. Even when the conductive fiber acquires stretching properties, the recovery rate from stretch of the conductive fiber is a value as low as about 2 to 3%, and no feeling of fitting is obtained when the conducive fiber is used in a work glove, and thus the crimping processing of the conductive fiber is not practical. Accordingly, as in the present invention, it is necessary to set at 0 to 10% the recovery rate from stretch of the whole of the filament yarn(s) to be used in combination with the conductive fiber.

[0027] Even when a filament yarn is in a condition of an unprocessed yarn, the filament yarn can be used as long as the recovery rate from stretch of the filament yarn satisfies the above-described range. However, in the case where the filament yarn has sleight stretching properties, the feeling of fitting is improved when the filament yarn is incorporated into the glove. Accordingly, it is preferable to use as a filament yarn a crimp processed yarn the recovery rate from stretch of which has been decreased.

[0028] As the filament yarn, commercially available yarns whose recovery rates from stretch fall within the above-described range may also be used; or alternatively, the recovery rate from stretch of a yarn having a recovery rate from stretch exceeding the above-described range is decreased so as to fall within the above-described range, and then the yarn may also be used as the filament yarn. Examples of the method for decreasing the recovery rate from stretch of a filament yarn include the following.

[0029] First, the filament yarn is softly wound around a bobbin so as for the package density to be 0.2 to 0.3 g/cm^3 and is washed with hot water at about 70 to 100°C for 0.17 to 1 hour. Then, the filament yarn is dewatered for 1 to 30 minutes, and dried at 60 to 100°C for 40 to 300 minutes. By heat treating the filament yarn in this way, the recovery rate from stretch of the filament yarn can be decreased. Such a treatment can be performed, for example, by using a heretofore known dyeing machine as a substitute for a proper machine.

[0030] It is to be noted that the above-described conditions can be appropriately adjusted depending on the qualities and the like of the materials forming the filament yarn.

[0031] As a covering yarn to be used for covering, for example, the above-described conductive fiber may be used, or alternatively, the following may also be used: unprocessed yarns of polyester fiber, reinforced polyethylene fiber, aramid fiber, nylon fiber, and acrylic fiber; and crimp processed yarns obtained by crimping processing of these yarns.

[0032] Examples of the structure of the composite yarn in the present invention include the following (i) to (v). The structures (i) to (v) of the composite yarn are described with reference to FIGS. 1 to 5.

[0033] (i) A structure in which a filament yarn is used as a core yarn, and a conductive fiber is wound as a covering yarn around the core yarn. FIG. 1(a) shows a composite yarn having the structure (i). Specifically, FIG. 1(a) shows a composite yarn obtained by using the filament yarn 1 as the core yarn, and by covering the core yarn with the conductive fiber 2. As shown in FIG. 1(b), even when the tension is removed after the covering or the production of a glove or the like, the outward protrusion of the conductive fiber 2, smaller in recovery, is suppressed.

[0034] (ii) A structure in which a filament yarn is used us a core yarn, a conductive fiber is used as a yarn attached to the core yarn, and the core yarn and the attached yarn are covered with a covering yarn. FIG. 2(a) shows a composite yarn having the structure (ii). Specifically, FIG. 2(a) shows a composite yarn obtained by using the filament yarn 1 as the core yarn and the conductive fiber 2 as the attached yarn, and by covering with another filament yarn 1 the core yarn and the attached yarn. As shown in FIG. 2(b), even when the tension is removed after the covering or the production of a glove or the like, the outward protrusion of the conductive fiber 2, smaller in recovery, is suppressed.

[0035] (iii) A structure in which a bundle of paralleled filament yarns is used as a core yarn, and a conductive fiber is wound as a covering yarn around the core yarn. In other words, this is a structure in which the core yarn in above-described structure (i) is replaced with a plurality of core yarns. FIG. 3(a) shows the structure (iii). Specifically, FIG. 3 (a) shoes a composite yarn obtained by using as the core yarn the bundle of paralleled filament yarns 1, and by covering the core yarn with the conductive fiber 2. As shown in FIG. 3(b), even when the tension is removed after the covering or the production of a glove or the like, the outward protrusion of the conductive fiber 2, smaller in recovery, is suppressed.

[0036] (iv) A structure in which a conductive fiber is used as a core yarn, and a filament yarn is wound as a covering yarn around the core yarn. FIG. 4(a) shoes a composite yarn having the structure (iv). Specifically, FIG. 4(a) the composite yarn obtained by using the conductive fiber 2 as the core yarn, and by covering the core yarn with the filament yarn 1. As shown in FIG. 4(b), even when the tension is removed after the covering or the production of a glove or the like, the outward protrusion of the conductive fiber 2, smaller in recovery, is suppressed.

[0037] (v) A structure in which a bundle of paralleled conductive fibers is used as a core yarn, and a filament yarn is wound as a covering yarn around the core yarn. In other words, this is a structure in which the core yarn in above-described structure (iv) is replaced with the bundle of core yarns. FIG. 5(a) shows a composite yarn having the structure (v). Specifically, FIG. 5(a) shows a composite yarn obtained by using as the core yarn the bundle of paralleled conductive fibers 2, and by covering the core yarn with the filament yarn 1. As shown in FIG. 5(b), even when the tension is removed after the covering or the production of a glove or the like, the outward protrusion of the conductive fibers 2, smaller in recovery, is suppressed.

[0038] When the recovery rate from stretch of the whole of the filament yarn(s) in the composite yarn exceeds 10%, as compared to FIGS. 1(b) to 5(b), a phenomenon in which the protrusion of the conductive fiber(s) from the surface of the composite yarn or the surface of a glove becomes remarkable. In other words, in the present invention, the recovery rate from stretch rate of the whole of the filament yarn(s) in the composite yarn is specified to be 0 to 10%, and hence the protrusion of the conductive fiber(s) from the surface of the composite yarn or the surface of the glove can be suppressed.

[0039] Among the above-described composite yarns, the composite yarn having the structure (i) is most preferable from the viewpoint of effectively suppressing the detachment of the conductive fiber.

[0040] The number of covering turns per 1 m of the core is preferably about 50 to 700 turns, more preferably 100 to 500 turns and furthermore preferably 200 to 400 turns. When the number of covering turns exceed 700 turns/m (T/M), the composite yarn becomes hard, accordingly knitting such a composite yarn becomes difficult, and the feeling in the form of a glove may be degraded. When the number of covering turns is less then 50 turns/m, it is impossible to perform covering with a heretofore known conventional covering machine, and thus the production of a composite yarn cannot be performed as the case may be.

[0041] Examples of the way of winding in performing the covering include an S-winding and a Z-winding. In performing the covering, by adopting a winding reverse to the winding of the core yarn (specifically, a way of winding in which: for the S-winding adopted for the core yarn, a Z-winding is adopted for the covering yarn; and for the Z-winding adopted for the core yarn, an S-wingding is adopted for the covering yarn), preferably no twisting is caused in the composite yarn and the knitted products to end up with satisfactory finishing results.

[0042] When a conductive fiber or a doubled and twisted yarn including the conductive fiber is used as a covering yarn, the area in which the conductive fiber is exposed on the surface of the composite yarn or on the surface of the glove becomes large. Consequently, the effect to decrease the surface resistivity is improved. On the other hand, however, since the area in which the conductive fiber is exposed on the surface of the composite yarn or on the surface of the glove becomes large, the detached amount of the conductive fiber is increased. Accordingly, from the viewpoint of suppressing the detached amount of the conductive fiber, preferably the conductive fiber or the doubled and twisted yarn including the conductive fiber is not used as the covering yarn, but is used for a core yarn, an attached yarn and a yarn to be twisted.

[0043] The composite yarns having such structures as described above are obtained with the following methods.

[0044] Specifically, the aforementioned composite yarn is obtained by passing through the steps of: decreasing the recovery rate from stretch of the filament yarn so as to be 0 to 10% with such method as described above; where necessary, obtaining a filament yarn(s) including at least in part thereof filament yarn(s) decreased in recovery rate from stretch so as for the recovery rate from stretch of the whole of the filament yarn(s) to be 0 to 10%; and obtaining the composite yarn by use of the filament yarn(s) and a conductive fiber by means of covering, doubling and twisting or the like.

[0045] By knitting composite yarn obtained as described above, the work glove and the fabric of the present invention can be obtained. In the present invention, the fabric means a knitted item, a woven fabric, a non-woven fabric and the like.

[0046] The method for knitting the composite yarn may be either a method in which the whole of the glove is knitted only with the above-described composite yarn by means of a heretofore known conventional method or a heretofore known conventional apparatus, or a method in which just part of the glove such as the fingertips is selected and knitted with the composite yarn. When part of the work glove is knitted with the above-described composite yarn, it is also preferable to knit with the composite yarn and a filament yarn in a course ratio of 1:1 to 1:10 (specifically, one course is knitted with the composite yarn, and the successive ten courses are knitted with the filament yarn). The stretching properties of the composite yarn is degraded by the inclusion of the conductive fiber in the composite yarn as compared to the case where no conductive fiber is included. Accordingly, by knitting the composite yarn and a filament yarn in a course ratio of 1:1 to 1:10, the portion knitted only with a filament yarn or a polyurethane elastic yarn having a high recovery rate from stretch (for example, about 50%) can be selectively included. Consequently, the feeling of fitting or the texture in the form of a work glove, a fabric or the like can be improved. Additionally, a uniform chargeability can be imparted to the whole of the glove, the whole of the fabric or the like.

[0047] When the work glove or the fabric of the present invention is obtained by using a composite yarn, the surface resistance of the work glove or the fabric is preferably 1×10^5 to 1×10^{10} Ω/sq. and more preferably 1×10^6 to 1×10^8 Ω/sq. The surface resistance falling within this range is preferable because such a surface resistance allows the static electricity to slowly diffuse. When the surface resistance is less than 1×10^5 Ω/sq., in the case where the conductive fiber is detached, an electric shock or a short-circuiting may occur. On the other hand, when the surface resistance exceeds 1×10^{10} Ω/sq., the insulation breakdown due to electrostatic discharge may occur. The surface resistance can be controlled so as to fall within above-described range by appropriately regulating the way of knitting (specifically, the ratio between the number of the courses allotted to the composite yarn and the number of the courses allotted to the filament yarn) in the case of knitting the composite yarn or by appropriately regulating the mixing ratio between the conductive fiber and the filament yarn in the composite yarn.

[0048] In the work glove obtained by knitting the composite yarn or the work glove obtained by sewing the fabric obtained by knitting the composite yarn, the surface of the fingertip portions, the palm portion, or the whole of the glove may also be subjected to a processing with a synthetic rubber, a resin or the like for the purpose of preventing slipping.

[0049] Examples of the processing to prevent slipping includes: a processing in which a slip-preventing coating is formed on the fingertip portions or the palm portion with a polyurethane resin, a synthetic rubber or the like; and a processing in which slip-preventing projecting portions are formed with a synthetic rubber, a PVC-based polymer or the like. For example, the obtained glove is put over a hand-shaped immersion mold, immersed in a polyurethane resin solution or the like, subjected to water substitution, and dried. By means of such a method, on the fingertip portions or the palm portion, a slip-preventing coating can be formed with a polyurethane resin, a synthetic rubber or the like, or slip-preventing projecting portions can be formed with a synthetic resin, a PVC-based polymer or the like.

[0050] FIG. 6(a) is a diagram of a glove subjected to such a slip-prevention processing, as viewed from the back portion side thereof. FIG. 6(b) is a diagram of a glove subjected to a slip-prevention processing, as viewed from the palm portion side thereof. In the glove 3, the palm portion is coated with a resin 4.

[0051] Examples of the synthetic rubber include NBR, chloroprene, acrylic rubber, polyurethane, vinyl acetate-PVC copolymer and PVC homopolymer.

[0052] Alternatively, by squeezing a synthetic rubber compound, vinyl-acetate-PVC copolymer or PVC homopolymer on the palm portion of the glove, printing with a convex stencil may be conducted to perform a slip-prevention processing.

[0053] When the above-described slip-prevention processings are applied to the obtained glove, filling may also be performed for the purpose of preventing the excessive percolation of the resin or the like on the surface of the glove. Specifically, filling can be performed as follows: a hand mold having been immersed in a calcium nitrate coagulant is immersed in a synthetic rubber compound such as NBR, chloroprene, acrylic rubber, or polyurethane, and then dried, and subjected to leaching and curing. Another filling method may be a method in which after immersion and drying, the product is demolded and then subjected to leaching, dewatering and curing.

[0054] The composite yarn of the present invention, and the work glove and the fabric obtained from the composite yarn are particularly suitably used in the fiends requiring conductivity an low dust emission, such as a semiconductor fabrication process, a painting process or a clean room work.

Examples

[0055] Hereinafter, the present invention is described in more detail with reference to Examples. However, these Examples are not intended to limit the present invention.

[0056] Hereinafter, the evaluation methods used in Examples and Comparative Examples are described.

1. Surface Resistance

[0057] From each of the gloves obtained in Examples and Comparative Examples, a circular piece of a knitted fabric of about 8 cm in diameter was cut out to be used as a specimen. The specimen was set in a surface resistance measurement apparatus (Model 272A, manufactured by Monroe Electronics, Inc.) (applied voltage: 10 v), and the value after the elapsed time of 15 seconds was read as the surface resistance. The reading of the value after the elapsed time of 15 seconds was partially based on EN 1149-1. The measurement conditions were such that the temperature was set at room temperature of 23°C, and the humidity was set at 45%.

2. Detached Amount of Conductive Fiber

2.1 Dust Emission Test

[0058] The 1000 gloves obtained in each of Examples and Comparative Examples were prepared. The prepared glovers were washed for 15 minutes with a washing solution prepared by dissolving 50 g of a nonionic surfactant (trade name: Supper L, manufactured by Gembu Co., Ltd.) in 113 L of pure water; and then the gloves were ringed three times with ultrapure water to perform a clean washing. After the clean washing, according to Japanese Industrial Standard B 9923 (a tumbling method), the number of the particles of 0.5 μm or more floating in the air, per 1 cft^3, emitted as dust from the 10 gloves (the number of particles from the 10 gloves) was measured. The measured value was evaluated as a value corresponding to the detached amount of the fiber.

[0059] In the present invention, the case where the number of the floating particles was less than 10 was evaluated as practically usable.

2.2 Adhesive Tape Forced Peeling Test

[0060] The three gloves obtained in each of Examples and Comparative Examples were prepared. One of the prepared gloves was rubbed 100 times with a piece of white cotton cloth, and another glove was rubbed 300 times with another piece of white cotton cloth, by using the Gakushin-Type Rubbing Tester for Color Fastness (Trade name: RT-200, manufactured by Daiei Kagaku Seiki Mfg. Co., Lad.). Next, each of the not rubbed glove, the 100-times rubbed glove and the 300-times rubbed glove was subjected to the following operation: an adhesive tape (Cellophane Tape, manufactured by Nichiban Co., Ltd.)(size: 20 mm × 20 mm) was attached to the sample glove under a load of 300 g over a period of 5 seconds an then peeled off, and a cycle of such operations was repeated 5 times in total with the same adhesive tape. Then, the surface of the adhesive tape was observed with a microscope (trade name: VHX-900, Keyence Corp.), and the number of the attached conductive fibers was counted. The measured value of the number of the attached conductive fibers was evaluated as a value corresponding to the detached amount of the fiber.

[0061] In the present invention, the case where the number of the attached conductive fibers was less than 10 was evaluated as practically usable.

3. Recovery Rate from Stretch

[0062] The measurement method of the recovery rate from stretch defined by Japanese Industrial Standard L 1013 is described with reference to FIG. 7.

[0063] A filament yarn was sampled from the composite yarn forming each of the gloves obtained in Examples and Comparative Examples; the sampled filament yarn was hung on a hook 5 in a looped shape, a load 7 of (0.176 mN × 20 × displayed tex number) was applied to the loop-shaped filament yarn, thus a small hank of 10 turns and about 40 cm in the hank length was formed, and thus the filament yarn was formed into a sample 6 which was a bundle of 20 strings of the filament yarns. Next, the sample 6 was immersed in water set at 60°C for 20 minutes, then subjected to water draining, and dried naturally on a filter paper for 24 hours. As shown in FIG. 7, under the condition that the sample 6 was applied a load 8 of (8.82 mN × 20 × displayed tex number) in addition to the load 7 of (0.176 mN × 20 × displayed tex number), the sample 6 was allowed to slowly move downward into water 9 set at 20±2°C and was immersed in the water for 2 minutes. Then, the sample 6 was taken out of the water and the hank length was measured. Immediately, by using a ring 10 for releasing the load, the load 8 of (8.82 mN × 20 × displayed tex number) was removed, the sample 6 was allowed to stand for 2 minutes, and then the hank length was again measured. Thus, the recovery rate from stretch Er (%) was calculated on the basis of the following formula:

[0064]

$$Er = [(a - b)/a] \times 100$$

wherein

a: the hank length (mm) when the load 8 of (8.82 mN x 20 × displayed tex number) was applied in addition to the load 7 of (0.176 mN × 20 × displayed tex number); and

b: the hank length (mm) when the load 7 of (0.176 mN × 20 × displayed tex number) was applied.

It is to be noted that, the measurement was performed five times, and the average value of the five measured values was taken as the recovery rate from stretch.

[0065] Next, the materials used in Examples and Comparative Examples are listed below.

(A) Filament Yarns

[0066]

- (A-1): Woolly nylon (70d-24f, recovery rate from stretch: 24%) (manufactured by Toray Industries, Inc.)
- (A-2): Woolly nylon (70d-24f, recovery rate from stretch: 7%)

[0067] Woolly nylon (A-1) was softly wound around a bobbin so as to adjust the package density to be 0.2 to 0.3 g/cm^3. Then, the woolly nylon (A-1) softly wound around the bobbin was placed in a dyeing machine (trade name: LLCD-50/90, manufactured by Hisaka Works, Ltd.), washed with hot water at about 90°C for about 1 hour, and then, dewatered for 15 minutes, and dried at 70°C for 200 minutes to reduce the recovery rate from stretch to 7%. The filament yarn thus obtained was used.

- (A-3): Polyester yarn (50d-36f unprocessed yarn, recovery rate from stretch: 1.5%) (manufactured by KB Seiren, Ltd.)

- (A-4): Woolly nylon (70d-24f, recovery rate from stretch: 10.0%)

[0068] Woolly nylon (A-1) was softly wound around a bobbin so as to adjust the package density to be 0.2 to 0.3 g/cm^3. Then, the woolly nylon (A-1.) softly wound around the bobbin was placed in the dyeing machine (trade name: LLCD-50/90, manufactured by Hisaka Works, Ltd.), washed with hot water at about °75°C for about 1 hour, and then, dewatered for 15 minutes, and dried at 70°C for 200 minutes to reduce the recovery rate from stretch to 10.0%. The filament yarn thus obtained was used.

- (A-5) : Woolly nylon (70d-24f, recovery rate from stretch: 5%)

[0069] Woolly nylon (A-1) was softly wound around a bobbin so as to adjust the package density to be 0.2 to 0.3 g/cm^3. Then, the woolly nylon (A-1) softly wound around the bobbin was placed in the dyeing machine (trade name: LLCD-50/90, manufactured by Hisaka Works, Ltd.), washed with hot water at about 100°C for about 1 hour, and then, dewatered for 15 minutes, and dried at 70°C for 200 minutes to reduce the recovery rate from stretch to 5%. The filament yarn thus obtained was used.

- (A-6): Woolly polyester (75d-36f, recovery rate from stretch: 1.2%)

[0070] Woolly polyester (75d-36f, recovery rate from stretch: 20%) was softly wound around a bobbin so as to adjust the package density to be 0.2 to 0.3 g/cm^3. Then, the woolly polyester softly wound around the bobbin was placed in the dyeing machine (trade name: LLCD-50/90, manufactured by Hisaka Works, Ltd.), washed with hot water at about 95°C for about 1 hour, and then, dewatered for 15 minutes, and dried at 70°C for 200 minutes to reduce the recovery rate from stretch to 1.2%. The filament yarn thus obtained was used.

- (A-7): High strength polyethylene (100d-36f, recovery rate from stretch: 2%) (manufactured by Toyobo Co., Ltd.)
- (A-8): Aramid fiber (200d unprocessed yarn, recovery rate from stretch: 2.5%)

(B) Conductive Fibers

[0071]

- (B-1): Copper-dyed fiber yarn (50d-30f, recovery rate from stretch: 3.0%) (trade name: Thunderon, manufactured by Nihon Sanmo Dyeing Co., Ltd.)
- (B-2): Carbon fiber yarn (20d-3f, recovery rate from stretch: 2.9%) (trade name: 9R1, manufactured by KB Seirein, Ltd.)
- (B-3): Stainless steel fiber (32.7d, recovery rate from stretch: 1.2%) (trade name: Nasron, manufactured by Nippon Seisen Co., Ltd.)
- (B-4): Copper-dyed fiber yarn (75d-18f, recovery rate from stretch: 3.0%) (Copper Sulfide Composite Fiber, manufactured by Showa Glove Co.)
- (B-5): Copper-dyed fiber yarn (40d-13f, recovery rate from stretch: 2.5%) (trade name: Thunderon, manufactured by Nihon Sanmo Dyeing Co., Ltd.)
- (B-6): Copper-dyed fiber yarn (40d-13f, recovery rate from stretch: 3.0%) (trade name:, manufactured by Nihon Sanmo Dyeing Co., Ltd.)

(Example 1)

[0072] A composite yarn was obtained by using four yarns of (A-2) as a core and by winding a yarn of (B-1) around the core at a rate of 300 T/M to cover the core. The covering (and doubling and twisting to be described below) was performed with a spindle-double covering machine (trade name: KC5D108, manufactured by Kakinoki K.K.). The obtained composite yarn was for the whole (from the fingertips to the cuff portion) of a glove to knit the glove. The knitting of the glove was performed with a 13G knitting machine (trade name: New SFG, manufactured by Shima Seiki Mfg., Ltd.)

(Example 2)

[0073] By using the composite yarn obtained in Example 1 and (A-1), a glove was knitted with a course ratio of the composite yarn:(A-l) = 1:2.

(Example 3)

[0074] By using the composite yarn obtained in example 1 and (A-1), a glove was knitted with a course ratio of the composite yarn:(A-l) = 1:10.

(Examples 4)

[0075] A composite yarn was obtained by using a yarn of (A-2) as a core an a yarn of (B-1) as an attached yarn, and by winding two yarns of (A-2) around the core and she attached yarn at a rate of 300 T/M to cover core and the attached yarn. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 7.1%. The obtained composite yarn was used for whole of a glove to knit the glove.

(Example 5)

[0076] A composite yarn was obtained by using four yarns of (A-2) as a core and by winding a yarn of (B-2) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 7.3%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 6)

[0077] A composite yarn was obtained by using two yarns of (A-2) as a core and a yarn of (B-2) as an attached yarn, and by winding two yarns of (A-2) around the core and the attached yarn at a rate of 300 T/M to cover the core and the attached yarn. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 7.3%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 7)

[0078] A composite yarn was obtained as follows: three yarns of (A-2) were used as a core; a doubled and twisted yarn was beforehand obtained by doubling and twisting a yarn of (B-1) and a yarn of (A-3) at a rate of 200 T/M; and the composite yarn was obtained by winding the doubled and twisted yarn around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 6.3%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 8)

[0079] A composite yarn was obtained in the same manner as in Example 7 except that a yarn of (B-2) was used tin place of a yarn of (B-1). The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 6.7%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 9)

[0080] A composite yarn was obtained as follows: a yarn of (A-2) was used as a core; a doubled and twisted yarn (recovery rate from stretch: 2.9%) was beforehand obtained by doubling and twisting a yarn of (B-1) ann a yarn of (A-3) at a rate of 200 T/M and used as an attached yarn; and the composite yarn was obtained by winding two yarns of (A-1) around the core and the attached yarn at a rate of 300 T/M to cover the core and the attached yarn. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 5.2%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 10)

[0081] A composite yarn was obtained in the same manner as in Example 9 except that a yarn of (B-2) was used in place of a yarn of (B-1). The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 5.7%. The obtained composite yarn was used for the whole of a glove to knit the grove.

(Example 11)

[0082] A composite yarn was obtained as follows: a doubled and twisted yarn was obtained by doubling and twisting three yarns of (B-1) and used as a core; and then composite yarn was obtained by winding two yarns of (A-2) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 5.5%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 12)

[0083] A composite yarn was obtained as follows: a yarn of (A-2) was used as a core; a doubled and twisted yarn was beforehand obtained by doubling and twisting two yarns of (B-1) at a rate of 200 T/M and used as an attached yarn; and the composite yarn was obtained by winding two yarns of (A-2) around the core and the attached yarn at a rate of 300 T/M to cover the core and the attached yarn. The recovers rate from stretch of the whole of the filament yarns in the obtained composite yarn was 6.2%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 13)

[0084] A composite yarn was obtained as follows: a doubled and twisted yarn was obtained by doubling and twisting two yarns of (B-1) at a rate of 300 T/M; the composite yarn was obtained by further doubting twisting she obtained doubled and twisted yarn and two yarns of (A-2) at a rate of 300 T/M. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 5.9%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 14)

[0085] A composite yarn was obtained as follows: a doubled and twisted yarn was obtained by doubling and twisting a yarn of (B-1) and a yarn of (A-2) at a rate of 300 T/M and used as a core yarn; and the composite yarn was obtained by covering the core yarn with a yarn of (A-2) at a rate of 300 T/M. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 6.9%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 15)

[0086] The glove obtained in Example 1 was put over a metal immersion mold, and only the palm was immersed in a solution (solid content: 10% by mass) prepared by dissolving polyurethane (trade name: Crisvon MP-812, manufactured by DIC Corp.) in N,N-dimethylformamide, and the glove was subjected to warm water substitution at 50°C for 1 hour, and then dried at 100°C for 30 minutes to obtain a glove with the palm portion thereof coated with the polyurethane resin.

(Example 16)

[0087] A composite yarn was obtained by using two yarns of (A-4) as a core, and by winding a yarn of (B-1) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 8.5%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 17)

[0088] A composite yarn was obtained by using two yarns of (A-6) as a core, and by winding a yarn of (B-1) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 2.2%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 18)

[0089] A composite yarn was obtained by using two yarns of (A-7) as a core, and by winding a yarn of (B-1) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 2.7%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 19)

[0090] A composite yarn was obtained by using a yarn of (A-8) as a core, and by winding a yarn of (B-1) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 3.2%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 20)

[0091] A composite yarn was obtained by using a yarn of (B-3) and two yarns of (A-6) as a core, and by winding a yarn of (B-1) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 2.2%. The obtained composite yarn was used fop the whole of a glove to knit the glove.

(Example 21)

[0092] A composite yarn was obtained by using four yarns of (A-5) as a core, and by winding a yarn of (B-4) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 5.0%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Example 22)

[0093] A composite yarn was obtained by using four yarns of (A-5) as a core, and by winding a yarn of (B-5) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 5.2%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Examples 23)

[0094] With a woolly nylon 30d yarn, a tricot knitted texture (fabric) was obtained with a circular knitting machine (trade name: MA100, manufactured by Hatta Tateami Co., Lid.). By using the composite yarn obtained in Examples 1, sewing on a sewing machine was performed at an interval of 1 cm across the whole of the tricot knitted texture, with a single needle, lockstitch, automatic zigzag stitch, automatic thread cutting sewing machine (trade name: LZ2-B856E-301, manufactured by Brother Industries, Lot.). Then, the texture was cut to the shape of a glove, and sewn into the glove.

(Comparative Example 1)

[0095] A composite yarn was obtained by using three yarns of (A-1) as a core, and by winding a yarn of (B-1) around the core at a rate of 300 T/M to cover the core. The recovery rate from stretch of the whole of tie filament yarns in the obtained composite yarn was 20.5%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Comparative Example 2)

[0096] A composite yarn was obtained in the same manner as in Comparative example 1 except that four yarns of (A-1) were used as a core, and (B-2) was used in place of (B-1) The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 23.2%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(comparative Example 3)

[0097] A composite yarn was obtained by using a yarn of (A-1) as a core and a yarn of (B-1) as an attached yarn, and by winding two yarns of (A-2) around the core and the attached yarn at a rate of 300 T/M to cover the core and the attached yarn. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 11.7%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Comparative Examples 4)

[0098] A glove was knitted in the same manner as in Comparative Example 3 except that a composite yarn obtained by using as an attached yarn a yarn of (B-2) in place of a yarn of (B-1) was used. The recovery rate from stretch of the whole of the filament yarns in then obtained composite yarn was 12.6%.

(Comparative Examples 5)

[0099] A composite yarn with hidden conductive fiber was obtained as follows: two yarns of (A-1) was used as a core; a yarn of (B-1) was wound around the core at a rate of 300 T/M; a yarn of (A-1) wound over the preceding winding at a rate of 300 T/M reversely relative to the preceding winding; further, a yarn of (A-1) was wound over the preceding winding at a rate of 300 T/M reversely relative to the preceding winding; thus a composite yarn in which the conductive fiber was hidden was obtained. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 21.7%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Comparative Example 6)

[0100] A composite yarn was obtained in the same manner as in Comparative Example 5 except that (B-2) was used in place of (B-1). The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 23.4%. The obtained composite yarn was used for the whole of a glove to knit the glove.

(Comparative Example 7)

[0101] A yarn obtained by doubling and twisting our yarns of (A-1) was used for the whole of a glove to knit the glove. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 24.5%.

(Comparative Example 8)

[0102] A composite yarn obtained in the manner as in Example 13 except that (A-1) as used in place of (A-2) . The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 15.8%. The obtained composite yarn used for the whole of a glove to knit the glove.

(Comparative Example 9)

[0103] A composite yard obtained in the same manner as in Example 14 except that (A-1) was used in place of (A-2 . The recovery rate from stretch of whole of the filament yarns in the obtained composite yarn was 13.1%. Obtained composite yarn was used for the whole of a glove to knit the glove.

(Comparative Examples 10 and 11)

[0104] Gloves having a palm portion covered with a polyurethane resin obtained in the same manner as in Example 15 except that the gloves obtained in Comparative Examples 1 and 2 were used in Comparative Examples 10 and 11, respectively.

(comparative Example 12)

[0105] A composite yarns was obtained by using three yarns of (B-6) as a core and by winding two yarns of (A-1) around the core at a of 300 T/M to cover the core. The recovery rate from stretch of the whole of the filament yarns in the obtained composite yarn was 14.8% The obtained composite yarn was used for the whole of a glove to knit the glove.

(Comparative Example 13)

[0106] With a woolly nylon 30d yarn, a tricot knitted texture (fabric) was obtained with a circular knitting machine (trade name: MA100, manufactured by Hatta Tateami Co., Ltd.). By using the composite yarn obtained in Comparative Examples 1, sewing on a sewing machine was performed at an interval of 1 cm across the whole of the tricot knitted texture, with a single needle, lockstitch, electronic zigzag stitch, automatic thread cutting sewing machine (trade name: LZ2-B856E-301, manufactured by Brother Industries, Ltd.). Then, the texture was cut to the shape of a glove, and tried to be sewn into the glove, However, the composite yarn got loose and hence the sewing into the glove was unsuccessful.

[0107] The physical properties of the gloves obtained in Examples and Comparative Examples were tested. The evaluation results of Examples 1 to 12 are shown in Table 1, the evaluation results of Examples 13 to 23 are shown in Table 2, and the evaluation results of Comparative Examples 1 to 13 are shown in Table 3.

[0108]

[Table 1]

	Recovery rate from stretch of the whole of the filament yarns in the composite yarn (%)	Dust emission test (particles/ cft^3)	Adhesive Tape Forced Peeling Test			Surface resistance (Ω/sq.)
			Before rubbing	After 100 times rubbing	After 300 times rubbing	
Example 1	7.0	4	3	4	9	4×10^6
Example 2	7.0	3	2	3	8	6×10^6
Example 3	7.0	2	2	2	7	2×10^8
Example 4	7.1	1	4	2	7	4×10^6

(continued)

	Recovery rate from stretch of the whole of the filament yarns in the composite yarn (%)	Dust emission test (particles/ cft^3)	Adhesive Tape Forced Peeling Test			Surface resistance (Ω/sq.)
			Before rubbing	After 100 times rubbing	After 300 times rubbing	
Example 5	7.3	0	1	5	5	4×10^7
Example 6	7.3	0	1	1	1	3×10^7
Example 7	6.3	2	2	3	6	4×10^6
Example 8	6.7	0	1	3	3	5×10^7
Example 9	5.2	2	0	2	5	4×10^6
Example 10	5.7	1	0	1	1	5×10^7
Example 11	5.5	1	2	2	3	4×10^6
Example	6.2 12	2	1	1	3	5×10^7

[0109]

[Table 2]

	Recovery rate from stretch of the whole of the filament yarns in the composite yarn (%)	Dust emission test (particles/ cft^3)	Adhesive Tape Forced Peeling Test			Surface resistance (Ω/sq.)
			Before rubbing	After 100 times rubbing	After 300 times rubbing	
Example 13	5.9	2	1	4	7	5×10^6
Example 14	6.9	0	2	3	6	7×10^6
Example 15	7.0	3	4	1	3	5×10^6
Example 16	8.5	1	1	2	4	6×10^6
Example 17	2.2	2	1	2	6	7×10^6
Example 18	2.7	0	2	3	8	4×10^6
Example 19	3.2	3	2	2	4	5×10^6
Example 20	2.2	1	0	2	5	7×10^6
Example 21	5.0	0	0	1	1	6×10^6
Example 22	5.2	4	3	3	4	8×10^6
Example 23	7.0	1	1	4	5	5×10^6

[0110]

[Table 3]

	Recovery rate from stretch of the whole of the filament yarns in the composite yarn (%)	Dust emission test (particles/ cft^3)	Adhesive Tape Forced Peeling Test			Surface resistance (Ω/sq.)
			Before rubbing	After 100 times rubbing	After 300 times rubbing	
Comparative Example 1	20.5	36	7	27	39	4×10^6
Comparative Example 2	23.2	11	6	15	28	5×10^7
Comparative Example 3	11.7	34	6	24	33	4×10^6
Comparative Example 4	12.6	13	5	13	21	5×10^7
Comparative Example 5	21.7	20	8	24	35	4×10^6
Comparative Example 6	23.4	14	4	16	23	5×10^7
Comparative Example 7	24.5	6	6	9	31	5×10^{12}
Comparative Example 8	15.8	37	6	18	33	5×10^6
Comparative Example 9	13.1	31	8	21	38	8×10^6
Comparative Example 10	20.5	33	7	25	39	6×10^6
Comparative Example 11	23.2	15	7	17	31	7×10^7
Comparative Example 12	14.8	30	8	11	30	6×10^6
Comparative Example 13	20.5	-	-	3	-	7×10^6

[0111] As can be seen from the results of Examples 1 to 23, for the purpose of reducing the detached amount of the conductive fiber, it is essential to set at 0 to 10% the recovery rate from stretch of the core yarn around which the conductive fiber is wound, the yarn attached to the conductive fiber, or the yarn to be twisted with the conductive fiber. The effect due to the recovery rate from stretch set at 0% to 10% is clearly seen in comparison with Comparative Examples.

[0112] As can be from Examples 21 and 22, it has been found that the larger is the denier number of the conductive fiber per one filament, the smaller the detached amount of the conductive fiber tends to be. Also, as can be seen from a comparison between Examples 9 and 10, it has been found that the detached amount in the case of a carbon fiber is smaller than the detached amount in the case of a copper-dyed fiber.

[0113] Moreover, from the results of Examples 7 to 14, the following are obvious. Specifically, it has been found that both of the carbon fiber and the copper-dyed fiber are made to be more hardly detached in the tape forced peeling test by mutually doubling and twisting the conductive fibers or by doubling and twisting with a polyester yarn. It has also been found that in the case where the conductive fibers are used for the core, when conductive fibers are used as doubled and twisted with each other, the detached amount of the conductive fibers can be reduced. Moreover, it has been found that the detached amount of the conductive fibers can be reduced even when the conductive fibers are doubled and twisted with another fiber, namely, an unprocessed yarn or a fiber having a recovery rate from stretch of

10% or less, made of polyester, reinforced polyethylene, aramid, nylon or acrylic polymer.

[0114] As can be seen from Comparative Example 5, it has been found that in the glove using a conductive fiber, the detached amount of the conductive fiber remains unchanged even when the conductive fiber is made to be hidden.

Industrial Applicability

[0115] The work glove of the present invention meets the demands for the countermeasure against the static electricity and for low dust emission, and is useful for use in the semiconductor fabrication process, the painting process, the clean room work and the like.

Claims

1. A work glove wholly or partly knitted with a composite yarn comprising a filament yarn(s) and a conductive fiber, the glove being **characterized in that** a recovery rate from stretch of a whole of the filament yarn(s) included in the composite yarn is 0 to 10%.

2. The work glove according to claim 1, **characterized in that** the filament yarn is a core yarn, and the conductive fiber is a covering yarn wound around the core yarn.

3. The work glove according to claim 1, **characterized in that** the filament yarn is the core yarn, the conductive fiber is a yarn attached to the core yarn, and the core yarn and the attached yarn are covered with a covering yarn.

4. The work glove according to claim 1, **characterized in that** the conductive fiber is a core yarn, and the filament yarn is a covering yarn wound around the core yarn.

5. The work glove according to claim 1, **characterized in that** the composite yarn is a yarn obtained by doubling and twisting the filament yarn and the conductive fiber.

6. The work glove according to any one of claims 1 to 5, **characterized in that** the conductive fiber is of a form of a doubled and twisted yarn.

7. The work glove according to any one of claims 1 to 6, **characterized in that** fingertip portions, a palm portion or a whole surface of the work glove is covered with a synthetic rubber or a resin.

8. A method for producing a work glove, **characterized by** comprising:

   decreasing a recovery rate from stretch of a crimp processed yarn;
   preparing a filament yarn comprising at least in part thereof the crimp processed yarn decreased in the recovery rate from stretch and having a total recovery rate from stretch of 0 to 10%;
   preparing a composite yarn by using the filament yarn and a conductive fiber; and
   knitting the composite yarn into the work gloves

9. A composite yarn comprising a filament yarn(s) and a conductive fiber, **characterized in that** a recovery rate from stretch of a whole of the filament yarn(s) included in the composite yarn is 0 to 10%.

10. The composite yarn according to claim 9, **characterized in that** the filament yarn is a core yarn, and the conductive fiber is a covering yarn wound around the core yarn.

11. The composite yarn according to claim 9, **characterized in that** the filament yarn is a core yarn, and the conductive fiber is a yarn attached to the core yarn, and the core yarn and the attached yarn are covered with a covering yarn.

12. The composite yarn according to claim 9, **characterized in that** the conductive fiber is a core yarn, and the filament yarn is a covering yarn wound around the core yarn.

13. The composite yarn according to claim 9, **characterized in that** the filament yarn and the conductive fiber are doubled and twisted.

14. The composite yarn according to any one of claims 9 to 13, **characterized in that** the conductive fiber is of a form of a doubled and twisted yarn.

15. A method for producing a composite yarn, **characterized by** comprising
decreasing a recovery rate from stretch of a crimp processed yarn;
preparing a filament yarn comprising at least in part thereof the crimp processed yarn decreased in the recovery rate from stretch and having a total recovery rate from stretch of 0 to 10%; and
preparing the composite yarn by using the filament yarn and a conductive fiber.

16. A fabric **characterized in that** the whole or part of the fabric is formed of the composite yarn according to any one of claims 9 to 15.

FIG. 1A

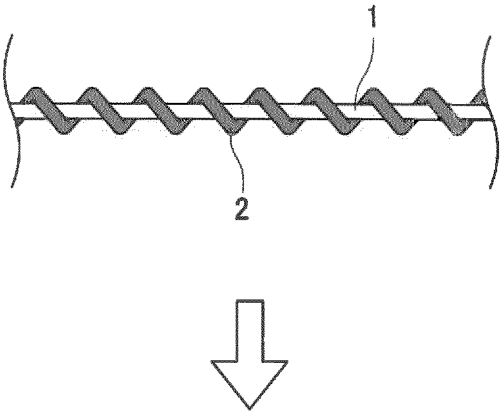


FIG. 1B

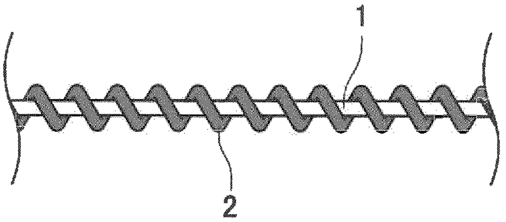
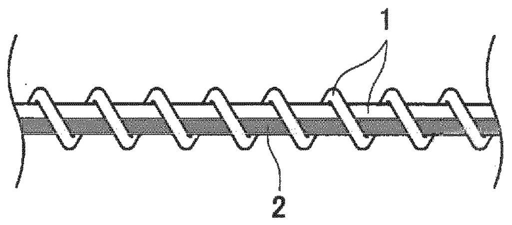


FIG. 2A



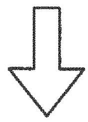


FIG. 2B

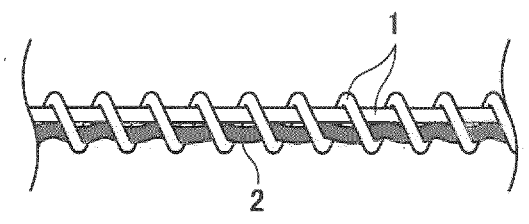


FIG. 3A

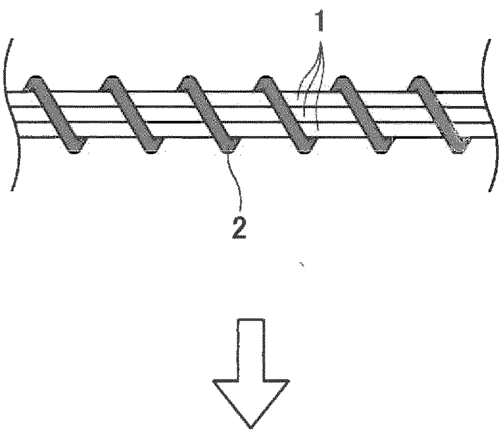
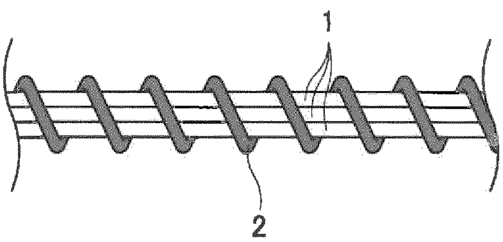
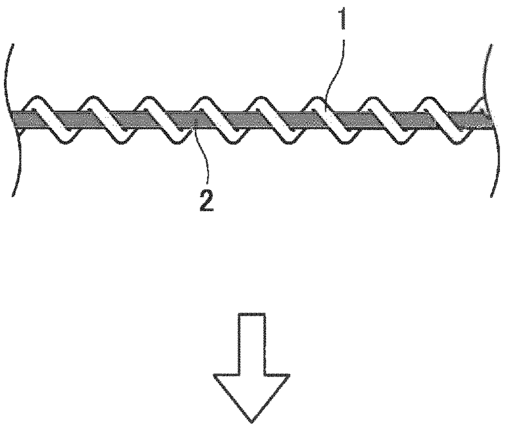


FIG. 3B



F I G. 4 A



F I G. 4 B

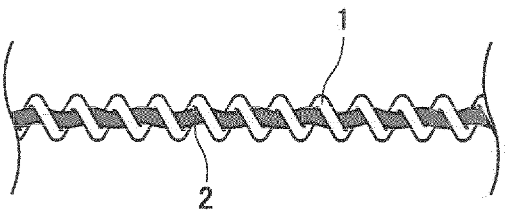


FIG. 5A

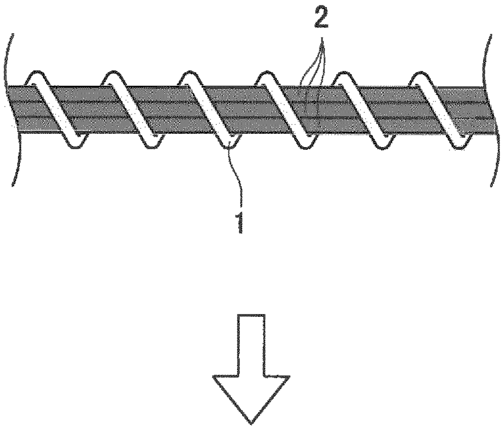


FIG. 5B

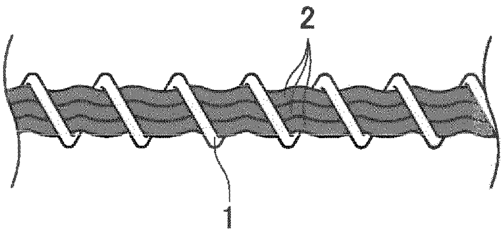


FIG. 6A

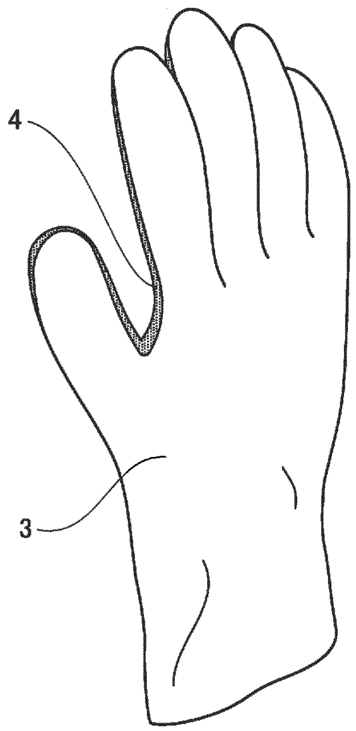


FIG. 6B

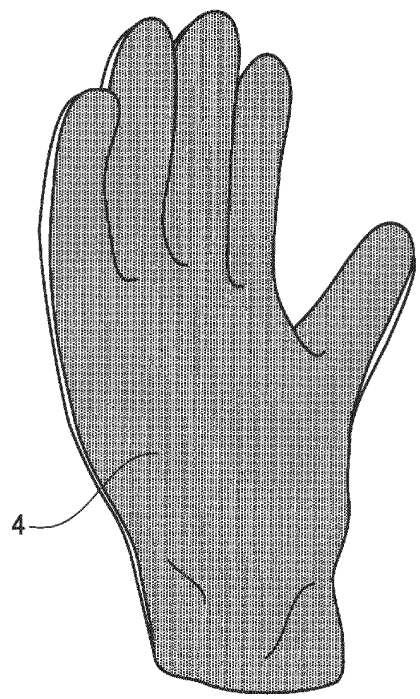
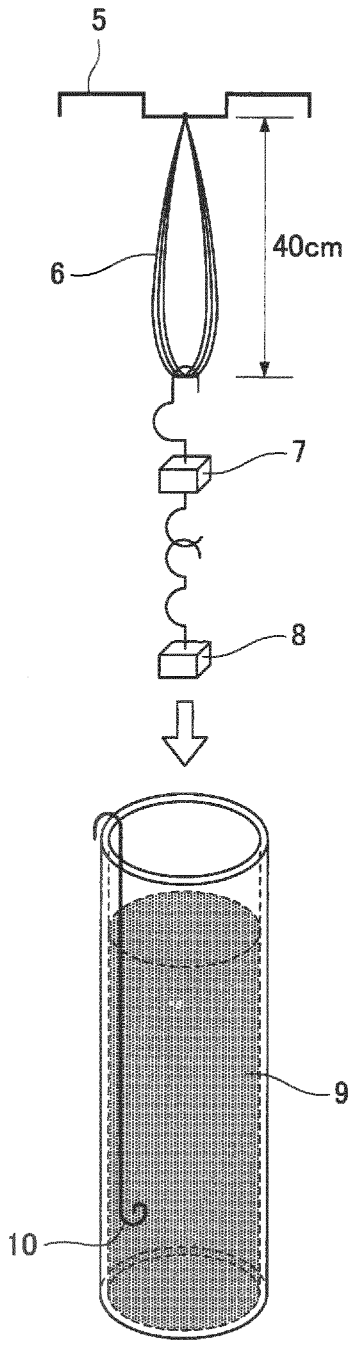


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/062999

A. CLASSIFICATION OF SUBJECT MATTER
A41D13/08(2006.01)i, *A41D13/00*(2006.01)i, *A41D19/00*(2006.01)i, *D02G3/04*(2006.01)i, *D02G3/28*(2006.01)i, *D02G3/38*(2006.01)i

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)
A41D13/08, A41D13/00, A41D19/00, D02G3/04, D02G3/28, D02G3/38

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2007-39839 A (Du Pont-Toray Co., Ltd.), 15 February 2007 (15.02.2007), paragraphs [0026], [0029], [0033] (Family: none)	1-4,6,9-12, 14,16 5,7-8,13,15
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 58476/1986(Laid-open No. 170717/1987) (Kawatoku Shoji Kabushiki Kaisha), 29 October 1987 (29.10.1987), fig. 1 (Family: none)	5,13

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
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"&" document member of the same patent family

Date of the actual completion of the international search 04 October, 2010 (04.10.10)	Date of mailing of the international search report 12 October, 2010 (12.10.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/062999

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 116464/1986(Laid-open No. 24221/1988) (Midori Anzen Co., Ltd.), 17 February 1988 (17.02.1988), page 3; fig. 1 (Family: none)	7
Y	JP 3-829 A (Unitika Ltd.), 07 January 1991 (07.01.1991), page 3, upper left column (Family: none)	8,15
A	JP 2006-63456 A (Morito Co., Ltd.), 09 March 2006 (09.03.2006), entire text; all drawings (Family: none)	1-8
A	JP 2009-46785 A (Toray Industries, Inc.), 05 March 2009 (05.03.2009), paragraphs [0027], [0049] (Family: none)	1-16
A	JP 10-8340 A (Shimono Shikimono Kabushiki Kaisha), 13 January 1998 (13.01.1998), entire text; all drawings (Family: none)	1-16
A	JP 57-167425 A (Kanebo, Ltd.), 15 October 1982 (15.10.1982), entire text; all drawings (Family: none)	1-16

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

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- JP 2009102779 A **[0003]**
- JP 3042096 B **[0003]**
- JP 2006063456 A **[0003]**
- JP H654720 B **[0003]**