

(19)



(11)

EP 4 825 198 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

21.10.2026 Bulletin 2026/43

(51) International Patent Classification (IPC):

A24D 3/16 ^(2006.01) **A24D 3/06** ^(2006.01)
A24D 3/10 ^(2006.01)

(21) Application number: **26171260.8**

(52) Cooperative Patent Classification (CPC):

A24D 3/163; A24D 3/062; A24D 3/063;
A24D 3/067; A24D 3/068; A24D 3/10

(22) Date of filing: **08.04.2026**

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA

Designated Validation States:

GE KH LA MA MD TN

(30) Priority: **18.04.2025 KR 20250050723**

27.02.2026 KR 20260036985

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(54) **FILTER FOR SMOKING ARTICLE AND SMOKING ARTICLE INCLUDING THE SAME**

(57) A smoking article filter and a smoking article including the same are provided. The smoking article filter includes a filter portion including regenerated cel-

lulose tow including crimped regenerated cellulose-based fibers and activated carbon disposed in the regenerated cellulose tow.

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Description

[Technical Field]

[0001] The present invention relates to a smoking article filter and a smoking article including the same, and more particularly, to a smoking article filter and a smoking article including the same in which lyocell tow consisting of crimped lyocell fibers is applied to a smoking article filter including activated carbon, and thus a binder or an additive is not used, thereby suppressing a decrease in a specific surface area of activated carbon and stably fixing activated carbon with a crimping structure of fibers.

[Background Art]

[0002] Generally, because a smoking article filter is a portion directly held in the oral cavity of a consumer during smoking, it is essential to secure sufficient mechanical strength and elasticity. Also, there are demands to suppress fall-off of activated carbon used as an adsorbent in a filter manufacturing process, prevent contamination of a manufacturing apparatus, and maintain the quality of the finally provided smoking article.

[0003] Conventionally, cellulose acetate (CA) fibers have been widely utilized as a main material of smoking article filters. Filters based on CA fibers can secure hardness and elasticity of the filter through plasticization by having a plasticizer (e.g., triethyl citrate (TEC), triacetin (TA), etc.) added thereto, can prevent fall-off of activated carbon by more firmly fixing activated carbon particles as an adsorbent in a fiber structure, thus preventing the shape of the filter from easily collapsing during smoking, can ensure uniform transfer of atomization, and can suppress contamination of a manufacturing apparatus and decline in the quality of the final product.

[0004] Meanwhile, in regenerated cellulose filters based on lyocell, viscose, and other regenerated cellulose-based fibers, unlike in the filters based on CA fibers, the plasticization reaction due to adding a plasticizer does not occur. Therefore, adding a plasticizer does not contribute to securing physical properties of smoking article filters, and thus there are problems that activated carbon is prone to fall off, and sufficient hardness and elasticity (or restoring force) are not secured. When an additive or a binder is added to a regenerated cellulose filter to minimize fall-off of activated carbon and impart hardness in order to address the above problems, there is a problem that efficiency of activated carbon is reduced due to the additive or the binder being sprayed onto a surface of the activated carbon.

[0005] Therefore, in manufacturing activated carbon filters based on regenerated cellulose, there is a need for development of a technology that can simultaneously prevent fall-off of activated carbon particles and maintain an excellent specific surface area of activated carbon.

[Disclosure]

[Technical Problem]

[0006] The present invention is directed to providing a smoking article filter including activated carbon and a smoking article including the same in which fibers (preferably lyocell fibers) having crimps, of which the number is in a predetermined numerical range, are applied as regenerated cellulose tow (preferably lyocell tow) constituting the smoking article filter so that the activated carbon is stably fixed in the regenerated cellulose tow (preferably lyocell tow) by a crimped structure, and introduction of the activated carbon into an oral cavity of a consumer is prevented.

[0007] The present invention is also directed to providing a smoking article filter including activated carbon and a smoking article including the same in which the activated carbon is physically settled and fixed by an entangled structure between fibers due to a regenerated cellulose tow structure using crimped regenerated cellulose-based fibers without using an additive or a binder, thereby preventing fall-off of the activated carbon and contamination of a manufacturing apparatus during a manufacturing process, while also preventing pores of the activated carbon from being blocked due to an additive or a binder, and preventing a decrease in a specific surface area of the activated carbon and a decrease in efficiency of absorption of a gaseous component.

[0008] Objectives of the present invention are not limited to those mentioned above, and other unmentioned objectives should be clearly understood by those of ordinary skill in the art to which the present invention pertains based on the description below.

[Technical Solution]

[0009] One aspect of the present application provides a smoking article filter including a filter portion including regenerated cellulose tow including crimped regenerated cellulose-based fibers and activated carbon disposed in the regenerated cellulose tow.

[0010] In some embodiments, the regenerated cellulose-based fibers may include at least one or more of viscose fibers and lyocell fibers.

[0011] In some embodiments, the regenerated cellulose-based fibers may include lyocell fibers, and the regenerated cellulose tow may be lyocell tow.

[0012] In some embodiments, the number of crimps of the regenerated cellulose-based fibers may range from 10 ea/inch to 70 ea/inch (from 3.94 ea/cm to 27.56 ea/cm).

[0013] In some embodiments, the number of crimps of the regenerated cellulose-based fibers may range from 25 ea/inch to 50 ea/inch (from 9.84 ea/cm to 19.69 ea/cm).

[0014] In some embodiments, the filter portion may not include a binder, an additive, or a plasticizer.

[0015] In some embodiments, the activated carbon may be disposed in spaces between a plurality of the crimped regenerated cellulose-based fibers.

[0016] In some embodiments, an iodine adsorption capacity of the activated carbon may range from 910 to 1,300 mg/g.

[0017] In some embodiments, the activated carbon may be included in an amount ranging from 0.5 mg/mm to 4 mg/mm based on a length of the regenerated cellulose tow.

[0018] Another aspect of the present application provides a smoking article including: a smoking material portion; and a smoking article filter disposed downstream of the smoking material portion, wherein the smoking article filter includes a filter portion that includes lyocell tow including crimped lyocell fibers and activated carbon disposed in the lyocell tow and a filter portion wrapper that surrounds the filter portion.

[0019] In some embodiments, the number of crimps of the lyocell fibers may range from 10 ea/inch to 70 ea/inch (from 3.94 ea/cm to 27.56 ea/cm).

[0020] In some embodiments, the filter portion may not include a binder, an additive, or a plasticizer.

[Advantageous Effects]

[0021] According to a smoking article filter including activated carbon and a smoking article including the same according to one embodiment, since regenerated cellulose tow, in particular, lyocell tow, is configured to have a crimped structure having crimps of which the number is in a predetermined range, the activated carbon can be physically settled and fixed in the tow through an entangled structure between fibers that is formed by the crimped structure. Accordingly, it is possible to effectively prevent introduction of the activated carbon into an oral cavity of a consumer during a smoking process.

[0022] Also, although a binder or an additive is not used, activated carbon is stably seated and fixed between fibers constituting tow by use of a crimped structure, and thus the activated carbon is stably seated in the tow, and falling of the activated carbon to the outside of a manufacturing apparatus can be minimized during a manufacturing process of a smoking article filter. Accordingly, contamination of the manufacturing apparatus can be prevented, and stability of the manufacturing process can be improved.

[0023] Further, by not using a binder or an additive, a phenomenon in which a binder or an additive is dispersed on a surface of activated carbon and blocks pores of the activated carbon is prevented, thereby suppressing a decrease in a specific surface area (Brunauer-Emmett-Teller (BET)) of the activated carbon and thus preventing a decrease in efficiency of absorption of a gaseous component included in mainstream smoke.

[0024] Therefore, a smoking article filter and a smoking article including the same according to the present invention have effects of providing a smoking article filter and a smoking article including the same capable of simultaneously improving stability of fixing activated carbon, stability of a manufacturing process, and efficiency of removing a gaseous component.

[Description of Drawings]

[0025] FIG. 1 is a view illustrating a schematic configuration of a smoking article according to one embodiment of the present invention.

[Modes of the Invention]

[0026] Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. Advantages and features of the present disclosure and methods of achieving the same should become clear with embodiments described in detail below with reference to the accompanying drawings. However, the technical spirit of the present disclosure is not limited to the following embodiments and may be implemented in various different forms. The following embodiments are only provided to make the technical spirit of the present disclosure complete and completely inform those of ordinary skill in the art to which the present disclosure

pertains of the scope of the present disclosure. The technical spirit of the present disclosure is defined only by the scope of the claims.

[0027] In assigning reference numerals to components of each drawing, it should be noted that the same reference numerals are assigned to the same components wherever possible even when the components are illustrated in different drawings. Also, in describing the present disclosure, when it is determined that the detailed description of a known related configuration or function may obscure the gist of the present disclosure, the detailed description thereof will be omitted.

[0028] Unless otherwise defined, all terms including technical or scientific terms used herein have the same meaning as commonly understood by those of ordinary skill in the art to which the present disclosure pertains. Terms defined in commonly used dictionaries should not be interpreted in an idealized or overly formal sense unless expressly so defined herein. Terms used herein are for describing the embodiments and are not intended to limit the present disclosure. In the specification, a singular expression includes a plural expression unless the context clearly indicates otherwise.

[0029] Also, in describing components of the present disclosure, terms such as "first," "second," "A," "B," "(a)," and "(b)" may be used. Such terms are only used for distinguishing one component from another component, and the essence, order, sequence, or the like of the corresponding components is not limited by the terms. In a case in which a certain component is described as being "connected," "coupled," or "linked" to another component, it should be understood that, although the component may be directly connected or linked to the other component, still another component may also be "connected," "coupled," or "linked" between the two components.

[0030] The terms "comprise," "include," "comprising," "including," "contain," "containing," "have," and/or "having" used herein do not preclude the presence or addition of one or more components, steps, operations, and/or devices other than those mentioned.

[0031] In addition, unless explicitly specified otherwise, the term "or" is intended to mean an inclusive "or" rather than an exclusive "or." For example, a condition "A or B" is satisfied by any of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present). The use of the term "at least one" or "one or more" should be understood as including one as well as any quantity of two or more. In addition, the use of the phrase "at least one of X, Y, and Z" should be understood as including X alone, Y alone, and Z alone, as well as any combination of X, Y, and Z.

[0032] As used herein, any reference to "one embodiment" or "an embodiment" means that a particular element, feature, structure, or characteristic described in connection with the corresponding embodiment is included in at least one embodiment. The appearance of the phrase "in one embodiment" in various places in the specification does not necessarily always refer to the same embodiment.

[0033] First, some terms used herein will be clarified.

[0034] In the present specification, "smoking article" may refer to any product that can be smoked or any product that can provide a smoking experience, regardless of whether the product is based on tobacco, tobacco derivatives, expanded tobacco, reconstituted tobacco, or tobacco substitutes. For example, smoking articles may include products that can be smoked, such as cigarettes, cigars, and cigarillos.

[0035] In the present specification, "smoking material" may refer to any type of material that may be used in a smoking article.

[0036] In the present specification, "upstream" or "upstream direction" may refer to a direction away from the mouth of a smoker, and "downstream" or "downstream direction" may refer to a direction toward the mouth of the smoker.

[0037] Hereinafter, various embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0038] In the present specification, the term "user" may be interchangeably used with "consumer" or "smoker."

[0039] In the present specification, "longitudinal direction" may refer to a direction corresponding to a longitudinal axis of a smoking article. The "longitudinal axis" of a smoking article may refer to a virtual line extending in the main longitudinal direction of the smoking article. This axis usually continues from one side end (e.g., a mouthpiece or filter end) of a smoking article to the other side end (e.g., a combustion or heat source end).

[0040] In the present specification, "lyocell filter" refers to a filter including lyocell tow or consisting of lyocell tow.

[0041] In the present specification, "lyocell tow" includes a plurality of lyocell fibers or consists of a plurality of lyocell fibers. In some embodiments, lyocell tow may be a bundle formed by cross-linking adjacent lyocell fibers.

[0042] In the present specification, "lyocell fibers" may refer to fibers made of lyocell cellulose. In particular, lyocell fibers may be fibers, in particular, regenerated cellulose-based fibers, made of cellulose derived, or mainly derived, from wood pulp.

[0043] In the present specification, "non-circular cross-section" is defined as a cross-section having a shape including a plurality of protrusions instead of having a circular shape. For example, a cross-section having a shape in which a plurality of protrusions branch and/or extend from a center and/or the center of the cross-section may be referred to as "non-circular cross-section." Here, "protrusions" may refer to distinct, extended segments or arms extending out-

ward from a central core or a joining point of a cross-section of a lyocell fiber.

[0044] In some embodiments, a lyocell fiber may have a Y-shaped cross-section with three protrusions branching and/or extending from the center and/or the center of the cross-section, a cross-shaped cross-section with four protrusions, a star-shaped cross-section with five or more protrusions, or an O-shaped cross-section, but the present disclosure is not limited thereto.

[0045] In some embodiments, a lyocell fiber may include three or more protrusions branching and/or extending from the center and/or the center of the cross-section.

[0046] In some embodiments, a lyocell fiber included in lyocell tow may have a Y-shaped cross-section in terms of its intended use for application to cigarette filters.

[0047] In the present specification, "consisting of" a certain component may mean being made of the corresponding component.

[0048] In the present specification, "wrapping" of a smoking article with a wrapper may refer to surrounding at least a portion of a surface around a longitudinal axis of each portion, segment, and/or structure of a smoking article with a wrapper.

[0049] In the present specification, "basis weight" refers to a mass per unit area of wrapping paper and/or a wrapper. A basis weight of wrapping paper and/or a wrapper may be determined by measuring the mass and area of the wrapping paper and/or wrapper and dividing the mass of the wrapping paper and/or wrapper by the area thereof. The unit of the basis weight may be grams per square meter (gsm), i.e., g/m².

[0050] In the present specification, "hard wrapping paper" refers to wrapping paper having a basis weight of a predetermined value or more.

[0051] In some embodiments, "general wrapping paper" may refer to wrapping paper whose surface is not treated to be grease-resistant, and "general hard wrapping paper" may refer to hard wrapping paper whose surface is not treated to be grease-resistant.

[0052] A smoking article filter may collect at least a portion of smoke components generated during smoking of a smoking article.

[0053] In the present specification, "resistance to draw" refers to a static pressure difference between both ends of a sample when an airflow passes through the sample. For example, resistance to draw may be measured using the method specified in ISO Standard 6565:2015. According to ISO Standard 6565:2015, resistance to draw may refer to a static pressure difference between both ends of a sample when an airflow passes through the sample under normal conditions where a volumetric flow rate is 17.5 mm/s at a discharge end (a temperature of 22±2 °C and a relative humidity of 60±5%).

[0054] In the present specification, when a physical quantity is not separately indicated, "component %" and "component ratio" refer respectively to wt% of the component and a weight ratio of the component.

[0055] In the present specification, the unit "mmH₂O" is a unit of pressure and means "mmWG."

[0056] A smoking article filter may collect at least a portion of smoke components generated during smoking of a smoking article. In some embodiments, a smoking article filter may collect at least some of phenols included in smoke components generated during smoking of a smoking article.

[0057] In the present specification, "smoking article filter hardness" is a numerical value of a degree to which a diameter of a cigarette filter is maintained when the cigarette filter is pressed with a force of a certain level in the vertical direction, and specifically, may be calculated by Equation 1 below.

[Equation 1]

$$\text{Smoking article filter hardness (\%)} = [D - a] / D \times 100$$

[0058] Here, D represents a filter diameter (mm), and a represents a distance (mm) the filter moves downward (is pressed) due to a 300 g weight. Measured values necessary to calculate the hardness of the smoking article filter may be obtained using a device generally used in the art, such as a hardness measurement device, and for example, DHT 200™ of Filtrona Co., Ltd. may be used. In measuring hardness, the applied force takes into account a force actually applied when a smoker holds a cigarette.

[0059] In the present specification, "fiber spreading" refers to a process of separating bundled fibers of a fiber bundle, and "fiber spreading ratio" refers to a rotational speed ratio between a fiber spreading roller at a front end and a feed roller at a rear end that are included in a fiber spreading apparatus used to separate bundled fibers of a fiber bundle and can be calculated by Equation 2 below. Here, the feed roller may be a roller that compresses and grips a fiber bundle and supplies a predetermined amount of the fiber bundle to a fiber spreading portion at a predetermined speed, and the fiber spreading roller may be a roller that untangles and separates the fibers by rotating at a high

speed. Further, the fiber spreading ratio may increase with an increase in a rotational speed difference between the fiber spreading roller and the feed roller, and a higher fiber spreading ratio may indicate a higher degree to which the fibers are untangled.

[Equation 2] Fiber spreading ratio = (rotational speed of fiber spreading roller at front end/rotational speed of feed roller at rear end) [Equation 2]

[0060] In the present specification, "activated carbon powder" refers to activated carbon made of particles each having a particle diameter smaller than 0.18 mm. In the present specification, "activated carbon particles" refers to activated carbon made of particles each having a particle diameter ranging from 0.18 mm to 5 mm. The particle diameter may be measured by laser diffraction or sieve analysis. In particular, the particle diameter of a particle having a diameter smaller than 0.18 mm may be measured by laser diffraction. In particular, the particle diameter of a particle having a diameter of 0.18 mm or larger may be measured by sieve analysis.

[0061] In the present specification, the term "crimp" or "crimped" may refer to a configuration in which a wave shape, a curl, or an undulation is inherently formed on or imparted through a mechanical, thermal, and/or chemical process to a material such as a fiber, a (mono)filament, a multi-filament, and/or yarn. Crimps may have periodic variations from a linear axis along a length of a material, a fiber, a (mono)filament, a multi-filament, and/or yarn. In the material, fiber, filament, multi-filament, and/or yarn, one crimp may be defined as one repeating unit of the periodic variations. The periodic variations may be bends, waveforms, a zigzag shape, or a nonlinear structure similar to a zigzag shape. In particular, "crimped fiber" may refer to a fiber having a corrugated pattern formed thereon, more specifically, a fiber having bends, waveforms, a zigzag shape, or a nonlinear structure similar to a zigzag shape formed thereon in the longitudinal direction thereof. The presence of crimps affects characteristics, such as elasticity, bulk, resilience, and texture, of a material and a woven fabric made of the material. Hereinafter, various embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0062] FIG. 1 is a view illustrating a schematic configuration of a smoking article according to one embodiment of the present invention.

[0063] Throughout the specification, "smoking article" may refer to anything capable of generating an aerosol, such as tobacco (cigarettes) and cigars. The smoking article may include an aerosol-generating material and/or an aerosol-forming substrate. Also, the smoking article may include a solid material based on tobacco raw materials, such as reconstituted tobacco leaves, cut tobacco, and reconstituted tobacco. A smoking material may include volatile compounds.

[0064] Referring to FIG. 1, a smoking article 100 includes a smoking material portion 10, a filter portion 20, a smoking material portion wrapper 30a, a filter portion wrapper 30b, and tipping paper 40. A smoking article filter according to the present invention may include the filter portion 20 and the filter portion wrapper 30b surrounding the filter portion 20. In the smoking article 100, the smoking material portion 10 is located upstream of the filter portion 20.

[0065] In some embodiments, the smoking material portion 10 may be filled with a smoking material such as raw tobacco leaves, reconstituted tobacco leaves, or a mixture of tobacco leaves and reconstituted tobacco leaves. In some embodiments, the smoking material portion 10 may be filled with a processed smoking material in the form of sheets or cut tobacco. In some embodiments, the smoking material portion 10 may have the form of a longitudinally extending rod whose length, circumference, and diameter are not particularly limited, but the length, circumference, and diameter may be adjusted to sizes generally used in the art in consideration of the amount of smoking material filled therein, user (consumer) preferences, or the like.

[0066] In some embodiments, the smoking material portion 10 may include at least one aerosol-generating material of glycerin, propylene glycol, ethylene glycol, dipropylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, and oleyl alcohol. In some embodiments, the smoking material portion 10 may contain other additives such as a flavoring agent, a wetting agent, and/or an acetate compound. In some embodiments, the aerosol-generating material and/or the additives may be contained in the smoking material.

[0067] In some embodiments, the smoking material portion 10 may be wrapped with the smoking material portion wrapper 30a. A portion of cigarette smoke generated in a combustion process of a typical smoking material portion 10 is released into the atmosphere through the smoking material portion wrapper 30a before passing through the cigarette filter, and sidestream smoke causes discomfort to passive smokers. Various attempts, such as filling conventional cigarette paper with a filler such as magnesium oxide, titanium oxide, cerium oxide, aluminum oxide, calcium carbonate, or zirconium carbonate, have been made to reduce sidestream smoke, but because tobacco smoke taste degradation occurs or combustion interruption, ash integrity degradation, etc., occur when sidestream smoke is reduced simply by applying a filler, it has been difficult to address the above problem through appropriate combinations of materials included in fillers. A filler in which magnesium oxide (MgO) and/or magnesium hydroxide (Mg(OH)₂) are/is mixed with calcium carbonate (CaCO₃) may be applied to the smoking material portion wrapper 30a according

to one embodiment of the present invention in order to reduce the sidestream smoke and prevent tobacco smoke taste degradation, ash integrity degradation, and combustion interruption.

[0068] In some embodiments, the smoking article filter may be disposed downstream of the smoking material portion 10. In some embodiments, the filter portion 20 of the smoking article filter is disposed downstream of the smoking material portion 10 and serves as a filter through which an aerosol material generated in the smoking material portion 10 passes right before being inhaled by the user (consumer or smoker). In some embodiments, the filter portion 20 may be manufactured using various materials or manufactured in various forms.

[0069] The smoking article filter according to some embodiments of the present invention may include the filter portion 20 and the filter portion wrapper 30b surrounding the filter portion 20.

[0070] The filter portion 20 according to some embodiments of the present invention may include regenerated cellulose tow including a plurality of regenerated cellulose-based fibers or made of a plurality of regenerated cellulose-based fibers, and activated carbon disposed in the regenerated cellulose tow.

[0071] In some embodiments, the plurality of regenerated cellulose-based fibers included in the filter portion 20 may be crimped fibers, and the regenerated cellulose tow may consist of crimped regenerated cellulose-based fibers. Here, "crimped fibers" may refer to fibers having a corrugated pattern formed thereon, more specifically, a fiber having bends, waveforms, a zigzag shape, or a nonlinear structure similar to a zigzag shape formed thereon in the longitudinal direction thereof.

[0072] In some embodiments, in the regenerated cellulose tow consisting of the crimped regenerated cellulose-based fibers, the regenerated cellulose-based fibers may be untangled by a fiber spreading process, and spaces may be formed between the regenerated cellulose-based fibers.

[0073] In some embodiments, the activated carbon may be provided as a plurality of pieces of activated carbon, and the plurality of pieces of activated carbon may be disposed to be seated on the spaces between the regenerated cellulose-based fibers in the regenerated cellulose tow consisting of the crimped regenerated cellulose-based fibers. Accordingly, the plurality of pieces of activated carbon may be stably fixed in a crimped structure in the regenerated cellulose tow that is configured between the crimped regenerated cellulose-based fibers. That is, the plurality of pieces of activated carbon may be stably fixed in the regenerated cellulose tow by being accommodated in the spaces between the regenerated cellulose fibers and being surrounded or trapped by the crimped structure.

[0074] In some embodiments, a binder or an additive may not be included in the regenerated cellulose tow consisting of the crimped regenerated cellulose-based fibers. That is, although a binder or an additive is not added into the regenerated cellulose tow, the plurality of pieces of activated carbon may be stably fixed and seated in the regenerated cellulose tow due to the crimped structure of the regenerated cellulose tow.

[0075] In some embodiments, the smoking article filter including the regenerated cellulose tow may replace all or part of a filter portion 20 of an existing smoking article, and when the smoking article filter replaces part of the filter portion 20, a filter material that is used conventionally may be used together. For example, a cellulose acetate filter, a hollow tube filter, or the like may be used as the conventional filter material.

[0076] The filter portion 20 is illustrated as a mono filter made of a single filter in FIG. 1, but the present disclosure is not limited thereto. For example, in some embodiments, the filter portion 20 may be provided as a dual filter, a triple filter, or the like, which includes two or more filters, in order to increase filter efficiency.

[0077] In some embodiments, the filter portion 20 may include a dual filter including a first filter portion and a second filter portion disposed downstream of the first filter portion. In this case, in some embodiments, the filter portion according to the present invention that includes the regenerated cellulose tow consisting of the plurality of crimped regenerated cellulose-based fibers and the activated carbon disposed (seated) in the regenerated cellulose tow may be disposed between the smoking material portion 10 and the second filter portion. That is, by activated carbon being included in the first filter portion and not being included in the second filter portion, activated carbon can be prevented from falling into the mouth of the user.

[0078] However, the present disclosure is not limited thereto, and in some embodiments, when the filter portion 20 is the dual filter including the first filter portion and the second filter portion disposed downstream of the first filter portion, the smoking article filter according to the present invention that includes the regenerated cellulose tow consisting of the crimped regenerated cellulose-based fibers and the activated carbon may be applied as at least one or more of the first filter portion and the second filter portion.

[0079] In some embodiments, when the filter portion 20 is provided as a dual filter, a triple filter, or the like, the filter (which may hereinafter be referred to as "activated carbon regenerated cellulose filter") of the present invention including the regenerated cellulose tow including the crimped regenerated cellulose-based fibers and the activated carbon disposed in the regenerated cellulose tow may be applied to any one of the plurality of filters, and a cellulose acetate filter and/or a paper filter may be applied to another of the plurality of filters. In this case, in some embodiments, a length of the regenerated cellulose filter of the present invention may be 25% to 50% of the entire length (100%) of the filter portion 20.

[0080] In the present specification, regenerated cellulose-based fibers may be cellulose-based fibers formed by

processing a naturally generated cellulose-based material.

[0081] In some embodiments, the regenerated cellulose-based fibers may include at least one or more of viscose fibers and lyocell fibers or may be made of at least one or more of viscose fibers and lyocell fibers, and preferably, the regenerated cellulose-based fibers may include lyocell fibers or may be made of lyocell fibers.

[0082] In some embodiments, the regenerated cellulose tow including the plurality of regenerated cellulose-based fibers may be lyocell tow that includes a plurality of lyocell fibers or is made of a plurality of lyocell fibers.

[0083] In some embodiments, the lyocell tow may only include the plurality of lyocell fibers and may not include fibers other than the lyocell fibers. That is, the lyocell tow may be made of the plurality of lyocell fibers. As the lyocell tow is made only of lyocell fibers, biodegradability of the smoking article filter including the filter portion including the lyocell tow may be excellent.

[0084] Description will be given below based on a case in which the regenerated cellulose-based fibers are lyocell fibers, and the regenerated cellulose tow is lyocell tow. However, the present disclosure is not limited thereto, and the regenerated cellulose-based fibers may be other fibers as long as the fibers are based on cellulose that is not chemically modified.

[0085] In some embodiments, the filter portion 20 may be surrounded and wrapped with the filter portion wrapper 30b.

[0086] In some embodiments, the filter portion wrapper 30b may include wrapping paper. In some embodiments, the filter portion wrapper 30b may include general wrapping paper or hard wrapping paper.

[0087] In some embodiments, the filter portion wrapper 30b may include porous general wrapping paper. In some embodiments, the filter portion wrapper 30b may include porous general wrapping paper having a porosity ranging from 20 K to 50 K or from 22 K to 46 K, preferably a porosity ranging from 23 K to 25 K, from 34 K to 36 K, or from 44 K to 46 K, and more preferably a porosity of 24 K, 35 K, or 45 K. In some embodiments, the filter portion wrapper 30b may include porous general wrapping paper having a porosity of 24 K. Because the filter portion wrapper 30b includes porous general wrapping paper instead of general wrapping paper or hard wrapping paper treated to be grease-resistant, biodegradability of the smoking article filter according to some embodiments of the present invention can be improved.

[0088] However, the present disclosure is not limited thereto, and in some embodiments, the filter portion wrapper 30b may include hard wrapping paper. Hereinafter, in the present specification, hard wrapping paper may be wrapping paper having a basis weight within or beyond a predetermined numerical range. In particular, hard wrapping paper may be wrapping paper having a basis weight of 40 gsm or more, preferably 50 gsm or more, more preferably 60 gsm or more, even more preferably 70 gsm or more, and still more preferably 75 gsm or more. In some embodiments general wrapping paper may be wrapping paper having a basis weight of less than 40 gsm, preferably less than 38 gsm, and more preferably less than 36 gsm.

[0089] Also, the present disclosure is not limited thereto, and in some embodiments, the filter portion wrapper 30b may include general wrapping paper or hard wrapping paper treated to be grease-resistant.

[0090] In some embodiments, the smoking material portion 10 wrapped with the smoking material portion wrapper 30a and the filter portion 20 wrapped with the filter portion wrapper 30b may be combined and wrapped with the tipping paper 40. In some embodiments, as illustrated in FIG. 1, the tipping paper 40 may be wrapped around at least a portion (for example, a partial downstream region) of the smoking material portion wrapper 30a and an outer periphery of the filter portion wrapper 30b. In other words, in some embodiments, at least a portion of the smoking material portion 10 and the filter portion 20 may be further wrapped and physically combined with the tipping paper 40.

[0091] According to some embodiments of the present invention, the tipping paper 40 may be made of nonporous wrapping paper that has not been treated to be grease-resistant, but the present invention is not limited thereto. Also, in some embodiments, the tipping paper 40 may include an incombustible material to prevent a phenomenon in which the filter portion 20 burns, but the present invention is not limited thereto.

[0092] The filter portion 20 of the smoking article filter according to one embodiment of the present invention will be described in detail below.

[0093] Embodiments according to the present invention relate to a smoking article filter included in the smoking article 100, and the smoking article filter according to one embodiment of the present invention includes the filter portion 20 including lyocell tow that includes crimped lyocell fibers and activated carbon that is disposed in the lyocell tow. In some embodiments, the smoking article filter may further include the filter portion wrapper 30b surrounding the filter portion 20.

[0094] In some embodiments, in the lyocell tow consisting of the crimped lyocell fibers, spaces may be formed between the crimped lyocell fibers.

[0095] In some embodiments, the number of crimps of the crimped lyocell fibers constituting the lyocell tow may range from 10 ea/inch to 70 ea/inch (from 3.94 ea/cm to 27.56 ea/cm), from 15 ea/inch to 65 ea/inch (from 5.91 ea/cm to 25.59 ea/cm), or from 20 ea/inch to 60 ea/inch (from 7.87 ea/cm to 23.62 ea/cm), preferably from 25 ea/inch to 50 ea/inch (from 9.84 ea/cm to 19.69 ea/cm).

[0096] In the present specification, "ea/inch" or "ea/cm" may indicate the number of crimps (bends) formed per 1 inch of fiber or 1 cm of fiber, and for example, 10 ea/inch (3.94 ea/cm) may mean 10 crimps (bends) are formed per inch (3.94 crimps (bends) are formed per cm). For example, when the number of crimps is small, because the number of crimps (bends, corrugations) in the lyocell fibers is small, an entangled structure between the lyocell fibers may not be sufficiently formed. On the other hand, when the number of crimps increases, because the number of crimps (bends, corrugations) in the lyocell fibers increases, an entangled structure between the lyocell fibers may be easily formed. However, when the number of crimps is excessively large, the lyocell fibers may be excessively entangled, it may be difficult to form spaces (voids) between the lyocell fibers, and it may be difficult to adjust resistance to draw.

[0097] When the number of crimps of the lyocell fibers is within the above numerical range, because a void structure and an entangled structure are formed in balance between the fibers, and activated carbon is stably seated or trapped in spaces in the lyocell tow in an activated carbon adding process during a lyocell filter manufacturing process, a fall-off rate of activated carbon is minimized and appropriate resistance to draw can be provided because excessive airflow resistance is not caused. On the other hand, when the number of crimps is below the above numerical range, despite a fiber spreading process being performed, an entangled structure between the fibers is insufficient, a fiber structure allowing activated carbon to be stably seated and trapped is insufficient, and thus the fall-off rate of activated carbon may increase, the efficiency of the filter manufacturing process may decrease, and filter quality may decline. In addition, when the number of crimps is beyond the above numerical range, the lyocell fibers of the lyocell tow may be excessively entangled or compressed, airflow passage may be reduced, and thus resistance to draw may excessively increase, uniformity of a porous structure may decrease, and smoking quality may be degraded.

[0098] In some embodiments, the number of crimps of the crimped lyocell fibers constituting the lyocell tow may range from 0.39 ea/mm to 2.76 ea/mm, from 0.59 ea/mm to 2.56 ea/mm, or from 0.79 ea/mm to 2.36 ea/mm, preferably from 0.98 ea/mm to 1.97 ea/mm. In the present specification, "ea/mm" may indicate the number of crimps (bends) formed per 1 mm of fiber.

[0099] In some embodiments, a tensile strength of the lyocell tow may be 40 N or more, 42 N or more, 44 N or more, 46 N or more, or 48 N or more, preferably 50 N or more. When the tensile strength is in the above range, a problem of disconnection of the lyocell fibers does not occur in a process of spreading the crimped lyocell fibers, and a process having a higher fiber spreading ratio can be performed. In the present specification, the tensile strength may be measured using a testing instrument such as FAVIMAT+, which is Textechno's apparatus for testing material characteristics. Specifically, a test piece collected from lyocell is fixed between two grips, and the test piece is stretched at a tensile speed of 20 mm/min until the test piece ruptures. A force (N) at the time the test piece ruptures is the tensile strength used in the present specification. Prior to measuring the tensile strength, the test piece collected from the lyocell tow is preliminarily dried at 110 °C for 2 hours, is dried at 20 ± 2 °C, and is left under steady temperature and humidity conditions for 24 hours or more.

[0100] In some embodiments, activated carbon may be provided as a plurality of pieces of activated carbon, and the plurality of pieces of activated carbon (or activated carbon) may be disposed in the lyocell tow. In some embodiments, the plurality of pieces of activated carbon (or activated carbon) may be disposed to be uniformly dispersed in the lyocell tow in the longitudinal direction of the lyocell tow. However, the present disclosure is not limited thereto, and in some embodiments, the plurality of pieces of activated carbon (or activated carbon) may be disposed to be nonuniformly dispersed in the lyocell tow in the longitudinal direction of the lyocell tow.

[0101] In some embodiments, the plurality of pieces of activated carbon (or activated carbon) may be disposed in spaces (or voids) formed by an entangled structure between the crimped lyocell fibers constituting the lyocell tow in the lyocell tow. Due to this structure, the plurality of pieces of activated carbon (or activated carbon) may be fixed in the lyocell tow while surrounded/trapped and supported by the crimped lyocell fibers. Accordingly, the plurality of pieces of activated carbon may be stably seated in the lyocell tow due to the entangled structure of the crimped lyocell fibers. Due to such a structure, fall-off of activated carbon can be minimized during the manufacturing process, and fall-off of activated carbon can also be minimized during storage and distribution processes.

[0102] In some embodiments, the lyocell filter may not include a binder or an additive dispersed in the lyocell tow.

[0103] Unlike cellulose acetate (CA) fibers, lyocell fibers do not have a plasticizer that causes a plasticization reaction, and a plasticization reaction caused by an additive or the like may not occur in the lyocell fibers. Meanwhile, when activated carbon is added onto lyocell tow that is not plasticized, the activated carbon may bounce off due to elastic resilience of the fibers and may fall to the outside. The lyocell filter according to the present invention uses lyocell tow consisting of crimped lyocell fibers having a predetermined number of crimps that can form an appropriate entangled structure between the lyocell fibers, and thus activated carbon can be stably trapped and supported in the lyocell tow without using a binder or an additive. That is, the lyocell tow according to the present invention can provide a structure in which activated carbon is fixed by the entangled structure between the fibers and spreading of the fibers without depending on an adhesive force of an additive or a binder.

[0104] In addition, because no binder or additive is included in the lyocell tow, no binder or additive is adsorbed or dispersed on a surface of activated carbon disposed in the lyocell tow, and thus it is possible to prevent a problem in

which an adsorption capacity decreases due to a decrease in the specific surface area of the activated carbon. In addition, because no binder or additive is included in the lyocell tow, it is possible to provide a lyocell filter having excellent biodegradability.

[0105] In some embodiments, activated carbon may be manufactured by carbonizing, activating, and refining wood, bamboo, sawdust, coconut shells, lignin, lignite, peat, etc. Activated carbon may be classified according to form into activated carbon powder and activated carbon particles. In some embodiments, activated carbon powder or activated carbon particles may be applied as activated carbon.

[0106] In some embodiments, activated carbon may perform a function of absorbing a gaseous component in mainstream smoke generated during smoking.

[0107] In some embodiments, the activated carbon may have a specific surface area that allows the activated carbon to absorb an aerosol included in the mainstream smoke. The activated carbon may have a specific surface area ranging from 600 to 3,000 m²/g. Preferably, in some embodiments, the activated carbon may have a specific surface area ranging from 700 to 2,500 m²/g. More preferably, the activated carbon may have a specific surface area ranging from 1,000 to 2,000 m²/g. The specific surface area may be determined using the Brunauer-Emmett-Teller (BET) gas adsorption method according to ISO 9277 (2014-01). However, the specific surface area of the activated carbon is not necessarily limited to the above ranges, and the activated carbon may have any other specific surface area that allows the activated carbon to absorb an aerosol of the mainstream smoke.

[0108] In some embodiments, an iodine adsorption capacity of the activated carbon disposed in the lyocell tow may range from 910 to 1,300 mg/g, from 920 to 1,250 mg/g, from 930 to 1,200 mg/g, or from 940 to 1,150 mg/g, preferably from 950 to 1,100 mg/g. In the present specification, the iodine adsorption capacity may be measured using KSM 1802-a (activated carbon testing method according to Korean Industrial Standards (2009, Korean Agency for Technology and Standards)).

[0109] In some embodiments, a plurality of pieces of activated carbon may be disposed in the lyocell tow, and the plurality of pieces of activated carbon may be included in an amount ranging from 0.5 mg/mm to 4 mg/mm, from 0.6 mg/mm to 3.9 mg/mm, from 0.7 mg/mm to 3.8 mg/mm, from 0.8 mg/mm to 3.7 mg/mm, from 0.9 mg/mm to 3.6 mg/mm, from 1.0 mg/mm to 3.5 mg/mm, from 1.1 mg/mm to 3.4 mg/mm, from 1.2 mg/mm to 3.3 mg/mm, from 1.3 mg/mm to 3.2 mg/mm, from 1.4 mg/mm to 3.1 mg/mm, or from 1.5 mg/mm to 3.0 mg/mm, preferably in an amount ranging from 1.55 mg/mm to 2.9 mg/mm, from 1.6 mg/mm to 2.8 mg/mm, from 1.65 mg/mm to 2.7 mg/mm, from 1.7 mg/mm to 2.6 mg/mm, from 1.75 mg/mm to 2.5 mg/mm, from 1.8 mg/mm to 2.4 mg/mm, or from 1.85 mg/mm to 2.3 mm/mg, more preferably in an amount ranging from 1.9 mg/mm to 2.25 mg/mm, from 1.9 mg/mm to 2.2 mg/mm, or from 1.9 mg/mm to 2.1 mg/mm, and even more preferably in an amount of 2.0 mg/mm in the lyocell tow based on the longitudinal direction of the lyocell tow, but the present disclosure is not limited thereto.

[0110] In some embodiments, a lyocell filter including activated carbon may have a hardness of 85% or more and may have a hardness of 85% or more, 86% or more, 87% or more, 88% or more, 89% or more, 90% or more, 91% or more, 92% or more, 93% or more, or 94% or more, preferably, a hardness of 95% or more. The hardness of a smoking article filter is a numerical value of a degree to which a diameter of a smoking article filter is maintained when the smoking article filter is pressed with a force of a certain level in the vertical direction, and specifically, may be calculated by Equation 3 below.

[Equation 3]

$$\text{Smoking article filter hardness (\%)} = [D - a]/D \times 100$$

[0111] Here, D represents a filter diameter (mm), and a represents a distance (mm) the filter moves downward (is pressed) due to a 300 g weight. Measured values necessary to calculate the hardness of the smoking article filter may be obtained using a device generally used in the art, and for example, DHT 200™ of Filtrona Co., Ltd., may be used. In measuring hardness, the applied force takes into account a force actually applied when a smoker holds a cigarette. A hardness value of 85% or more obtained through the smoking article filter according to one embodiment of the present invention is technically significant because it shows that hardness can be secured at a level that allows the conventional cigarette filter consisting of cellulose acetate to be replaced with the smoking article filter according to one embodiment of the present invention that uses lyocell tow which is an eco-friendly material, and because it shows that an excellent hardness of 95% or more can be applied.

[0112] In some embodiments, the lyocell tow consisting of the crimped lyocell fibers may be manufactured by performing a fiber spreading process that untangles a fiber bundle so that predetermined spaces are formed between the lyocell fibers. In some embodiments, the fiber spreading process may be a process for forming voids (spaces) between the fibers by separating and spacing multiple continuous filaments joined in the form of a bundle. Specifically,

in some embodiments, the fiber spreading process may be performed using a fiber spreading apparatus on a material consisting of the crimped lyocell fibers. In some embodiments, the fiber spreading apparatus may include a feed roller that provides crimped lyocell fibers and a fiber spreading roller that spreads the crimped lyocell fibers provided from the feed roller, and the degree of fiber spreading may be adjusted through a fiber spreading ratio, which is a ratio of a rotational speed of the fiber spreading roller to a rotational speed of the feed roller, calculated by Equation 4 below.

[Equation 4] Fiber spreading ratio = (rotational speed of fiber spreading roller at front end/rotational speed of feed roller at rear end) [Equation 4]

[0113] In the fiber bundle, a density of the tow after fiber spreading by the fiber spreading process may be lower than a density of the tow before fiber spreading. For example, an increase in the fiber spreading ratio may indicate an increase in an average interval between the fibers and an increase in the spaces between the fibers in the tow, and a decrease in the fiber spreading ratio may indicate a decrease in the average interval between the fibers, leading to a high density, and a decrease in the spaces between the fibers in the tow.

[0114] That is, a ratio of the spaces in which activated carbon is disposed between the fibers of the lyocell tow may be adjusted by adjusting the density of the fibers according to adjustment of the fiber spreading ratio in the fiber spreading process during the process of manufacturing the lyocell tow.

[0115] The lyocell tow according to some embodiments may be manufactured to have a fiber spreading ratio ranging from 1.1 to 1.7 or from 1.2 to 1.6, preferably a fiber spreading ratio ranging from 1.3 to 1.5, and more preferably a fiber spreading ratio of 1.5. Within the above range, appropriate spacing and entangled structure are formed between the fibers, and damage to the fibers may not occur during the filter manufacturing process while the fall-off rate of activated carbon is minimized. For example, when the fiber spreading ratio is beyond the above numerical range, fiber spreading may be performed with an excessive tensile force or mechanical tension, and damage to the fibers or disconnection of the fibers may occur. Conversely, when the fiber spreading ratio is below the above numerical range, the fibers may not be sufficiently spread, the formation of voids between the fibers may be limited, and accordingly, a problem in which activated carbon is not stably seated and the fall-off rate thereof increases occurs.

[0116] In addition, the fiber spreading process may be performed on the lyocell tow according to some embodiments so that a width of the tow after passing the fiber spreading roller is greater than a width of the tow before passing the fiber spreading roller by 10% or more. Specifically, a rate of increase of the width of the tow due to the fiber spreading process may be 10% or more, and the rate of increase of the width of the tow may be calculated by Equation 5 below.

Rate of increase of width of tow = (width after passing - width before passing)/(width before passing) *100 [Equation 5]

[0117] Hereinafter, the configurations of the present invention and the advantageous effects according thereto will be described in more detail using examples and comparative examples. However, the examples are merely for describing the present invention in more detail, and the scope of the present invention is not limited to these examples.

<Comparative Example 1>

[0118] A smoking article filter rod was manufactured by performing fiber spreading with a fiber spreading ratio of 1.2 on cellulose acetate fibers, and then adding activated carbon in an amount of 2 mg/mm based on a longitudinal direction of the filter using the tow having a length of 108 mm, a circumference of 24.2 mm, and a resistance to draw ranging from 250 to 350 mmH₂O.

<Comparative Example 2>

[0119] A smoking article filter rod was manufactured in the same manner as in Comparative Example 1 except that the fiber spreading ratio was 1.1, and triacetin was added as a plasticizer in an amount of 7% relative to the weight of the cellulose acetate tow.

<Comparative Example 3>

[0120] A smoking article filter rod was manufactured in the same manner as in Comparative Example 1 except that triacetin was added as a plasticizer in an amount of 7% relative to the weight of the cellulose acetate tow.

<Example 1>

[0121] A smoking article filter rod was manufactured by performing fiber spreading with a fiber spreading ratio of 1.1 on lyocell fibers having a number of crimps of 30 ea/inch (11.81 ea/cm), and then adding activated carbon in an amount of 2 mg/mm based on a longitudinal direction of the filter using the tow having a length of 108 mm, a circumference of 24.2 mm, and a resistance to draw ranging from 250 to 350 mmH₂O.

<Example 2>

[0122] A smoking article filter rod was manufactured in the same manner as in Example 1 except that the fiber spreading ratio was 1.2.

<Example 3>

[0123] A smoking article filter rod was manufactured in the same manner as in Example 1 except that the fiber spreading ratio was 1.3.

<Example 4>

[0124] A smoking article filter rod was manufactured in the same manner as in Example 1 except that the fiber spreading ratio was 1.5.

<Example 5>

[0125] A smoking article filter rod was manufactured in the same manner as in Example 1 except that the fiber spreading ratio was 1.7.

<Experimental Example 1: Analysis of fall-off rate of activated carbon according to fiber spreading ratio and fiber type>

[0126] The smoking article filter rods according to Comparative Examples 1 to 3 and Examples 1 to 5 were placed on a sieve shaker, the sieve shaker was operated for 10 minutes, the weight of activated carbon that fell to the outside of the filter was measured, a ratio of the weight of activated carbon that fell relative to the weight of activated carbon that was added was obtained, and the fall-off rate was calculated, which is shown in Table 1 below.

[Table 1]

	Filter tow material	Presence of plasticizer or additive	Fiber spreading ratio	Fall-off rate (%)
Comparative Example 1	Cellulose acetate (CA)	No	1.2	1.87
Comparative Example 2		Yes (triacetin, 7%)	1.1	0.85
Comparative Example 3			1.2	0.91
Example 1	Lyocell	No	1.1	2.28
Example 2		No	1.2	1.96
Example 3		No	1.3	1.72
Example 4		No	1.5	1.02
Example 5		No	1.7	Damage to fibers

[0127] Referring to Table 1, it can be confirmed that, in the case of the cellulose acetate filter rods of Comparative Examples 1 and 3, the fall-off rate of activated carbon decreased due to adding a plasticizer. From this, it can be confirmed that activated carbon can be stably fixed in the cellulose acetate tow by the plasticized fibers. Meanwhile, it can be confirmed that the fall-off rate of activated carbon significantly increased in Examples 1 and 2 (lyocell tow in which a plasticizer or the like was not added) compared to Comparative Examples 2 and 3 (cellulose acetate tow in which a plasticizer was added). From this, it can be expected that, in the lyocell tow of Examples 1 and 2, fall-off of activated carbon occurred because a plasticization reaction did not occur and a structure for fixing activated carbon

was insufficient in an internal structure of the filter. It can be confirmed that, compared to Examples 1 and 2, the fall-off rate of activated carbon decreased in Examples 3 and 4 in which the fiber spreading ratio increased. From this, it can be confirmed that, when the fiber spreading ratio is increased, an entangled structure and a void structure are sufficiently formed between fibers, and a structure where activated carbon can be seated is stably provided. In particular, it can be confirmed that, in the case of Example 4, the fall-off rate was similar to that in Comparative Examples 2 and 3 which were cellulose acetate filters to which a plasticizer was added, and fall-off of activated carbon was efficiently prevented. Meanwhile, it can be confirmed that, in the case of Example 5, residue was generated because the fibers were damaged due to an excessively high fiber spreading ratio.

<Example 6>

[0128] A smoking article filter rod was manufactured in the same manner as in Example 3 except that the number of crimps of lyocell fibers was 10 ea/inch (3.94 ea/cm). Meanwhile, the number of crimps is the number of crimps formed in 1 inch or 1 cm of one strand of lyocell fiber, and the number of crimps may be measured using an opto-electronic sensor provided on a FAVIMAT instrument.

<Example 7>

[0129] A smoking article filter rod was manufactured in the same manner as in Example 3 except that the number of crimps of lyocell fibers was 25 ea/inch (9.84 ea/cm).

<Example 8>

[0130] A smoking article filter rod was manufactured in the same manner as in Example 3 except that the number of crimps of lyocell fibers was 70 ea/inch (27.56 ea/cm).

<Experimental Example 2: Analysis of fall-off rate of activated carbon according to number of crimps>

[0131] The smoking article filter rods according to Examples 6 to 8 were placed on a sieve shaker, the sieve shaker was operated for 10 minutes, and then the weight of activated carbon that fell to the outside of the filter was measured. Then, a ratio of the weight of activated carbon that fell relative to the weight of activated carbon that was added was obtained, and the fall-off rate was calculated, which is shown in Table 2 below.

[Table 2]

	Filter tow material	Fiber spreading ratio	Number of crimps (ea/inch (ea/cm))	Fall-off rate (%)
Example 6	Lyocell	1.3	10(3.94)	4.1
Example 7		1.3	25(9.84)	1.65
Example 8		1.3	70(27.56)	1.2

[0132] Referring to Table 2, it can be confirmed that, in Example 6, because the number of crimps was 10 ea/inch (3.94 ea/cm), the number of crimps in the lyocell fibers was too small, and an entangled structure between the fibers was not formed, the fall-off rate of activated carbon was significantly high due to the entangled structure not being sufficiently generated despite the fiber spreading process being performed. In addition, referring to Examples 7 and 8, it can be confirmed that, with an increase in the number of crimps, the fall-off rate of activated carbon decreased because more entangled structures were provided. However, it was confirmed that, when the number of crimps is excessively large, although the fall-off rate of activated carbon can be decreased, the entangled structure may be excessively formed, it may become difficult to adjust resistance to draw, and bundling of fibers may occur or a porous structure may become nonuniform when manufacturing the filter.

<Example 9>

[0133] A smoking article filter rod was manufactured in the same manner as in Example 3 except that a tensile strength of lyocell tow was adjusted to 40 N.

<Example 10>

[0134] A smoking article filter rod was manufactured in the same manner as in Example 9 except that a tensile strength of lyocell tow was adjusted to 50 N.

<Example 11>

[0135] A smoking article filter rod was manufactured in the same manner as in Example 9 except that a tensile strength of lyocell tow was adjusted to 76 N.

<Experimental Example 3: Analysis of filter manufacturability according to tensile strength>

[0136] The smoking article filter rods according to Examples 9 to 11 were placed on a sieve shaker, the sieve shaker was operated for 10 minutes, and then the weight of activated carbon that fell to the outside of the filter was measured, a ratio of the weight of activated carbon that fell relative to the weight of activated carbon that was added was obtained, and the fall-off rate was calculated, which is shown in Table 3 below.

[Table 3]

	Filter tow material	Fiber spreading ratio	Tensile strength (N)	Fall-off rate (%)
Example 9	Lyocell	1.3	40	Filter manufacturability decreased (residue)
Example 10		1.3	50	Filter manufacturability decreased during high-speed manufacturing
Example 11		1.3	76	1.02

[0137] Referring to Table 3, it can be confirmed that, in the case of Example 9, manufacturability decreased due to generation of residue in the fiber spreading process, and it can be confirmed that, in the case of Example 10, manufacturability decreased at a high manufacturing speed. That is, it can be confirmed that the higher the tensile strength of the lyocell tow, the easier it is to manufacture a filter to which a high fiber spreading ratio is applied. Accordingly, it can be confirmed that a tensile strength of 50 N or more is preferable for the tensile strength of lyocell tow for high-speed manufacturing and application of various fiber spreading ratios.

<Comparative Example A>

[0138] A smoking article filter rod was manufactured by adding activated carbon in an amount of 2 mg/mm based on a longitudinal direction of the filter without adding a plasticizer to cellulose acetate tow consisting of cellulose acetate fibers.

<Example A>

[0139] A smoking article filter rod was manufactured by adding activated carbon in an amount of 2 mg/mm based on a longitudinal direction of the filter without adding an additive or the like to lyocell tow consisting of lyocell fibers.

<Comparative Example B>

[0140] A smoking article filter rod was manufactured in the same manner as in Example A except that a binder solution including 25 wt% dextrin was added in an amount of 10 wt% relative to the total weight of lyocell tow to the lyocell tow.

<Comparative Example C>

[0141] A smoking article filter rod was manufactured in the same manner as in Example A except that polyethylene glycol (PEG) was added as an additive in an amount of 10 wt% relative to the total weight of lyocell tow to the lyocell tow.

<Experimental Example 4: Evaluation of iodine adsorption capacity of activated carbon according to application of additive or binder>

[0142] A plurality of pieces of added activated carbon were collected from the smoking article filter rods according to Comparative Examples A to C and Example A, an iodine adsorption capacity of activated carbon was analyzed using the KSM 1802-a analysis method, the iodine adsorption capacity right after manufacture is shown in Table 4, and the iodine adsorption capacity 1 hour after manufacture is shown in Table 5.

[Table 4]

Test item	Activated carbon	Comparative Example A	Example A	Comparative Example B	Comparative Example C
Iodine adsorption capacity (mg/g)	1,096	1,007	995	910	593

[Table 5]

Test item	Activated carbon	Comparative Example A	Example A	Comparative Example B	Comparative Example C
Iodine adsorption capacity (mg/g)	1,096	997	1,008	953	571

[0143] Referring to Table 4 and Table 5, it can be confirmed that the iodine adsorption capacity was higher in Example A in which a binder or a functional additive was not added to the lyocell filter, compared to Comparative Examples B and C in which a binder or a functional additive was added to the lyocell filter. That is, it can be confirmed that, while an additive or the like was adsorbed toward activated carbon and the iodine adsorption capacity decreased when a binder or an additive was added, the iodine adsorption capacity of activated carbon was excellent and a decrease in performance of adsorbing a gaseous component in mainstream smoke did not occur in the case of Example A in which an additive or the like was not added.

[0144] Although embodiments of the present disclosure have been described above with reference to the accompanying drawings, those of ordinary skill in the art to which the present disclosure pertains should understand that the present disclosure may be embodied in other specific forms without changing the technical spirit or essential features thereof. Therefore, the embodiments described above should be understood as being illustrative, instead of limiting, in all aspects. The scope of protection of the present disclosure should be interpreted based on the claims below, and all technical ideas within the scope equivalent to the claims should be interpreted as falling within the scope of rights of the technical spirit defined by the present disclosure.

Claims

1. A smoking article filter comprising:
a filter portion including regenerated cellulose tow including crimped regenerated cellulose-based fibers and activated carbon disposed in the regenerated cellulose tow.
2. The smoking article filter of claim 1, wherein the regenerated cellulose-based fibers include at least one or more of viscose fibers and lyocell fibers.
3. The smoking article filter of claim 1, wherein:
the regenerated cellulose-based fibers include lyocell fibers; and
the regenerated cellulose tow is lyocell tow.
4. The smoking article filter of claim 1, wherein the number of crimps of the regenerated cellulose-based fibers ranges from 10 ea/inch to 70 ea/inch.
5. The smoking article filter of claim 4, wherein the number of crimps of the regenerated cellulose-based fibers ranges from 25 ea/inch to 50 ea/inch.
6. The smoking article filter of claim 1, wherein the filter portion does not include a binder, an additive, or a plastici-

zer.

7. The smoking article filter of claim 1, wherein the activated carbon is disposed in spaces between a plurality of the crimped regenerated cellulose-based fibers.

8. The smoking article filter of claim 1, wherein an iodine adsorption capacity of the activated carbon ranges from 910 to 1,300 mg/g.

9. The smoking article filter of claim 1, wherein the activated carbon is included in an amount ranging from 0.5 mg/mm to 4 mg/mm based on a length of the regenerated cellulose tow.

10. A smoking article comprising:

a smoking material portion; and

a smoking article filter disposed downstream of the smoking material portion, wherein the smoking article filter includes:

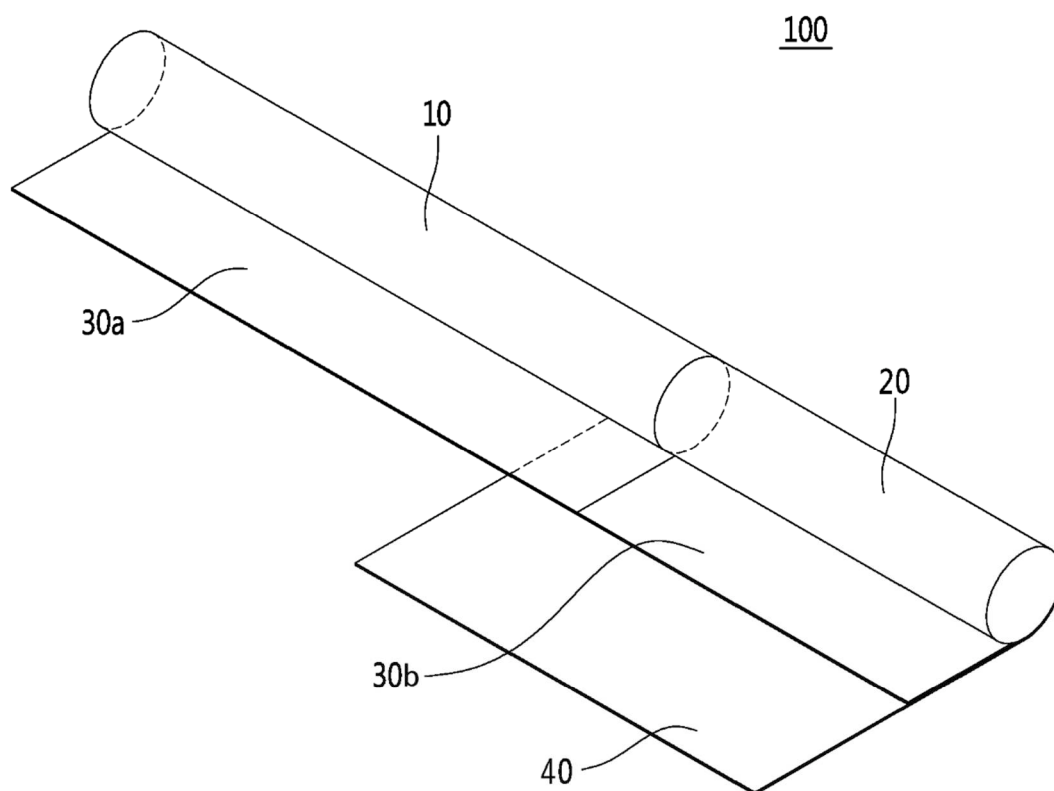
a filter portion that includes lyocell tow including crimped lyocell fibers and activated carbon disposed in the lyocell tow; and

a filter portion wrapper that surrounds the filter portion.

11. The smoking article of claim 10, wherein the number of crimps of the lyocell fibers ranges from 10 ea/inch to 70 ea/inch.

12. The smoking article of claim 10, wherein the filter portion does not include a binder, an additive, or a plasticizer.

FIG. 1





EUROPEAN SEARCH REPORT

Application Number

EP 26 17 1260

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2008/295852 A1 (RIEPERT LUDWIG [DE] ET AL) 4 December 2008 (2008-12-04) * paragraphs [0002], [0020]; claims; examples *	1-12	INV. A24D3/16 A24D3/06 A24D3/10
X,P	WO 2025/088019 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 1 May 2025 (2025-05-01) * page 8, line 26 - line 27; claims; examples *	1,2,6-8, 10,12	
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