{DESCRIPTION}

{Title of Invention}

COMPOSITE CONDUCTIVE MATERIAL, POWER STORAGE DEVICE, CONDUCTIVE DISPERSION, CONDUCTIVE DEVICE, CONDUCTIVE COMPOSITE AND THERMALLY CONDUCTIVE COMPOSITE AND METHOD OF PRODUCING A COMPOSITE CONDUCTIVE MATERIAL

{Technical Field}

{0001}

The present invention relates to a composite conductive material, a power storage device, a conductive dispersion, a conductive device, a conductive composite, ~~and~~ a thermally conductive composite and method of producing a composite conductive material.

{Background Art}

{0002}

In recent years, addition of various nanomaterials has been studied for purposes of downsizing and weight saving in various fields. In particular, for problems of environments or resources, carbon materials such as graphene, CNT and fullerene have attracted attention as nonmetal nanomaterials. For example, a lithium-ion battery currently put to practical use has been improved in its capacity owing to an improvement of the active material itself. However, the capacity is significantly lower than its theoretical capacity, and further improvement has been desired.

which graphene is easily exfoliated, the graphene being able to be dispersed at a high concentration or to a high degree.

A part or whole of the graphene precursor is exfoliated by ultrasonic waves, stirring and kneading to produce a mixed material being "graphene-like graphite", containing material from the graphene precursors to the graphene. A size, thickness, etc. of the graphene-like graphite is not limited since they are variable depending on an addition amount, a process time, etc. of the graphene precursors, however, the graphene-like graphite is preferably more flaked.

That is, in other words, the graphite-based carbon material (the graphene precursor) is a type of graphite capable of being easily exfoliated and dispersed as graphene-like graphite by existing stirring and kneading processes or devices.

Since the graphene-like graphite is excellent in conductivity, it is found that, when it is used in a high dispersion state, for example, in a positive electrode of a lithium-ion secondary battery, a capacity thereof can be made close to its theoretical capacity.

{0008}

The invention has been completed focusing on such problems, and ~~an object~~ embodiments of the invention ~~is~~ seek to provide a composite conductive material, a power storage device, a conductive dispersion, a conductive device, a conductive

composite, and a thermally conductive composite, which are excellent in conductivity.

{Solution to Problem}

{0009}

A first aspect of the present invention provides a ~~In order to solve the aforementioned problems, the~~ composite conductive material ~~of the present invention~~ comprisinges at least graphene-like graphite exfoliated from a graphite-based carbon material and a conductive material dispersed in a base material,

the graphite-based carbon material characterized by having a rhombohedral graphite layer (3R) and a hexagonal graphite layer (2H), wherein a Rate (3R) of the rhombohedral graphite layer (3R) and the hexagonal graphite layer (2H), based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$\text{Rate (3R)} = P3/(P3+P4)\times 100 \cdots \text{Equation 1}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer (3R) based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer (2H) based on the X-ray diffraction method, the graphene-like graphite being a mixed material containing the graphite-based carbon material to graphene, produced by exfoliating a part or whole of the graphite-based carbon

material, and the graphene being a crystal of a mean size of 100 nm or more and formed in a flake-like or sheet-like shape having 10 layers or less.

{0009a}

A second aspect of the present invention provides a method of producing a composite conductive material, comprising a step of kneading at least a graphite-based carbon material and a conductive material into a base material,

the graphite-based carbon material having a rhombohedral graphite layer (3R) and a hexagonal graphite layer (2H), wherein a Rate (3R) of the rhombohedral graphite layer (3R) and the hexagonal graphite layer (2H), based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$\text{Rate (3R)} = P3/(P3+P4)\times 100 \quad \cdots\cdot \text{ Equation 1}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer (3R) based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer (2H) based on the X-ray diffraction method.

{0009b}

According to the features, the composite material is excellent in conductivity. This is because, it is speculated that, the graphene-like graphite exfoliated from the graphite-based

{CLAIMS}

{Claim 1}

A composite conductive material comprising at least graphene-like exfoliated from a graphite-based carbon material and a conductive material dispersed in a base material,

the graphite-based carbon material having a rhombohedral graphite layer (3R) and a hexagonal graphite layer (2H), wherein a Rate (3R) of the rhombohedral graphite layer (3R) and the hexagonal graphite layer (2H), based on an X-ray diffraction method, which is defined by following Equation 1, is 31% or more:

$$\text{Rate (3R)} = P3/(P3+P4)\times 100 \cdots \text{(Equation 1)}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer (3R) based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer (2H) based on the X-ray diffraction method.

{Claim 2}

The composite conductive material according to claim 1, wherein the conductive material is a microparticle in a string-like, straight chain-like, linear, or flake-like shape.

{Claim 3}

The composite conductive material according to claim 2, wherein the microparticle has an aspect ratio of 5 or more.

{Claim 4}

The composite conductive material according to claim 1 or 2, wherein a weight ratio of the graphite-based carbon material to the conductive material is 1/50 or more and less than 10.

{Claim 5}

The composite conductive material according to claim 1, wherein the base material is an active material for a battery.

{Claim 6}

The composite conductive material according to claim 5, wherein the active material is a positive electrode active material.

{Claim 7}

The composite conductive material according to claim 1, wherein the base material is a polymer.

{Claim 8}

The composite conductive material according to claim 1, wherein the base material is a material that is annihilated by vaporization or the like.

{Claim 9}

A power storage device, such as a primary battery, a secondary battery, or a capacitor, comprising the composite conductive material according to claim 1.

{Claim 10}

A conductive dispersion, such as a conductive ink, a conductive paste, or a conductive slurry, comprising the composite conductive material according to claim 1.

{Claim 11}

A conductive device, such as a transparent electrode, a transparent conductive film, a conductive circuit, or a substrate, being coated or printed using the conductive dispersion according to claim 1.

{Claim 12}

A conductive composite for use in preventing electrification and static electricity, intercepting electromagnetic waves, or the like, comprising the composite conductive material according to claim 1.

{Claim 13}

A thermal conductive composite, such as a heat sink or a heat radiation grease, comprising the composite conductive material according to claim 1.

{CLAIMS}

{Claim 1}

A composite conductive material comprising at least graphene-like graphite exfoliated from a graphite-based carbon material and a conductive material dispersed in a base material,

the graphite-based carbon material having a rhombohedral graphite layer and a hexagonal graphite layer, wherein a Rate of the rhombohedral graphite layer and the hexagonal graphite layer, based on an X-ray diffraction method, which is defined by following Equation 1, is 31% or more:

$$Rate = P3/(P3+P4)\times 100 \cdots\cdots \text{(Equation 1)}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer based on the X-ray diffraction method,

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer based on the X-ray diffraction method

the graphene-like graphite being a mixed material containing the graphite-based carbon material to graphene, produced by exfoliating a part or whole of the graphite-based carbon material, and

the graphene being a crystal of a mean size of 100 nm or more and formed in a flake-like or sheet-like shape having 10 layers or less.

{Claim 2}

The composite conductive material according to claim 1, wherein the conductive material is a microparticle in a string-like, straight chain-like, linear, or flake-like shape.

{Claim 3}

The composite conductive material according to claim 2, wherein the microparticle has an aspect ratio of 5 or more.

{Claim 4}

The composite conductive material according to claim 1 or 2, wherein a weight ratio of the graphite-based carbon material to the conductive material is 1/50 or more and less than 10.

{Claim 5}

The composite conductive material according to claim 1, wherein the base material is an active material for a battery.

{Claim 6}

The composite conductive material according to claim 5, wherein the active material is a positive electrode active material.

{Claim 7}

The composite conductive material according to claim 1, wherein the base material is a polymer.

{Claim 8}

The composite conductive material according to claim 1, wherein the base material is a material that is annihilated when in use by combustion, oxidation, vaporization or evaporation.

{Claim 9}

A power storage device according to claim 1.

{Claim 10}

A conductive dispersion according to claim 1.

{Claim 11}

A conductive device, such as a transparent electrode, a transparent conductive film, a conductive circuit, or a substrate, being coated or printed using the conductive dispersion according to claim 10.

{Claim 12}

A conductive composite according to claim 1.

{Claim 13}

A thermal conductive composite according to claim 1.

{Claim 14}

A method of producing a composite conductive material, comprising a step of kneading at least a graphite-based carbon material and a conductive material into a base material,

the graphite-based carbon material having a rhombohedral graphite layer and a hexagonal graphite layer, wherein a Rate of the rhombohedral graphite layer and the hexagonal graphite layer, based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$Rate = P3/(P3+P4)\times 100 \cdots \text{Equation 1}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer based on the X-ray diffraction method.

{Claim 15}

The method of producing the composite conductive material according to claim 14, wherein the conductive material is a microparticle in a string-like, straight chain-like, linear, or flake-like shape.

{Claim 16}

The method of producing the composite conductive material according to claim 15, wherein the microparticle has an aspect ratio of 5 or more.

{Claim 17}

The method of producing the composite conductive material according to claim 14 or 15, wherein a weight ratio of the graphite-based carbon material to the conductive material is 1/50 or more and less than 10.