MEANS TO SOLVE THE PROBLEM

(0036) The inventors of the present invention have made intensive study and as a result, have found a first ~~aspect~~ embodiment of the present invention such that a cluster of thin sheet graphite crystals which is composed of aggregation in such a state that thin sheet graphite crystals extend from the inside toward the outside (hereinafter also referred to simply as "a cluster of thin sheet graphite crystals of the present invention") can be produced by charging the powdery and/or particulate material of an organic compound pre-baked to an extent of containing remaining hydrogen (pre-baked starting material) in a closed vessel made of heat resistant material (for example, a vessel made of graphite) and subjecting the powdery and/or particulate material together with the vessel to hot isostatic pressing treatment (HIP treatment) under the predetermined conditions, and have found that such a cluster of thin sheet graphite crystals is useful as electrode materials for lithium ion batteries and hybrid capacitors and the method for production thereof is high in efficiency and productivity, and have completed the present invention.

(0037) Further, the inventors of the present invention have found a second ~~aspect~~ embodiment of the present invention such that a nano-silicon (Si) material (Si nano-wire and Si nano-rod in a fibrous form) of one-dimensional shape is produced at the same time as the production of the above-mentioned cluster of thin sheet graphite crystals by mixing a silicon powder to the pre-baked starting material, and subjecting the mixture together with the vessel to the HIP treatment by adjusting a maximum ultimate temperature in the HIP treatment to a

temperature (about 1320°C) being close to the melting point of Si or more, and have completed the present invention.

Furthermore, the inventors of the present invention have found a third ~~aspect~~ embodiment of the present invention such that thin sheet graphite crystals (for example, multiple-layer graphene having high crystallinity and a thickness of about 10 nm or less, especially multiple-layer graphene having a thickness of about 3.5 nm (about 10 layers) or less) and/or wrinkled and shrunk thin sheet graphite crystals and/or roll-shaped thin sheet graphite crystals that are suitable for preparing a transparent conductive film can be produced by pulverizing a mass of thin sheet graphite crystals composed of aggregates of thin sheet graphite crystals as a starting material, dispersing the pulverized resultant in a solvent, subjecting the dispersion to ultrasonic wave treatment and centrifuging, collecting a supernatant therefrom, and distilling off the solvent from the supernatant, and have completed the present invention.

In an aspect, the present disclosure provides a cluster of thin sheet graphite crystals composed of aggregates in such state that thin sheet graphite crystals extend from the inside toward the outside, wherein the thin sheet graphite crystals have a thickness of not more than 10 nm.

In another aspect, the present disclosure provides a cluster of graphite crystals obtained by partly cleaving the thin sheet graphite crystals of the cluster of thin sheet graphite crystals disclosed above.

In yet another aspect, the present disclosure provides a graphite-silicon composite material comprising a cluster of thin sheet graphite crystals composed of aggregates in such a state that thin

sheet graphite crystals extend from the inside toward the outside and a nano-silicon material of one-dimensional shape, wherein the thin sheet graphite crystals have a thickness of not more than 10 nm, and the nano-silicon material of one-dimensional shape is a vapor-phase-grown silicon in the form of fiber having a diameter of submicron size.

In still another aspect, the present disclosure provides thin sheet graphite crystals and/or wrinkled and shrunk graphite crystals thereof which are dispersed in a solvent and comprise multi-layer graphene having a thickness of not more than 10 nm.

In a further aspect, the present disclosure provides thin sheet graphite crystals and/or wrinkled and shrunk graphite crystals thereof which comprise multi-layer graphene having a thickness of not more than 10 nm.

(0038) Namely, the present invention relates to:

(1) a method for producing a cluster of thin sheet graphite crystals composed of aggregates in such a state that thin sheet graphite crystals extend from the inside toward the outside, comprising preparing a powdery and/or particulate material of an organic compound pre-baked to an extent of containing remaining hydrogen, charging the powdery and/or particulate material in a closed vessel made of heat resistant material, and subjecting the powdery and/or particulate material together with the vessel to hot isostatic pressing treatment using a compressed gas atmosphere, wherein a maximum ultimate temperature in the hot isostatic pressing treatment is 900°C

CLAIMS

1. A cluster of thin sheet graphite crystals composed of aggregates in such state that thin sheet graphite crystals extend from the inside toward the outside, wherein ~~thicknesses of~~ the thin sheet graphite crystals have a thickness of not more than ~~are~~ 10 nm ~~or less~~.

2. A cluster of graphite crystals obtained by partly cleaving the thin sheet graphite crystals of the cluster of thin sheet graphite crystals of claim 1.

3. A graphite-silicon composite material comprising a cluster of thin sheet graphite crystals composed of aggregates in such a state that thin sheet graphite crystals extend from the inside toward the outside and a nano-silicon material of one-dimensional shape, wherein ~~thicknesses of~~ the thin sheet graphite crystals have a thickness of not more than ~~are~~ 10 nm ~~or less~~, and the nano-silicon material of one-dimensional shape is a vapor-phase-grown silicon in the form of fiber having a diameter of submicron size.

4. Thin sheet graphite crystals and/or wrinkled and shrunk graphite crystals thereof which are dispersed in a solvent and comprise multi-layer graphene having a thickness of not more than 10 nm.

5. Thin sheet graphite crystals and/or wrinkled and shrunk graphite crystals thereof which comprise multi-layer graphene having a thickness of not more than 10 nm.