CLAIMS

1. A method for concentrating a valuable metal contained in a lithium ion secondary battery, for processing a lithium ion secondary battery or a positive electrode material of the lithium ion secondary battery, the lithium ion secondary battery or the positive electrode material containing manganese, and at least one element selected from the group consisting of cobalt and nickel, to concentrate a valuable metal containing either or both of cobalt and nickel, the method comprising:

performing a thermal treatment of heating the lithium ion secondary battery or the positive electrode material thereof to from 600°C through 1,200°C;

pulverizing and classifying a thermally treated product obtained in the thermal treatment;

performing a further thermal treatment of further heating a fine-grained product obtained in the pulverizing and classifying to from 700°C through 1,100°C, to transform either or both of cobalt and nickel in the oxides into metals while maintaining manganese unchanged from the form of oxide, and to form a granular aggregate containing at least one valuable metal selected from the group consisting of cobalt and nickel; and

wherein either or both of the thermal treatment and the further thermal treatment is performed in a reducing atmosphere.

2. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to claim 1,

wherein a negative electrode material of the lithium ion secondary battery contains carbon.

3. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to claim 1 or 2, comprising:

sorting and recovering a product in which either or both of cobalt and nickel

are concentrated, from a further thermally treated product obtained in the further thermal treatment.

4. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to claim 3,

wherein in the sorting, the product in which either or both of cobalt and nickel are concentrated and a product in which manganese is concentrated are recovered.

5. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to claim 3 or 4,

wherein in the sorting, separation utilizing difference in at least one of magnetic property, particle diameter, and specific gravity is performed.

6. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to any one of claims 1 to 5,

wherein in the thermal treatment, the lithium ion secondary battery is contained in a case containing aluminum, and aluminum derived from the case is separated during the heating.

7. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to any one of claims 1 to 6,

wherein in the pulverizing and classifying, pulverization by an impact, shearing, or compression is performed, and classification is performed using a sieve having a mesh size of from 0.1 mm through 2.4 mm.

8. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to any one of claims 1 to 7,

wherein in the further thermal treatment, a cumulative 50% volume-based particle diameter D_{50} of the granular aggregate containing at least one metal selected from the group consisting of cobalt and nickel is 1 μm or greater.

9. The method for concentrating a valuable metal contained in a lithium ion

secondary battery according to any one of claims 3 to 8,

wherein the sorting is magnetic sorting, and a magnetic flux density of a magnet in the magnetic sorting is 0.01 tesla or higher and 2 tesla or lower.

10. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to claim 9,

wherein the magnetic sorting is wet magnetic sorting, and a dispersant is added by 50 mg/L or greater to a slurry used in the wet magnetic sorting.

11. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to claim 10,

wherein the slurry used in the wet magnetic sorting is subjected to a particle dispersion treatment by ultrasonic waves.

12. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to any one of claims 1 to 11,

wherein in either or both of the thermal treatment and the further thermal treatment, a reducing component is added to form the reducing atmosphere.

13. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to any one of claims 1 to 12,

wherein in the thermal treatment or the further thermal treatment, the heating is performed in an air atmosphere or an oxidizing atmosphere for a part of a thermal treatment time, to reduce a grade of a reducing component in the thermally treated product or a further thermally treated product.

14. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to any one of claims 3 to 13,

wherein after the further thermal treatment and before the sorting, the thermally treated product is further pulverized.

15. The method for concentrating a valuable metal contained in a lithium ion secondary battery according to any one of claims 1 to 14,

wherein the fine-grained product obtained in the pulverizing and classifying is subjected to magnetic sorting using a magnetic force, and

magnetically attractable materials obtained in the magnetic sorting are subjected to the further thermal treatment.