Patent claims

1. Nickel mixed hydroxide with Ni as the main element and with a layer structure, comprising

   a) at least one element M_a from the group comprising Fe, Cr, Co, Ti, Zr and Cu which is present in two different oxidation states which differ by one electron in terms of the number of outer electrons;

   b) at least one element M_b from the group comprising B, Al, Ga, In and RE (rare earth metals, preferably Sc, Y or La) present in the trivalent oxidation state;

   c) optionally at least one element M_c from the group comprising Mg, Ca, Sr, Ba and Zn present in the divalent oxidation state;

   d) apart from the hydroxide, at least one additional anion from the group comprising halides (preferably fluoride or chloride), carbonate, sulfate, acetate, oxalate, borate and phosphate in a quantity sufficient to preserve the electroneutrality of the mixed hydroxide; and

   e) water of hydration in a quantity which stabilises the relevant structure of the mixed hydroxide.

2. Nickel mixed hydroxide according to claim 1, wherein the proportion of Ni is 60 to 92 mol %, preferably 65 to 85 mol %, more preferably 75 to 80 mol % and the total proportion of the elements M_a, M_b and M_c is 40 to 8 mol %, preferably 35 to 15 mol %, more preferably 25 to 20 mol %, in each case based on the total amount of Ni, M_a, M_b and M_c.

3. Nickel mixed hydroxide according to claim 1 and/or claim 2, wherein the proportion of the element M_a is 10 to 40 mol %, preferably 20 to 30 mol %, based on the total amount of the elements M_a, M_b and M_c.

4. Nickel mixed hydroxides according to at least one of claims 1 to 3, wherein the proportion of the element M_c is 1 to 30 mol %, based on the total amount of elements M_a, M_b and M_c.

5. Nickel mixed hydroxide according to at least one of claims 1 to 4, wherein the degree of oxidation α of the element M_a, defined according to the following formula (I), is from 0.01 to 0.99, preferably 0.1 to 0.9, more preferably 0.25 to 0.75:

$$\alpha = \frac{M_a^{+(x+1)}}{M_a^{+(x+1)} + M_a^{+x}} \qquad \text{(I)},$$

wherein $M_a^{+(x+1)}$ means the molar quantity of the element M_a in the higher oxidation state, and $M_a^{+(x)}$ the molar quantity of the element M_a in the lower oxidation state, and x is a number between 1 and 3.

6. Nickel mixed hydroxide according to at least one of claims 1 to 5 in the form of a powder with an average particle size from 1 to 100 µm.

7. Process for the preparation of the nickel mixed hydroxides according to any one of claims 1 to 6, comprising the reaction of the reaction components required to obtain the relevant mixed hydroxides in the form of water-soluble salts of Ni and of the elements M_a, M_b and optionally M_c in a basic, aqueous medium for the co-precipitation of hydroxide reaction products with the formation of a homogeneous suspension of said reaction products, wherein either water-soluble salts of the element M_a are used in different oxidation states or a water-soluble salt of the element M_a is used in the lower oxidation state and a partial oxidation is carried out until the desired ratio is obtained between the different oxidation states of the element M_a, or a water-soluble salt of the element M_a is used in the higher oxidation state and a partial reduction is carried out until the desired ratio is obtained between the different oxidation states of the element M_a, separation of the water from the suspension, and drying of the reaction products.

8. Process according to claim 7, wherein at least one of the reaction components is introduced into the aqueous medium by anodic oxidation of the corresponding metal.

9. Process according to claim 7 or 8, wherein the reaction is carried out at a pH from 8 to 13.

10. Process according to any one of claims 7 to 9, wherein partial oxidation is carried out by using oxygen, H_2O_2, hypochlorite, peroxodisulfates or percarbonates as oxidising agent.

11. Use of the nickel mixed hydroxides according to any one of claims 1 to 6 as cathode material in alkaline batteries.

Add A1