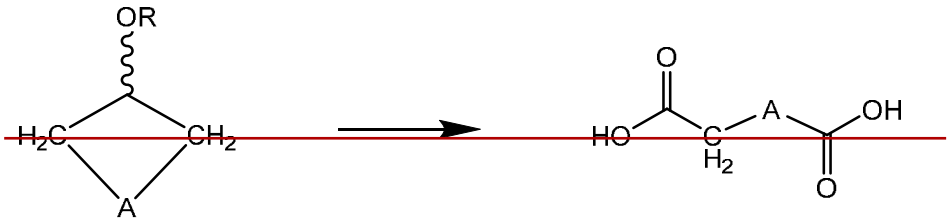
Claims:

1. Method for the electrochemical preparation of alkanedicarboxylic acids by ring-opening oxidation in aqueous alkaline solution, characterized in that the oxidation is carried out at a doped Ni(O)OH foam electrode, according to scheme (I)



Scheme (I)

where ~~~ represents a single or double bond, R accordingly being present or not,
where R is hydrogen or an acyl radical, wherein the acyl radical is the radical of an aliphatic monocarboxylic acid having 2 to 8 carbon atoms and
where A is a hydrocarbon having 4 to 30 carbon atoms, in which all ring carbon atoms of A in the cyclic reactant of scheme (I) bear at least one hydrogen substituent.

2. Method according to Claim 1, characterized in that the Ni(O)OH foam electrode is doped with non-metallic low-value main group elements, preferably elements of main group 5 and/or 6, more preferably selected from phosphorus, arsenic, selenium and sulfur.

3. Method according to Claim 1 or 2, characterized in that the Ni(O)OH foam electrode comprises 2 to 10% by weight phosphorus, preferably 3 to 9% by weight and more preferably 4 to 9% by weight, the phosphorus here being considered as an element and based on the metal mass of the electrode.

4. Method according to Claims 1 to 3, characterized in that the Ni(O)OH foam electrode is two or more millimetres thick, preferably more than 3 mm, more preferably more than 5 mm and especially preferably equal to or thicker than 6 mm.

5. Method according to at least one of Claims 1 to 4, characterized in that the Ni(O)OH foam electrode comprises nickel as metal preferably to an extent of at least 80% by weight, more preferably at least 90, 95, 98, 99% by weight, even more preferably at least 99.9, especially preferably at least 99.99% by weight.

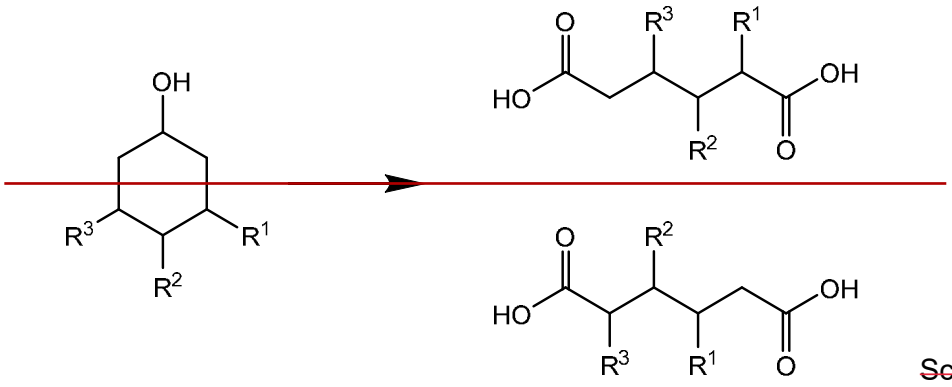
6. Method according to at least one of Claims 1 to 5, characterized in that aqueous solution signifies that up to 30% by volume of a cosolvent may be present in the solution.

7. Method according to at least one of Claims 1 to 6, characterized in that the alkaline additive to the aqueous solution is lithium hydroxide, sodium hydroxide or potassium hydroxide, preferably no further anions of bases being present.

8. Method according to at least one of Claims 1 to 7, characterized in that the concentration of the alkaline additive is preferably 0.5 to 2 mol/l, based on the aqueous alkaline solution, more preferably 0.8 to 1.5 mol/l and particularly preferably 1 mol/l with a possible deviation of up to 10%, preferably a deviation of up to 5% in the molarity.

9. Method according to at least one of Claims 1 to 8, characterized in that the concentration of the alkylcyclohexanols is 0.06 to 0.5 mol/l, preferably 0.08 to 0.3 and particularly preferably 0.09 to 0.11 mol/l.

10. Method according to at least one of Claims 1 to 9, characterized in that the method according to



Scheme (II)

is carried out,

where R^1, R^2, R^3 are the same or different, hydrogen or alkyl radicals having 1 to 8 carbon atoms, preferably 1 to 5 carbon atoms, linear or branched, in which at least one of the radicals R^1, R^2, R^3 is an alkyl radical,

wherein more preferably only one of the radicals R^1, R^2, R^3 is an alkyl radical having 1 to 4 carbon atoms and particularly preferably the radicals R^1 and R^3 are hydrogen and R^2 is an alkyl radical having 1 to 4 carbon atoms.

11. Method according to Claim 10, wherein the total amount of electrons applied is 8 to 10 F, more preferably 8.5 to 9 F.

12. Method according to at least one of Claims 1 to 10, characterized in that the method is carried out at a current density of 2 to 10 mA/cm^2, more preferably 2.5 to 7.5 mA/cm^2 and especially preferably 3.3 to 6 mA/cm^2, the area referring to the geometric area without consideration of the inner surface area of the foam.

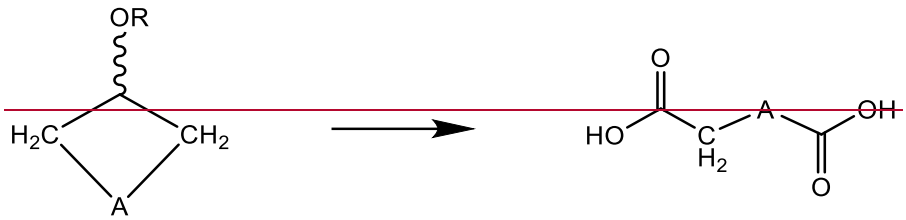
13. Method according to at least one of the preceding claims, characterized in that the electrolysis is carried out in a batch electrolytic cell or in a continuous flow electrolytic cell, preferably in a continuous flow electrolytic cell.

14. Method according to at least one of the preceding claims, characterized in that the cathode material used is stainless steel, platinum or nickel or a mixture.

15. Method according to at least one of the preceding claims, characterized in that the electrolysis is carried out at temperatures of 20 – 70°C, preferably 30 – 60°C, more preferably 35 – 50°C.

Claims:

1. Method for the electrochemical preparation of alkanedicarboxylic acids by ring-opening oxidation in aqueous alkaline solution, characterized in that the oxidation is carried out at an Ni(O)OH foam electrode doped with elements of main group 5 and/or 6, according to scheme (I)



Scheme (I)

where ~~~ represents a single or double bond, R accordingly being present or not,
where R is hydrogen or an acyl radical, wherein the acyl radical is the radical of an aliphatic monocarboxylic acid having 2 to 8 carbon atoms and
where A is a hydrocarbon having 4 to 30 carbon atoms, in which all ring carbon atoms of A in the cyclic reactant of scheme (I) bear at least one hydrogen substituent, characterized in that the Ni(O)OH foam electrode comprises 2 to 10% by weight phosphorus, the phosphorus here being considered as an element and based on the metal mass of the electrode.

2. Method according to Claim 1, characterized in that the Ni(O)OH foam electrode has a doping selected from phosphorus, arsenic, selenium and sulfur.

3. Method according to Claim 1 or 2, characterized in that the Ni(O)OH foam electrode comprises 3 to 9% by weight phosphorus, the phosphorus here being considered as an element and based on the metal mass of the electrode.

4. Method according to Claims 1 to 3, characterized in that the Ni(O)OH foam electrode is two or more millimetres thick, preferably more than 3 mm, more preferably more than 5 mm and especially preferably equal to or thicker than 6 mm.

5. Method according to at least one of Claims 1 to 4, characterized in that the Ni(O)OH foam electrode comprises nickel as metal preferably to an extent of at least 80% by weight.

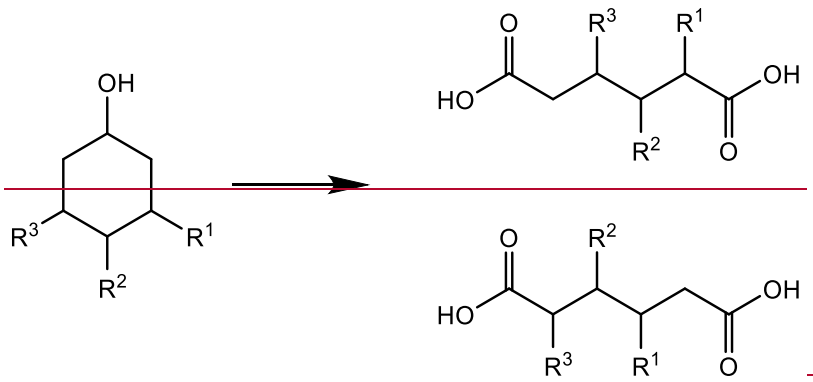
6. Method according to at least one of Claims 1 to 5, characterized in that the aqueous solution signifies that up to 30% by volume of a cosolvent may be present in the solution.

7. Method according to at least one of Claims 1 to 6, characterized in that the alkaline additive to the aqueous solution is lithium hydroxide, sodium hydroxide or potassium hydroxide, preferably no further anions of bases being present.

8. Method according to at least one of Claims 1 to 7, characterized in that the concentration of the alkaline additive is 0.5 to 2 mol/l, based on the aqueous alkaline solution, preferably 0.8 to 1.5 mol/l and particularly preferably 1 mol/l with a possible deviation of up to 10%, preferably a deviation of up to 5% in the molarity.

9. Method according to at least one of Claims 1 to 8, characterized in that the concentration of the cycloalkanols, where in scheme (I) R = hydrogen and ~~~~ is a single bond, is 0.06 to 0.5 mol/l, preferably 0.08 to 0.3 and particularly preferably 0.09 to 0.11 mol/l.

10. Method according to at least one of Claims 1 to 9, characterized in that the method according to



Scheme (II)

is carried out,

where R^1, R^2, R^3 are the same or different, hydrogen or alkyl radicals having 1 to 8 carbon atoms, preferably 1 to 5 carbon atoms, linear or branched, in which at least one of the radicals R^1, R^2, R^3 is an alkyl radical,

wherein more preferably only one of the radicals R^1, R^2, R^3 is an alkyl radical having 1 to 4 carbon atoms and particularly preferably the radicals R^1 and R^3 are hydrogen and R^2 is an alkyl radical having 1 to 4 carbon atoms.

11. Method according to at least one of Claims 1 to 10, characterized in that the method is carried out at a current density of 2 to 10 mA/cm^2, more preferably 2.5 to 7.5 mA/cm^2 and especially preferably 3.3 to 6 mA/cm^2, the area referring to the geometric area without consideration of the inner surface area of the foam.

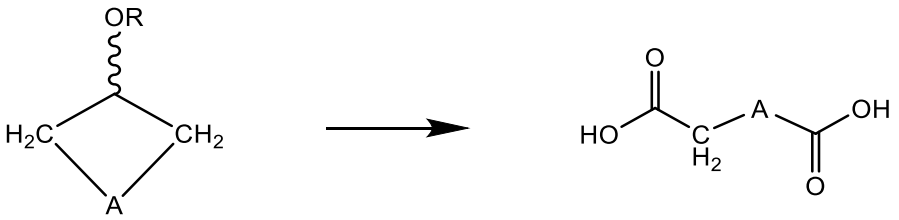
12. Method according to at least one of the preceding claims, characterized in that the electrolysis is carried out in a batch electrolytic cell or in a continuous flow electrolytic cell, preferably in a continuous flow electrolytic cell.

13. Method according to at least one of the preceding claims, characterized in that the cathode material used is stainless steel, platinum or nickel or a mixture.

14. Method according to at least one of the preceding claims, characterized in that the electrolysis is carried out at temperatures of 20 – 70°C, preferably 30 – 60°C, more preferably 35 – 50°C.

Claims:

1. Method for the electrochemical preparation of alkanedicarboxylic acids by ring-opening oxidation in aqueous alkaline solution, wherein the oxidation is carried out at an Ni(O)OH foam electrode doped with elements of main group 5 and/or 6, according to scheme (I)



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where ~~~ represents a single or double bond, R accordingly being present or not,
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where A is a hydrocarbon having 4 to 30 carbon atoms, in which all ring carbon atoms of A in the cyclic reactant of scheme (I) bear at least one hydrogen substituent, and wherein the Ni(O)OH foam electrode comprises 2 to 10% by weight phosphorus, the phosphorus here being considered as an element and based on the metal mass of the electrode.

2. Method according to Claim 1, wherein the Ni(O)OH foam electrode comprises 3 to 9% by weight phosphorus, the phosphorus here being considered as an element and based on the metal mass of the electrode.

3. Method according to Claims 1 to 2, wherein the Ni(O)OH foam electrode is two or more millimetres thick, preferably more than 3 mm, more preferably more than 5 mm and especially preferably equal to or thicker than 6 mm.

4. Method according to at least one of Claims 1 to 3, wherein the Ni(O)OH foam electrode comprises nickel as metal preferably to an extent of at least 80% by weight.

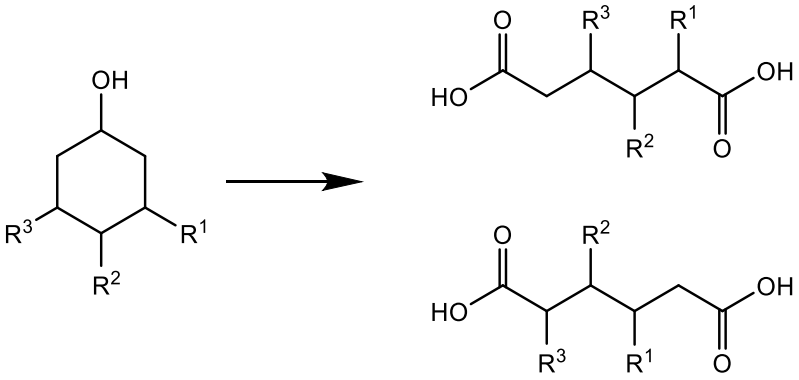
5. Method according to at least one of Claims 1 to 4, wherein the aqueous solution signifies that up to 30% by volume of a cosolvent may be present in the solution.

6. Method according to at least one of Claims 1 to 5, wherein the alkaline additive to the aqueous solution is lithium hydroxide, sodium hydroxide or potassium hydroxide, preferably no further anions of bases being present.

7. Method according to at least one of Claims 1 to 6, wherein the concentration of the alkaline additive is 0.5 to 2 mol/l, based on the aqueous alkaline solution, preferably 0.8 to 1.5 mol/l and particularly preferably 1 mol/l with a possible deviation of up to 10%, preferably a deviation of up to 5% in the molarity.

8. Method according to at least one of Claims 1 to 7, wherein the concentration of the cycloalkanols, where in scheme (I) R = hydrogen and ~~~ is a single bond, is 0.06 to 0.5 mol/l, preferably 0.08 to 0.3 and particularly preferably 0.09 to 0.11 mol/l.

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Scheme (II)

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having 1 to 4 carbon atoms and particularly preferably the radicals R^1 and R^3 are hydrogen and R^2 is an alkyl radical having 1 to 4 carbon atoms.

10. Method according to at least one of Claims 1 to 9, wherein the method is carried out at a current density of 2 to 10 mA/cm^2, more preferably 2.5 to 7.5 mA/cm^2 and especially preferably 3.3 to 6 mA/cm^2, the area referring to the geometric area without consideration of the inner surface area of the foam.

11. Method according to at least one of the preceding claims, wherein the electrolysis is carried out in a batch electrolytic cell or in a continuous flow electrolytic cell, preferably in a continuous flow electrolytic cell.

12. Method according to at least one of the preceding claims, wherein the cathode material used is stainless steel, platinum or nickel or a mixture.

13. Method according to at least one of the preceding claims, wherein the electrolysis is carried out at temperatures of 20 – 70°C, preferably 30 – 60°C, more preferably 35 – 50°C.