and wherein M is a metallic element selected from the group consisting of Y, Sm, Gd and Ca, when used for catalysing a methanation reaction.

[00024] In another embodiment, the present disclosure provides a catalyst, comprising between about 1% and about 40% by weight of the catalyst of metallic nickel disposed on a surface of a substrate, wherein said substrate has formula $Ce_{0.9}Gd_{0.1}O_2$, (i.e., x is 0.1), when used for catalysing a methanation reaction; wherein said substrate has a specific surface area of between about 10 and about 300 m^2/g; and wherein said substrate is particulate and the particles have a mean particle diameter of less than about 0.5 μm.

[00025] In another embodiment, the present disclosure provides a catalyst, comprising metallic nickel disposed on a substrate, wherein said substrate has formula $Ce_{1-x}Ca_xO_2$, wherein x is between about 0.01 and about 0.3, when used for catalysing a methanation reaction.

[00026] In another embodiment, the present disclosure provides a catalyst, comprising metallic nickel disposed on a substrate, wherein said substrate has formula $Ce_{1-x}Gd_xO_2$, wherein x is between about 0.01 and about 0.3, when used for catalysing a methanation reaction.

[00027] In another embodiment, the present disclosure provides a catalyst, comprising between about 1% and about 40% by weight of the catalyst of metallic nickel disposed on a surface of a substrate, wherein said substrate has formula $Ce_{0.9}Ca_{0.1}O_2$, (i.e., x is 0.1), when used for catalysing a methanation reaction; wherein said substrate has a specific surface area of between about 10 and about 300 m^2/g; and wherein said substrate is particulate and the particles have a mean particle diameter of less than about 0.5 μm.

[00028] In another embodiment, the present disclosure provides a catalyst, comprising between about 1% and about 40% by weight of the catalyst of metallic nickel disposed on a surface of a substrate, wherein said substrate has formula $Ce_{0.9}Sm_{0.1}O_2$, (i.e., x is 0.1), when used for catalysing a methanation reaction; wherein said substrate has a specific surface area of between about 10 and about 300 m^2/g; and wherein said substrate is particulate and the particles have a mean particle diameter of less than about 0.5 μm.

[00029] There is provided the use of a catalyst as defined above for catalysing a methanation reaction.

feedstock with a catalyst comprising metallic nickel disposed on a substrate, wherein said substrate has formula $Ce_{1-x}M_xO_2$, wherein x is between about 0.1 and about 0.3 and wherein M is a metallic element selected from the group consisting of a lanthanoid, a transition metal and an alkaline earth metal, wherein the feedstock includes coal gasification effluent or biomass gasification effluent and further includes a sulfur-containing gas or vapour at a concentration of about 0.1 to about 5000 ppm.

[00044] In another embodiment, the present disclosure provides a method for methanation of a feedstock including carbon monoxide and hydrogen, said method comprising contacting the feedstock with a catalyst comprising metallic nickel disposed on a substrate, wherein said substrate has formula $Ce_{0.9}M_{0.1}O_2$, (i.e., x is 0.1), and wherein M is a metallic element selected from the group consisting of Sm, Gd and Ca, wherein said substrate has a specific surface area of between about 10 and about 300 m^2/g; and wherein said substrate is particulate and the particles have a mean particle diameter of less than about 0.5 μm, wherein the feedstock includes coal gasification effluent or biomass gasification effluent and further includes a sulfur-containing gas or vapour at a concentration of about 0.1 to about 5000 ppm.

[00045] According to another embodiment of the disclosure, there is provided a method for reducing the carbon monoxide content of a gas mixture including carbon monoxide and hydrogen, said method comprising contacting the feedstock with a catalyst as defined above.

[00046] According to another embodiment, there is provided the use of a substrate of formula $Ce_{1-x}M_xO_2$, wherein x is between about 0 and about 0.3, optionally between about 0.01 and about 0.3, and wherein M, if present, is a metallic element other than Ce, for reducing poisoning of a catalytic element by a sulfur-containing gas or vapour.

[00046a] There is provided the use of a particulate substrate of general formula $Ce_{1-x}M_xO_2$, for reducing poisoning of a catalytic element by a sulfur-containing gas or vapour, said substrate comprising: Ce and at least one metallic element (M) selected from the group consisting of Y, Gd, Sm and alkaline earth metals, and wherein x is the total proportion of M and is between 0.01 and 0.3.

[00047] According to another embodiment, there is provided a method for reducing poisoning of a catalytic element by a sulfur-containing gas or vapour, said method comprising depositing said catalytic element on a substrate, wherein said substrate has formula $Ce_{1-x}M_xO_2$,

wherein x is between about 0 and about 0.3, optionally between about 0.01 and about 0.3, and wherein M, if present, is a metallic element other than Ce.

The following options may be used in conjunction with the above aspect either individually or in any suitable combination.

CLAIMS

1. A catalyst when used for catalysing a methanation reaction, said catalyst comprising: a catalytic element disposed on a substrate, wherein said substrate comprises Ce and at least one metallic element (M) selected from the group consisting of Y, Gd, Sm and alkaline earth metals; wherein said substrate has a general formula $Ce_{1-x}M_xO_2$, wherein x is the total proportion of M and is between 0.01 and 0.3, and wherein said substrate is particulate.

2. The catalyst of claim 1 when used for catalysing a methanation reaction, wherein the catalytic element is a transition metal.

3. The catalyst of claim 1 or claim 2 when used for catalysing a methanation reaction, wherein the catalytic element is selected from the group consisting of Co, Fe, Pt, Ru, Rh, Pd, Ni or Ir.

4. The catalyst of any one of claims 1 to 3 when used for catalysing a methanation reaction, wherein the catalytic element is metallic nickel.

5. The catalyst of any one of claims 1 to 4 when used for catalysing a methanation reaction, wherein x is between 0.01 and 0.25.

6. The catalyst of any one of claims 1 to 5 when used for catalysing a methanation reaction, wherein x is between 0.1 and 0.2.

7. The catalyst of any one of claims 1 to 6 when used for catalysing a methanation reaction, wherein the catalyst includes regions of metallic nickel dispersed on a surface of the substrate.

8. The catalyst of any one of claims 1 to 7 when used for catalysing a methanation reaction, wherein the catalyst includes between 1% and 40% of the catalytic element by weight.

9. The catalyst of any one of claims 1 to 8 when used for catalysing a methanation reaction, wherein the substrate has a specific surface area of between 10 and 300 m^2/g.

10. The catalyst as described in any one of claims 1 to 9, when used for catalysing a methanation reaction, wherein said methanation reaction reducing the carbon monoxide content of a gas mixture including carbon monoxide and hydrogen.

11. A method for methanation of a feedstock including carbon monoxide and hydrogen, said method comprising contacting the feedstock with a catalyst as described in any one of claims 1 to 9.

12. The method of claim 11 wherein the feedstock additionally includes carbon dioxide gas.

13. The method of claim 11 or 12 wherein the feedstock additionally includes steam.

14. The method of any one of claims 11 to 13 wherein the feedstock includes coal gasification effluent and/or biomass gasification effluent.

15. The method of any one of claims 11 to 14 wherein the feedstock additionally includes a sulfur-containing gas or vapour.

16. The method of claim 15 wherein the sulfur-containing gas or vapour is present at a concentration of 0.1 to 5000 ppm.

17. The method of claim 15 or 16 wherein the sulfur-containing gas or vapour includes any one or more of hydrogen sulfide, carbonyl sulfide, sulfur dioxide and an organic thiol.

18. The method of any one of claims 11 to 17 wherein the molar ratio of hydrogen to carbon monoxide in the feedstock is between 4:1 and 1:1.

19. The method of any one of claims 11 to 18 wherein contacting includes passing the feedstock through a packed bed reactor including the catalyst.

20. The method of any one of claims 11 to 19 wherein the feedstock has a pressure during said contacting of between abot 1 bar and 40 bar.

21. The method of any one of claims 11 to 20 wherein said contacting is conducted at a temperature of at least about 250 °C, or between 250 and 750 °C.

22. The method of any one of claims 11 to 21 wherein the feedstock has a gas hourly space velocity of between 1000 h^{-1} and 100 000 h^{-1}.

23. The method of any one of claims 11 to 22 wherein the temperature and feedstock gas hourly space velocity during said contacting are sufficient to achieve equilibrium conversion of carbon oxides to methane.