The weight ratio of the active material: the magnesium oxide support: the surfactant may be 0.01 to 40:59.6 to 99.5:0.04. In this range, the catalyst advantageously has high activity and long-lasting stability, and when the weight ratio is out of this range, a problem arises in that the activity of the catalyst readily decreases as the reaction progresses.

According to one preferred embodiment of the present invention, there is provided a nickel-molybdenum dry reforming catalyst in which nickel and molybdenum are impregnated on the surface of a magnesium oxide support and the nickel is surrounded by a surfactant, the catalyst having a nickel content of 0.01 to 100 wt% and a molybdenum content of 99.9 to 0 wt%. The nickel-molybdenum dry reforming catalyst according to the present invention is schematically shown in FIG. 3.

Furthermore, the catalyst according to the present invention may have a formula of $Ni_{10}Mo_2$@MgO.

A precursor of nickel in the method of preparing the nickel-molybdenum dry reforming catalyst of the present invention may be one or more selected from the group consisting of $NiCl_2$, $NiCl_2 \cdot 6H_2O$, $Ni(NO_3)_2$, $NiSO_4$, $(NH_4)_2Ni(SO_4)_2 \cdot 6H_2O$, $Ni(OCOCH_3)_2 \cdot 4H_2O$, $NiBr_2$, $NiCO_3$, NiF_2, NiI_2, $NiC_2O_4 \cdot 2H_2O$, and $Ni(ClO_4)_2 \cdot 6H_2O$, and a precursor of molybdenum may be one or more selected from the group consisting of $Mo(CO)_6$, MoO_3, Na_2MoO_4, $CaMoO_4$, $ZnMoO_4$, and $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$.

The prepared dry reforming catalyst may have a pore area of 0 to 5,000 m^2/g, preferably 10 to 3,000 m^2/g, and a conversion of 95 to 98%, and may be used for the dry reforming reaction of methane. Within the range of the pore area, the active metal may be supported. The larger the pore area, the more active material may be supported.

In still another aspect, the present invention is directed to a method for dry reforming of methane, comprising producing a synthetic gas composed of hydrogen

and carbon monoxide by reacting methane with carbon dioxide at 600 to 800°C in the presence of the dry reforming catalyst.

The method for dry reforming of the methane may be performed at a high pressure of 1 to 30 bar, preferably 1 to 20 bar, more preferably 1 to 16 bar.

EXAMPLES

Hereinafter, the present invention will be described in further detail with reference to examples. It will be obvious to a person having ordinary skill in the art that these examples are for illustrative purposes only and are not to be construed to limit the scope of the present invention.

Example 1: Preparation of $Ni_{10}Mo_2$@MgO Catalyst

Ethylene glycol (Samchun Chemicals), nickel chloride hydrate ($NiCl_26H_2O$, Samchun Chemicals), ammonium heptamolybdate tetrahydrate ($(NH_4)_6Mo_7O_{24}\cdot 4H_2O$, Samchun Chemicals) and polyvinylpyrrolidone (Sigma-Aldrich) were used. NaOH (Samchun Chemicals), hydrazine (Sigma Aldrich) and magnesium oxide were used as dry ice and magnesium metal.

First, 0.404 g of a nickel precursor and 36 mg of a molybdenum precursor were dissolved in 1 mL of water and 24 mL of ethylene glycol, and then 0.38 g of PVP was added thereto, followed by stirring. 0.9 g of magnesium oxide was added to the solution which was then stirred, after which the temperature of the solution was increased to 80°C. To the solution, a hydrazine solution (1.7 g of hydrazine/5 mL of ethylene glycol) was added, and when the solution changed color, a solution of 136 mg of NaOH in 10 mL of ethylene glycol was added. As the color of the solution gradually became black, nickel and molybdenum ions were reduced and impregnated on the surface of the magnesium oxide. After 1 hour of stirring, the solution was washed with water and dried, thereby obtaining a catalyst.

Example 2: Characterization of Reaction for Producing Synthetic Gas Using Catalyst

The synthesized catalyst was analyzed by TEM, and as a result, it was confirmed that nickel and molybdenum were distributed uniformly on the surface of the magnesium oxide and that the active material metal nickel was surrounded by the surfactant PVP.

FIG. 4 shows the results of measuring X-ray diffraction. As shown in FIG. 4, Ni and MgO were found. The concentration of Ni was relatively low, and thus the intensity of the peak was relatively weaker than that of MgO. Mo was not detected in the results of XRD due to its low concentration. To determine the exact metal contents, the elements contained in the catalyst were analyzed by ICP and elemental analysis. As a result, as shown in Table 1 below, it was confirmed that the content of nickel was 7.09% and the content of molybdenum was 1.55%. In addition, PVP used as the surfactant covered the surface of the active material, and thus the detected contents of carbon and nitrogen were 4.42% and 0.15%, respectively. To measure the porosity, the catalyst was adsorbed with liquid nitrogen at 77K, and the adsorbed quantity of the liquid nitrogen was measured. As a result, it was shown that the porosity of the catalyst was not high (20 m^2/g), but the activity of the catalyst was high (FIG. 5).

In order to examine the effect of temperature on the catalyst, 50 mg of the synthesized catalyst was placed in a quartz tube reactor, and the temperature-dependent activity of the catalyst was measured while changing the reaction temperature (FIG. 6). The operating temperature was 600 to 800°C. The composition of reactants was CO_2:CH_4:He = 1:1:8, and the flow rate was 50 mL/min. The weight hourly space velocity (WHSV) was 60 $L/g_{cat}h$. The conversion was measured by gas chromatography (Simadzu, GC Tracera). As shown in FIG. 6, the conversion increased

Claims:

1. A dry reforming catalyst in which an active material is impregnated on a surface of a metal oxide support and the active material is surrounded by a surfactant.

2. The dry reforming catalyst of claim 1, wherein the metal oxide is one or more selected from the group consisting of ZrO_2, MgO, TiO_2, Al_2O_3, SiO_2, CrO_2, Fe_2O_3, Fe_3O_4, CuO, ZnO, CaO, Sb_2O_4, Co_3O_4, Fe_3O_4, Pb_3O_4, Mn_3O_4, Ag_2O_2, U_3O_8, Cu_2O, Li_2O, Rb_2O, Ag_2O, Tl_2O, BeO, CdO, TiO, GeO_2, HfO_2, PbO_2, MnO_2, TeO_2, SnO_2, La_2O_3, Fe_2O_3, CeO_2, WO_2, UO_2, ThO_2, TeO_2 and MoO_3.

3. The dry reforming catalyst of claim 1, wherein the active material is one or more selected from the group consisting of nickel (Ni), cobalt (Co), ruthenium (Ru), palladium (Pd), iridium (Ir), platinum (Pt) and rhodium (Rh).

4. The dry reforming catalyst of claim 1, wherein the active material further comprises a promoter.

5. The dry reforming catalyst of claim 4, wherein the promoter is molybdenum (Mo).

6. The dry reforming catalyst of claim 1, wherein the dry reforming catalyst has a pore area of 0 to 5,000 m^2/g and a conversion of 95 to 98%.

7. The dry reforming catalyst of claim 1, wherein the catalyst is used for the dry reforming reaction of methane.

8. A nickel-molybdenum dry reforming catalyst in which nickel and molybdenum are impregnated on the surface of a magnesium oxide support and the nickel is surrounded by a surfactant, which comprises 0.01 to 100 wt% of the nickel and 99.9 to 0 wt% of the molybdenum.

9. The nickel-molybdenum dry reforming catalyst of claim 8, which has a formula of $Ni_{10}Mo_2$@MgO.

10. A method of preparing a dry reforming catalyst, comprising:

(a) obtaining a mixture by dissolving an active material precursor, a metal oxide support and a surfactant in a polyol solvent; and

(b) preparing a catalyst in which the active material is impregnated on the surface of the metal oxide support by adding a reducing agent to the mixture.

11. The method of preparing a dry reforming catalyst of claim 10, wherein the active material is one or more selected from the group consisting of nickel (Ni), cobalt (Co), ruthenium (Ru), palladium (Pd), iridium (Ir), platinum (Pt), rhodium (Rh), and molybdenum carbide (Mo_2C).

12. The method of preparing a dry reforming catalyst of claim 11, wherein the active material is nickel (Ni) and molybdenum (Mo).

13. The method of preparing a dry reforming catalyst of claim 12, wherein the weight ratio of nickel to molybdenum is 0.01 to 100: 99.9 to 0.

14. The method of preparing a dry reforming catalyst of claim 11, wherein a precursor of nickel is one or more selected from the group consisting of $NiCl_2$,

$NiCl_2 \cdot 6H_2O$, $Ni(NO_3)_2$, $NiSO_4$, $(NH_4)_2Ni(SO_4)_2 \cdot 6H_2O$, $Ni(OCOCH_3)_2 \cdot 4H_2O$, $NiBr_2$, $NiCO_3$, NiF_2, NiI_2, $NiC_2O_4 \cdot 2H_2O$, and $Ni(ClO_4)_2 \cdot 6H_2O$, and a precursor of molybdenum is one or more selected from the group consisting of $Mo(CO)_6$, MoO_3, Na_2MoO_4, $CaMoO_4$, $ZnMoO_4$, and $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$.

15. The method of preparing a dry reforming catalyst of claim 10, wherein the metal oxide is one or more selected from the group consisting of ZrO_2, MgO, TiO_2, Al_2O_3, SiO_2, CrO_2, Fe_2O_3, Fe_3O_4, CuO, ZnO, CaO, Sb_2O_4, Co_3O_4, Fe_3O_4, Pb_3O_4, Mn_3O_4, Ag_2O_2, U_3O_8, Cu_2O, Li_2O, Rb_2O, Ag_2O, Tl_2O, BeO, CdO, TiO, GeO_2, HfO_2, PbO_2, MnO_2, TeO_2, SnO_2, La_2O_3, Fe_2O_3, CeO_2, WO_2, UO_2, ThO_2, TeO_2 and MoO_3.

16. The method of preparing a dry reforming catalyst of claim 10, wherein the surfactant is one or more selected from the group consisting of polyvinylpyrrolidone (PVP), oleylamine, oleic acid, benzyl ether, trioctylphosphine, octadecylamine, hexadecylamine, cetyl trimethylammonium bromide (CTAB), polyethyleneglycol (PEG), 1,2-hexadecanediol and 1-octadecene.

17. The method of preparing a dry reforming catalyst of claim 10, wherein the reducing agent is one or more selected from the group consisting of hydrazine, $NaBH_4$, $LiAlH_4$, diisobutylaluminum hydride (DIBAL-H) and diborane.

18. The method of preparing a dry reforming catalyst of claim 10 wherein the weight ratio of the active material: the magnesium oxide support: the surfactant is 0.01 to 40:59.6 to 99.5:0.04.

19. A method of dry reforming methane, the method comprises producing a synthetic gas composed of hydrogen and carbon monoxide by reacting methane with

carbon dioxide at 600 to 800°C in the presence of the dry reforming catalyst of any one of claims 1 to 9.

20. The method of dry reforming methane of claim 19 wherein the method is performed at a pressure of 1 to 30 bar.