CLAIMS

1. A catalyst, comprising:

a single metal oxide on a catalyst support, and

a trace amount of a secondary metal oxide on the catalyst support, wherein the secondary metal oxide forms metal clusters with the single metal oxide.

2. The catalyst according to claim 1, wherein the catalyst support is loaded with between 5 percent by weight (wt%) and 15 wt% of the single metal oxide.

3. The catalyst according to claim 1 or 2, wherein a molar ratio of the single metal oxide to the secondary metal oxide is between 50 and 1050.

4. The catalyst according to claim 3, wherein the molar ratio of the single metal oxide to the secondary metal oxide is between 105 and 210.

5. The catalyst according to any one of the preceding claims, wherein the catalyst support is one of alumina ($Al_2O_3$), silica ($SiO_2$) and $Al_2O_3MgO$.

6. A catalyst synthesis method, comprising:

dissolving a single metal precursor in deionised water to form a precursor-containing solution;

adding a trace amount of a secondary metal precursor to the precursor-containing solution;

mixing a catalyst support into the precursor-containing solution to impregnate the catalyst support with the precursor-containing solution;

drying the impregnated catalyst support; and

calcining the dried impregnated catalyst support to form a supported single metal oxide catalyst with a trace amount of a secondary metal oxide, wherein the secondary metal oxide forms metal clusters with the single metal oxide.

7. The catalyst synthesis method according to claim 6, wherein the single metal precursor is one of iron (III) nitrate nonahydrate, iron chloride, iron carbonate, iron acetate, nickel chloride, nickel carbonate, nickel acetate and nickel (II) nitrate hexahydrate.

8. The catalyst synthesis method according to claim 6 or 7, wherein the catalyst support is one of alumina ($Al_2O_3$), silica ($SiO_2$) and $Al_2O_3MgO$.

9. The catalyst synthesis method according to any one of claims 6 to 8, wherein the secondary metal precursor is one of nickel (II) nitrate hexahydrate, nickel chloride, nickel carbonate and nickel acetate.

10. The catalyst synthesis method according to any one of claims 6 to 9, wherein a molar ratio of metal content in the single metal precursor to the secondary metal precursor is between 50 and 1050.

11. The catalyst synthesis method according to claim 10, wherein the molar ratio of the metal content in the single metal precursor to the secondary metal precursor is between 105 and 210.

12. The catalyst synthesis method according to any one of claims 6 to 11, wherein the dried impregnated catalyst support is calcined at a temperature of between 200 degrees Celsius (°C) and 800 °C.

13. The catalyst synthesis method according to claim 12, wherein the dried impregnated catalyst support is calcined at 500 °C.

14. A catalytic plastic conversion method, comprising:
providing the catalyst of any one of claims 1 to 7;
providing a quantity of plastic; and
performing catalytic-pyrolysis of the plastic using the catalyst.

15. The catalytic plastic conversion method according to claim 14, further comprising reducing the catalyst before performing catalytic-pyrolysis of the plastic using the reduced catalyst.

16. The catalytic plastic conversion method according to claim 15, wherein the catalyst is reduced at a temperature of between 600 °C and 800 °C.

17. The catalytic plastic conversion method according to claim 15 or 16, wherein the catalyst is reduced for a period of between 10 minutes (min) and 30 min.

18. The catalytic plastic conversion method according to any one of claims 14 to 17, wherein catalytic-pyrolysis of the plastic is performed at a temperature of less than 700 °C.

19. The catalytic plastic conversion method according to claim 18, wherein the temperature at which catalytic-pyrolysis of the plastic is performed is between 450 °C and 600 °C.

20. The catalytic plastic conversion method according to any one of claims 14 to 19, wherein catalytic-pyrolysis of the plastic is performed at a ramp rate of between 30 degrees Celsius per minute (°C/min) and 60 °C/min.

21. The catalytic plastic conversion method according to any one of claims 14 to 20, wherein catalytic-pyrolysis of the plastic is performed at ambient pressure.

22. The catalytic plastic conversion method according to any one of claims 14 to 21, wherein catalytic-pyrolysis of the plastic is performed for a period of between 5 min and 10 min.

23. The catalytic plastic conversion method according to any one of claims 14 to 22, wherein the plastic comprises one or more of polyethylene (PE), polyethylene terephthalate (PET), polystyrene (PS), household plastic waste and polypropylene (PP).

24. The catalytic plastic conversion method according to any one of claims 14 to 23, further comprising generating a plurality of carbon nanotubes from catalytic-pyrolysis of the plastic.

25. The catalytic plastic conversion method according to claim 24, wherein a yield of the carbon nanotubes from catalytic-pyrolysis of the plastic is between 28 percent by mass (wt%) and 84 wt% of carbon content in the plastic.

26. The catalytic plastic conversion method according to claim 25, wherein the yield of the carbon nanotubes from catalytic-pyrolysis of the plastic is between 70 wt% and 75 wt% of carbon content in the plastic.

27. The catalytic plastic conversion method according to any one of claims 24 to 26, further comprising generating hydrogen gas from catalytic-pyrolysis of the plastic.

28. The catalytic plastic conversion method according to claim 27, further comprising generating methane gas from catalytic-pyrolysis of the plastic.

29. The catalytic plastic conversion method according to claim 28, wherein the hydrogen gas comprises between 77 percent by volume (vol%) and 88 vol% of a gas stream from catalytic-pyrolysis of the plastic.

30. The catalytic plastic conversion method according to claim 29, wherein the methane gas comprises between 6 vol% and 18 vol% of the gas stream from catalytic-pyrolysis of the plastic.

31. The catalytic plastic conversion method according to any one of claims 14 to 23, further comprising introducing carbon dioxide ($CO_2$) when the plastic starts to decompose.

32. The catalytic plastic conversion method according to claim 31, further comprising generating synthesis gas from $CO_2$ reforming of the plastic.

33. The catalytic plastic conversion method according to claim 32, wherein the synthesis gas comprises between 27 vol% and 85 vol% of hydrogen gas.

34. The catalytic plastic conversion method according to claim 33, wherein the synthesis gas comprises between 80 vol% and 85 vol% of hydrogen gas.

35. The catalytic plastic conversion method according to claim 33 or 34, wherein the synthesis gas comprises between 10 vol% and 18 vol% of carbon monoxide gas.

36. The catalytic plastic conversion method according to claim 35, wherein the synthesis gas comprises between 10 vol% and 15 vol% of carbon monoxide gas.