CLAIMS:

1. A catalyst comprising at least one agglomerate of crystallites comprising cerium oxide interdispersed in titanium dioxide, and at least one island comprising cerium oxide on a surface of the titanium dioxide.

2. The catalyst of claim 1, wherein the titanium dioxide is anatase titanium dioxide.

3. The catalyst of claim 1, wherein the at least one agglomerate of crystallites and the at least one island are in a mixture on the surface of the titanium dioxide.

4. The catalyst of claim 1, wherein the at least one agglomerate of crystallites and the at least one island are distinct and do not overlap on the surface of the titanium dioxide.

5. The catalyst of claim 1, wherein the titanium dioxide is in the form of at least one aggregate of anatase crystallites, wherein the anatase crystallites are from 2 to 50 nm in diameter, and the at least one aggregate is from 25 to 150 nm in diameter.

6. The catalyst of claim 5, wherein the anatase crystallites are from 8 to 20 nm in diameter.

7. The catalyst of claim 5, wherein the at least one aggregate of anatase crystallites is from 50 to 100 nm in diameter.

8. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide is colloidal cerium oxide.

9. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide comprises crystallites of between 3 to 15 nm in diameter.

10. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide comprises cerium oxide crystallites of between 5 and 10 nm in diameter.

11. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide comprises at least one cerium oxide polycrystalline structure.

12. The catalyst of claim 1, wherein the at least one island comprising cerium oxide on a surface of the titanium dioxide comprises non-colloidal cerium oxide.

13. The catalyst of claim 12, wherein the source of non-colloidal cerium oxide is a soluble Ce salt.

14. The catalyst of claim 1, wherein the at least one island comprising cerium oxide dispersed on a surface of the titanium dioxide is less than 20 nm in diameter.

15. The catalyst of claim 1, wherein the at least one island comprising cerium oxide dispersed on a surface of the titanium dioxide is 3 nm thick or less.

16. The catalyst of claim 1, wherein the at least one island comprising cerium oxide dispersed on a surface of the titanium dioxide comprises a cerium oxide lattice.

17. The catalyst of claim 1, wherein the titanium dioxide further comprises at least one component selected from the group consisting of alumina, phosphorous, lanthanum, zirconium, silica, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

18. The catalyst of claim 17, wherein the component is a promoter.

19. The catalyst of claim 1, wherein the at least one agglomerate of crystallites further comprises at least one component selected from the group consisting of alumina, phosphorous, lanthanum, zirconium, silica, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

20. The catalyst of claim 1, wherein the at least one island further comprises at least one component selected from the group consisting of alumina, phosphorous, lanthanum, zirconium, silica, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

21. The catalyst of claim 1, wherein the catalyst is hydrothermally treated.

22. A method of producing a catalyst, comprising adding a first portion of cerium oxide to titanium dioxide, and subsequently adding a second portion of cerium oxide to the titanium dioxide.

23. The method of claim 22, wherein the titanium dioxide is anatase titanium dioxide.

24. The method of claim 22, wherein the first portion of cerium oxide is colloidal cerium oxide, and the second portion of cerium oxide is a soluble source of Ce.

25. The method of claim 22, wherein the first portion of the cerium oxide forms an agglomerate of cerium oxide crystallites interdispersed in the titanium dioxide, and the second portion of the cerium oxide forms at least one island on a surface of the titanium dioxide.

26. The method of claim 25, wherein the at least one agglomerate of crystallites and the at least one island are in a mixture on the surface of the titanium dioxide.

27. The method of claim 25, wherein the at least one agglomerate of crystallites and the at least one island are distinct and do not overlap on the surface of the titanium dioxide.

28. The method of claim 22, wherein the titanium dioxide further comprises at least one component selected from the group consisting of alumina, phosphorous, lanthanum, zirconium, silica, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

29. The method of claim 22, wherein the component is a promoter.

30. The method of claim 25, wherein the at least one agglomerate of crystallites further comprises at least one component selected from the group consisting of alumina, phosphorous, lanthanum, zirconium, silica, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

31. The method of claim 25, wherein the at least one island further comprises at least one component selected from the group consisting of alumina, phosphorous, lanthanum, zirconium, silica, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

32. A process of selectively reducing NOx levels in an exhaust gas comprising contacting the exhaust gas comprising NOx with a catalyst according to claim 1 in the presence of a reducing agent.

33. The process of claim 32, wherein the reducing agent is at least one selected from the group consisting of ammonia, urea and a hydrocarbon.

34. A formed SCR catalyst taking the shape of a pellet, cylinder, sphere, or monolith incorporating the catalyst of claim 1.

35. A promoted TiO2 support comprising titanium dioxide and at least one promoter selected from the group consisting of alumina, phosphorous, lanthanum, zirconium, silica, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

36. The promoted TiO2 support of claim 35, wherein the titanium dioxide is anatase titanium dioxide.

37. The promoted TiO2 support of claim 35, further comprising cerium oxide deposited thereon.

38. The promoted TiO2 support of claim 35, comprising at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide, and at least one island comprising cerium oxide on a surface of the titanium dioxide.

39. A method of forming colloidal CeO_2 comprising dissolving a cerium salt in water then slowly raising the pH to above 1.5 until a precipitate begins to form, then re-acidifying with nitric acid to pH 1.5.

40. The method of claim 39, wherein the cerium salt is dissolved in water until the pH is raised above 2.

The invention claimed is:

1. A catalyst comprising at least one agglomerate of crystallites comprising cerium oxide interdispersed in titanium dioxide, and at least one island comprising cerium oxide on a surface of the titanium dioxide.

2. The catalyst of claim 1, wherein the titanium dioxide is anatase titanium dioxide.

3. The catalyst of claim 1, wherein the at least one agglomerate of crystallites and the at least one island are in a mixture on the surface of the titanium dioxide.

4. The catalyst of claim 1, wherein the at least one agglomerate of crystallites and the at least one island are distinct and do not overlap on the surface of the titanium dioxide.

5. The catalyst of claim 1, wherein the titanium dioxide is in the form of at least one aggregate of anatase crystallites, wherein the anatase crystallites are from 2 to 50 nm in diameter, and the at least one aggregate is from 25 to 150 nm in diameter.

6. The catalyst of claim 5, wherein the anatase crystallites are from 8 to 20 nm in diameter.

7. The catalyst of claim 5, wherein the at least one aggregate of anatase crystallites is from 50 to 100 nm in diameter.

8. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide is colloidal cerium oxide.

9. A method of forming the catalyst of claim 8 wherein the colloidal cerium oxide is formed by a process comprising dissolving a cerium salt in water then slowly raising the pH to above 1.5 until a precipitate begins to form, then re-acidifying with nitric acid to pH 1.5.

10. The method of claim 9, wherein the cerium salt is dissolved in water until the pH is raised above 2.

11. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide comprises crystallites of between 3 to 15 nm in diameter.

12. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide comprises cerium oxide crystallites of between 5 and 10 nm in diameter.

13. The catalyst of claim 1, wherein the at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide comprises at least one cerium oxide polycrystalline structure.

14. The catalyst of claim 1, wherein the at least one island comprising cerium oxide on a surface of the titanium dioxide comprises non-colloidal cerium oxide.

15. The catalyst of claim 14, wherein the source of non-colloidal cerium oxide is a soluble Ce salt.

16. The catalyst of claim 1, wherein the at least one island comprising cerium oxide dispersed on a surface of the titanium dioxide is less than 20 nm in diameter.

17. The catalyst of claim 1, wherein the at least one island comprising cerium oxide dispersed on a surface of the titanium dioxide is 3 nm thick or less.

18. The catalyst of claim 1, wherein the at least one island comprising cerium oxide dispersed on a surface of the titanium dioxide comprises a cerium oxide lattice.

19. The catalyst of claim 1, wherein the titanium dioxide further comprises at least one component selected from the group consisting aluminum, phosphorus, lanthanum, zirconium, silicon, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

20. The catalyst of claim 19, wherein the component is a promoter.

21. The catalyst of claim 1, wherein the at least one agglomerate of crystallites further comprises at least one component selected from the group consisting of aluminum, phosphorus, lanthanum, zirconium, silicon, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

22. The catalyst of claim 1, wherein the at least one island further comprises at least one component selected from the group consisting of aluminum, phosphorus, lanthanum, zirconium, silicon, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

23. The catalyst of claim 1, wherein the catalyst is hydrothermally treated.

24. A formed SCR catalyst having a shape of a pellet, cylinder, sphere, or monolith comprising the catalyst of claim 1.

25. A promoted TiO_2 support comprising titanium dioxide; at least one agglomerate of crystallites comprising cerium oxide interdispersed in the titanium dioxide; at least one island comprising cerium oxide on a surface of the titanium dioxide; and at least one promoter selected from the group consisting of aluminum, phosphorus, lanthanum, zirconium, silicon, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

26. The promoted TiO_2 support of claim 25, wherein the titanium dioxide is anatase titanium dioxide.

27. The promoted TiO_2 support of claim 25, further comprising cerium oxide deposited thereon.

28. A method of producing the catalyst of claim 1, comprising adding a first portion of cerium oxide to titanium dioxide, and subsequently adding a second portion of cerium oxide to the titanium dioxide.

29. The method of claim 28, wherein the titanium dioxide is anatase titanium dioxide.

30. The method of claim 28, wherein the first portion of cerium oxide is colloidal cerium oxide, and the second portion of cerium oxide is a soluble source of Ce.

31. The method of claim 28, wherein the first portion of the cerium oxide forms an agglomerate of cerium oxide crystallites interdispersed in the titanium dioxide, and the second portion of the cerium oxide forms at least one island on a surface of the titanium dioxide.

32. The method of claim 31, wherein the at least one agglomerate of crystallites and the at least one

island are in a mixture on the surface of the titanium dioxide.

33. The method of claim 31, wherein the at least one agglomerate of crystallites and the at least one island are distinct and do not overlap on the surface of the titanium dioxide.

34. The method of claim 31, wherein the at least one agglomerate of crystallites further comprises at least one component selected from the group consisting of aluminum, phosphorus, lanthanum, zirconium, silicon, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

35. The method of claim 31, wherein the at least one island further comprises at least one component selected from the group consisting of aluminum, phosphorus, lanthanum, zirconium, silicon, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

36. The method of claim 28, wherein the titanium dioxide further comprises at least one component selected from the group consisting of aluminum, phosphorus, lanthanum, zirconium, silicon, niobium, strontium, boron, tungsten, molybdenum, manganese, cobalt, chromium, silver, bismuth, copper, europium, tin, zinc, praseodymium, antimony, iron, and oxides thereof.

37. The method of claim 28, wherein the component is a promoter.

38. A process of selectively reducing NOx levels in an exhaust gas comprising contacting the exhaust gas comprising NOx with a catalyst according to claim 1 in the presence of a reducing agent.

39. The process of claim 38, wherein the reducing agent is at least one selected from the group consisting of ammonia, urea and a hydrocarbon.