CLAIMS

1. A hydrogenation catalyst comprising:

copper oxide;

an alkali metal;

an acid-stabilized silica; and

manganese oxide

wherein:

the hydrogenation catalyst has a Brunauer-Emmett-Teller surface area of greater than or equal to 15 m^2/g, and

wherein the copper oxide is present in an amount from 70.0 wt.% to 80.0 wt.% by weight of the hydrogenation catalyst, and

wherein the acid-stabilized silica is formed from an acid-stabilized silica solution having a pH of less than 3.5, and

wherein the hydrogenation catalyst has less than 1.5 wt.% chromium or an oxide thereof, based on the total weight of the catalyst.

2. The hydrogenation catalyst of claim 1, wherein the Brunauer-Emmett-Teller surface area is from 15 m^2/g to 70 m^2/g.

3. The hydrogenation catalyst of any one of claims 1-2, wherein the copper oxide is present in an amount from about 70.0 wt% to about 75.0 wt% by weight of the hydrogenation catalyst.

4. The hydrogenation catalyst of any one of claims 1-3, wherein the alkali metal component comprises sodium.

5. The hydrogenation catalyst of any one of claims 1-4, wherein the alkali metal component is present in an amount from 0.01 wt.% to 8.0 wt.% by weight of the hydrogenation catalyst.

6. The hydrogenation catalyst of any one of claims 1-5 further comprising from 1.0 wt.% to 18.0 wt.% of calcium oxide by weight of the hydrogenation catalyst.

7. The hydrogenation catalyst of according to claim 1, wherein the manganese oxide is present in an amount from 0.01 wt.% to 5.0 wt.% by weight of the hydrogenation catalyst.

8. The hydrogenation catalyst of any one of claims 1-7, wherein the acid-stabilized silica is present in an amount from 5.0 wt.% to 20.0 wt.% by weight of the hydrogenation catalyst.

9. The hydrogenation catalyst of any one of claims 1-8, wherein the hydrogenation catalyst is a calcined and extruded hydrogenation catalyst.

10. The hydrogenation catalyst of any one of claims 1-9, wherein the hydrogenation catalyst material exhibits a pore volume ≥ 0.25 cm^3/g.

11. The hydrogenation catalyst of any one of claims 1-10, wherein the hydrogenation catalyst exhibits a packed bulk density of 0.8 g/cm^3 to 1.5 g/cm^3.

12. A method of preparing a calcined hydrogenation catalyst, the method comprising:

mixing a copper oxide and a clay material to obtain a dry material mixture;

combining the dry material mixture with an aqueous acid-stabilized silica solution, an alkali metal hydroxide, manganese oxide and water to obtain a wet material mixture; and

calcining the wet material mixture at a temperature, and for a time, sufficient to cure form a calcined hydrogenation catalyst;

wherein:

the calcined hydrogenation catalyst has a Brunauer-Emmett-Teller surface area of greater than or equal to 15 m^2/g; and

wherein the copper oxide is present in an amount from 70.0 wt.% to 80.0 wt.% by weight of the calcined hydrogenation catalyst; and

wherein the hydrogenation catalyst has less than 1.5 wt.% chromium or an oxide thereof, based on the total weight of the calcined hydrogenation catalyst;

the acid-stabilized silica solution has a pH of less than about 3.5.

13. A method of hydrogenating a ketone or aldehyde, the method comprising contacting the ketone or aldehyde with a hydrogenation catalyst according to any of the claims 1-11.

14. A method of synthesizing butanediol, the method comprising:
contacting a stream of dimethyl maleate with a hydrogenation catalyst according to any of the claims 1-11.

15. A method of hydrogenating an ester, the method comprising contacting the ester with a hydrogenation catalyst according to any of the claims 1-11.