CLAIMS

1. A method of synthesizing a metathesis and isomerization catalyst, the method comprising:

forming a catalyst precursor mixture comprising a diluent and a catalyst precursor, the catalyst precursor comprising an oxometallate precursor or a metal oxide precursor and at least one of an alumina precursor and a silica precursor, where the catalyst precursor mixture is absent a surfactant;

aerosolizing the catalyst precursor mixture;

drying the aerosolized catalyst precursor mixture to form a dried catalyst precursor, where drying the aerosolized catalyst precursor mixture comprises providing a flow of a carrier gas through the aerosolized catalyst precursor mixture and into a heated furnace to transport the aerosolized precursor into the heated furnace; and

thermally decomposing the dried catalyst precursor to yield the metathesis and isomerization catalyst, the metathesis and isomerization catalyst comprising a silica or silica and alumina support with an oxometallate or metal oxide distributed within the silica or silica and alumina support,

where the furnace is heated to between 500 and 1500 °C.

2. The method of claim 1 where the silica precursor comprises fumed silica.

3. The method of claim 1 where the catalyst precursor comprises the oxometallate precursor.

4. The method of claim 1 where the catalyst precursor comprises the metal oxide precursor.

5. The method of claim 1 where the alumina precursor comprises aluminum nitrate.

6. The method of claim 1 where the catalyst precursor comprises 0.1-99.9 wt. % silica precursor, 0.1-20 wt. % oxometallate precursor or metal oxide precursor, and 0.0-99.8 wt. % alumina precursor.

7. The method of claim 1 where the catalyst precursor mixture is aerosolized in a nebulizing unit.

8. The method of claim 1 where the carrier gas is air.

9. The method of claim 1 where the residence time in the heated furnace is between 0.1 and 60 seconds.

10. The method of claim 1 where the method further comprises collecting the metathesis catalyst and the isomerization catalyst with a filter from the flow of the carrier gas exiting the heated furnace.

11. The method of claim 1 where the catalyst precursor mixture comprises at least one of titania, ceria, rhenia, or a phosphate.

12. The method of claim 1 where the method further comprises aerosolizing a dopant stream concurrently with aerosolizing the catalyst precursor mixture.

13. The method of claim 1 where the metathesis and isomerization catalyst has a surface area of 100 to 700 m^2/g.

14. A method of synthesizing an isomerization catalyst, the method comprising:

forming a catalyst precursor mixture comprising a diluent and a catalyst precursor, the catalyst precursor comprising a silica precursor and an alumina precursor, where the catalyst precursor solution is absent a surfactant;

aerosolizing the catalyst precursor mixture;

drying the aerosolized catalyst precursor mixture to form a dried catalyst precursor, where drying the aerosolized catalyst precursor mixture comprises providing a flow of a carrier gas through the aerosolized catalyst precursor mixture and into a heated furnace to transport the aerosolized precursor into the heated furnace; and

thermally decomposing the dried catalyst precursor to yield the isomerization catalyst, the isomerization catalyst comprising a silica and alumina support,

where the furnace is heated to between 500 and 1500 °C.

15. A method of synthesizing a metathesis catalyst, the method comprising:

forming a catalyst precursor mixture comprising a diluent and a catalyst precursor, the catalyst precursor comprising an oxometallate precursor or a metal oxide precursor and at least one of an alumina precursor and a silica precursor, where the catalyst precursor mixture is absent a surfactant;

aerosolizing the catalyst precursor mixture;

drying the aerosolized catalyst precursor mixture to form a dried catalyst precursor, where drying the aerosolized catalyst precursor mixture comprises providing a flow of a carrier gas through the aerosolized catalyst precursor mixture and into a heated furnace to transport the aerosolized precursor into the heated furnace; and

thermally decomposing the dried catalyst precursor to yield the metathesis catalyst, the metathesis catalyst comprising a silica or silica and alumina support with an oxometallate or metal oxide distributed within the silica or silica and alumina support,

where the furnace is heated to between 500 and 1500 °C.