CLAIMS

1. A process for production of propylene comprising:

introducing a hydrocarbon stream comprising 2-butene to an isomerization catalyst zone to isomerize the 2-butene to 1-butene, where the isomerization catalyst zone comprises a silica-alumina catalyst with a ratio by weight of alumina to silica from 1:99 to 20:80;

passing the 2-butene and 1-butene to a metathesis catalyst zone to cross-metathesize the 2-butene and 1-butene into a metathesis product stream comprising propylene and C_4-C_6 olefins, where the metathesis catalyst comprises a mesoporous silica catalyst support impregnated with metal oxide; and

cracking the metathesis product stream in a catalyst cracking zone to produce propylene, where the catalyst cracking zone comprises a mordenite framework inverted (MFI) structured silica catalyst.

2. The process of claim 1 where the silica-alumina catalyst includes a surface area of 200 m^2/g to 600 m^2/g.

3. The process of claim 1 or 2 where the silica-alumina catalyst has a pore volume of at least 0.60 cm^3/g.

4. The process of any of claims 1 through 3 where the silica-alumina catalyst comprises an alumina to silica weight ratio between 1:99 and 10:90.

5. The process of any of claims 1 through 4 where the metal oxide of the mesoporous silica catalyst comprises one or more oxides of molybdenum, rhenium, tungsten, or combinations thereof.

6. The process of any of claims 1 through 5 where the metal oxide of the mesoporous silica catalyst is tungsten oxide (WO_3).

7. The process of any of claims 1 through 6 where the mesoporous silica has a pore volume of at least 0.60 cm^3/g.

8. The process of any of claims 1 through 7 where the MFI structured silica catalyst includes a total acidity of 0.001 mmol/g to 0.3 mmol/g.

9. A multiple-stage catalyst system for producing propylene from a hydrocarbon stream comprising 2-butene, the multiple-stage catalyst system comprising an isomerization catalyst zone, a metathesis catalyst zone downstream of the isomerization zone, and a cracking catalyst zone downstream of the metathesis catalyst zone where:

the isomerization catalyst zone comprises a silica-alumina catalyst with a ratio by weight of alumina to silica from 1:99 to 20:80, where the silica-alumina catalyst zone isomerizes the 2-butene to 1-butene;

the metathesis catalyst zone comprises a mesoporous silica catalyst support impregnated with metal oxide to form a mesoporous silica catalyst, where the mesoporous silica catalyst zone cross-metathesizes the 2-butene and 1-butene into a metathesis product stream comprising propylene and C_4-C_6 olefins; and

the cracking catalyst zone comprises a mordenite framework inverted (MFI) structured silica catalyst, where the cracking catalyst zone cracks the metathesis product stream to produce propylene.

10. The multiple-stage catalyst system of claim 9 where the isomerization catalyst zone, the metathesis catalyst zone, and the cracking catalyst zone are disposed in one reactor.

11. The multiple-stage catalyst system of claim 9 where the isomerization catalyst zone is disposed in a first reactor, the metathesis catalyst zone is disposed in a second reactor downstream of the first reactor, and the cracking catalyst zone is disposed in a third reactor downstream of the second reactor.

12. The multiple-stage catalyst system of claim 9 where the isomerization catalyst zone is disposed in a first reactor, the cracking catalyst zone is disposed in a second reactor downstream of the first reactor, and the metathesis catalyst zone is disposed in the first reactor downstream of the isomerization catalyst zone or in the second reactor upstream of the cracking catalyst zone.

13. The multiple-stage catalyst system of any of claims 9 through 12 where the silica-alumina catalyst comprises an alumina to silica weight ratio between 1:99 and 10:90.

14. The multiple-stage catalyst system of any of claims 9 through 13 where the metal oxide of the mesoporous silica catalyst comprises one or more oxides of molybdenum, rhenium, tungsten, or combinations thereof.

15. The multiple-stage catalyst system of any of claims 9 through 14 where the metal oxide of the mesoporous silica catalyst is tungsten oxide (WO_3).