CLAIMS

1. A process for producing propylene, the process comprising:

at least partially metathesizing butene in a metathesizing reaction zone comprising a metathesis catalyst to form a metathesis reaction product, the metathesis catalyst comprising a mesoporous silica-alumina catalyst support impregnated with metal oxide having a mesoporous silica-alumina catalyst support comprising from 5 weight percent to 50 weight percent alumina;

at least partially cracking the metathesis reaction product in a cracking reaction zone comprising a cracking catalyst to form a cracking reaction product, where the cracking catalyst comprises a MFI structured silica-containing catalyst and the cracking reaction product comprises propylene.

2. The process of claim 1 further comprising introducing a feed stream comprising the butene to the metathesizing reaction zone.

3. The process of claim 2 where the feed stream is a raffinate-2 stream from a fluidized catalytic cracking (FCC) reactor or an ethylene cracking reactor.

4. The process of either of claims 2 or 3 where the feed stream comprises:

from 20 wt. % to 60 wt. % of cis- or trans-2-butene, or both;

from 10 wt. % to 20 wt. % of 1-butene; and

from 5 wt. % to 20 wt. % n-butane.

5. The process of any of claims 1-4 where the mesoporous silica-alumina catalyst support of the mesoporous silica-alumina catalyst support impregnated with metal oxide comprises from 10 weight percent to 40 weight percent alumina.

6. The process any of claims 1-5 where the metal oxide of the combination catalyst support impregnated with metal oxide comprises one or more oxides of molybdenum, rhenium, tungsten, or combinations of these oxides.

7. The process of any of claims 1-6 where the mesoporous silica-alumina catalyst support impregnated with metal oxide comprises from 1 weight percent to 30 weight percent tungsten oxide.

8. The process of any of claims 1-7 where the mesoporous silica-alumina catalyst support impregnated with metal oxide includes a pore size distribution from 2.5 nm to 40 nm.

9. The process of any of claims 1-8 where the mesoporous silica-alumina catalyst support impregnated with metal oxide comprises a total pore volume of at least 0.600 cm^3/g.

10. The process of any of claims 1-9 where the cracking reaction zone is downstream of the metathesis reaction zone.

11. The process of any of claims 1-10 where the metathesis reaction zone and the cracking reaction zone are disposed within a single reactor.

12. The process of any of claims 1-11 where a volume ratio of the metathesis catalyst to the cracking catalyst is from 1:1 to 1:2.

13. The process of any of claims 1-12 where an acidity of the mesoporous silica-alumina catalyst support impregnated with metal oxide is from 0.001 mmol/g to 5 mmol/g.

14. A multiple-stage catalyst system for producing propylene from butene, the multiple-stage catalyst system comprising a metathesis reaction zone and a cracking reaction zone downstream of the metathesis reaction zone, where:

the metathesis reaction zone comprises a mesoporous silica-alumina catalyst support impregnated with metal oxide having a mesoporous silica-alumina catalyst support that comprises from 5 weight percent to 50 weight percent alumina; and

the cracking reaction zone comprises a MFI structured silica-containing catalyst, where the MFI structured silica-containing catalyst cracks a metathesis product stream to form a cracking product stream comprising propylene.

15. The multiple-stage catalyst system of claim 14 where the metathesis reaction zone and the cracking reaction zone are disposed within a single reactor.