CLAIMS

What is claimed is:

1. A process comprising the step of contacting under carbonylation conditions an alkene gas, carbon monoxide gas, an alkanol gas and a solid sulfide-based metal catalyst to produce an alkyl alkanoate.

2. A two-step process comprising:

A. Contacting under carbonylation conditions an alkene gas, carbon monoxide gas, an alkanol gas, and a solid, sulfide-based metal catalyst to produce an alkyl alkanoate; and

B. Contacting under condensation conditions the alkyl alkanoate of Step A with an aldehyde to produce an alkyl ester of an aliphatic carboxylic acid.

3. The process of Claim 1 or 2 in which the solid, sulfide-based metal catalyst comprises a Group VIII metal.

4. The process of Claim 3 in which the solid, sulfide-based metal catalyst comprises at least one of iron, cobalt, rhodium and nickel.

5. The process of any of the preceding claims in which the alkene gas is of the formula C_nH_{2n} in which n is from 2 to 12.

6. The process of any of the preceding claims in which the carbonylation conditions are halogen-free.

7. The process of any of the preceding claims in which the alkene gas is ethylene gas.

8. The process of any of the preceding claims in which the alkanol comprises 1-30 carbon atoms.

9. The process of any of the preceding claims in which the alkanol is methanol.

10. The process of any of the preceding claims in which the carbonylation conditions include a temperature from 200°C to 400°C and a pressure from 0.1 MPa to 10 MPa.

11. The process of any of the preceding claims conducted in a trickle-bed reactor.

12. The process of any of Claims 2-11 in which the condensation conditions include a temperature from 200°C to 400°C and a pressure from 0.1 MPa to 10 MPa.

13. A process comprising the step of contacting under carbonylation conditions ethylene gas, carbon monoxide gas, methanol gas and a solid sulfide-based metal catalyst to produce methyl propionate.

14. A two-step process comprising:

A. Contacting under carbonylation conditions ethylene gas, carbon monoxide gas, methanol gas, and a solid, sulfide-based metal catalyst to produce an methyl propionate; and

B. Contacting under condensation conditions the methyl propionate of Step A with formaldehyde to produce an methyl methacrylate.

CLAIMS

1. A process comprising the step of contacting under carbonylation conditions an alkene gas, carbon monoxide gas, an alkanol gas and a solid sulfide-based metal catalyst comprising a Group VIII metal to produce an alkyl alkanoate.

2. A two-step process comprising:

A. Contacting under carbonylation conditions an alkene gas, carbon monoxide gas, an alkanol gas, and a solid, sulfide-based metal catalyst comprising a Group VIII metal to produce an alkyl alkanoate; and

B. Contacting under condensation conditions the alkyl alkanoate of Step A with an aldehyde to produce an alkyl ester of an aliphatic carboxylic acid.

3. The process of Claim 1 or 2 in which the solid, sulfide-based metal catalyst comprises at least one of iron, cobalt, rhodium and nickel.

4. The process of any of the preceding claims in which the alkene gas is of the formula C_nH_{2n} in which n is from 2 to 12.

5. The process of any of the preceding claims in which the carbonylation conditions are halogen-free.

6. The process of any of the preceding claims in which the alkene gas is ethylene gas.

7. The process of any of the preceding claims in which the alkanol comprises 1-30 carbon atoms.

8. The process of any of the preceding claims in which the alkanol is methanol.

9. The process of any of the preceding claims in which the carbonylation conditions include a temperature from 200°C to 400°C and a pressure from 0.1 MPa to 10 MPa.

10. The process of any of the preceding claims conducted in a trickle-bed reactor.

11. The process of any of Claims 2-11 in which the condensation conditions include a temperature from 200°C to 400°C and a pressure from 0.1 MPa to 10 MPa.

12. A process comprising the step of contacting under carbonylation conditions ethylene gas, carbon monoxide gas, methanol gas and a solid sulfide-based metal catalyst comprising a Group VIII metal to produce methyl propionate.

13. A two-step process comprising:

A. Contacting under carbonylation conditions ethylene gas, carbon monoxide gas, methanol gas, and a solid, sulfide-based metal catalyst comprising a Group III metalto produce an methyl propionate; and

B. Contacting under condensation conditions the methyl propionate of Step A with formaldehyde to produce an methyl methacrylate.