Claims

1. A method for conversion of a starting alcohol being derived from any of biomass, triglycerides, wood, algae, fossil-based material, and syngas, or the starting alcohol is generated through any of fermentation and pyrolysis, or the starting alcohol is a fatty alcohol, wherein the method is performed in one-pot procedure without any purification of intermediates, , comprising:
   (i) oxidizing the starting alcohol to a corresponding aldehyde or ketone, wherein the oxidizing is performed with an oxidant and a catalyst, the oxidant being any one of oxygen, air, hydrogen peroxide, and sodium hypochlorite, and the catalyst being any one of a heterogeneous supported metal catalyst, a homogeneous organometallic complex, a metal-free catalyst, and an enzyme;
   (ii) condensation of the corresponding aldehyde or ketone to an enal or enone using a metal-free condensation catalyst; and
   (iii) reducing, using a heterogeneous metal catalyst and a reducing agent, the enal or enone to a product, said product being an alcohol, an aldehyde, a ketone, an acetal or a ketal, wherein the product has a longer chain than the chain of the starting alcohol.

2. The method according to claim 1, wherein said starting alcohol is a primary alcohol of formula R-$CH_2$-OH, wherein R is a H, an alkyl, an aryl, an alkenyl, or a heterocyclic group.

3. The method according to claim 1, wherein said starting alcohol is a secondary alcohol of formula R-CH(OH)-$R^1$, wherein R is a H, an alkyl, an aryl, an alkenyl, or a heterocyclic group and $R^1$ is an alkyl.

4. The method according to any one of the previous claims, comprising repeating the steps of claim 1, using the product alcohol as the starting alcohol.

5. The method according to any one of the previous claims, wherein the condensation of aldehydes is performed with an organocatalyst or a salt thereof, and the catalyst is pyrrolidine, proline, ammonium formiate or glycine, optionally in the presence of an acid, such as acetic acid.

6. The method according to any one of the previous claims, wherein reducing is performed with a reduction agent, which is formic acid, $H_2$, ammonium formiate, or Hantzsch ester.

7. The method according to claim 1, wherein the heterogeneous metal catalyst in the reduction is a heterogeneous Pd catalyst and the reduction agent is $H_2$-gas.

8. The method according to any one of the previous claims, comprising the steps of:
(i) providing the starting alcohol,
(ii) providing an oxidant, such as air, $H_2O_2$, $O_2$, or NaOCl,
(iii) providing an oxidizing catalyst, such as a heterogeneous supported metal catalyst, or a homogeneous organometallic complex, or a metal-free catalyst (mediator), or an oxidizing enzyme (EC 1:10:3:2) and oxidizing the starting alcohol, in the presence of said oxidizing catalyst, into the corresponding aldehyde or ketone,
(iv) providing a metal-free condensation catalyst system,
(v) optionally including an acid or a salt thereof, and converting the corresponding aldehyde or ketone, in the presence of said condensation catalyst system, into the enal or enone,
(vi) providing a reducing agent, such as formic acid, $H_2$, ammonium formiate, or Hantzsch ester,
(vii) providing a reducing catalyst, which is a heterogeneous metal catalyst and reducing the enal or enone, optionally in the presence of said reducing catalyst, into the product.

9. The method according to claim 8, wherein the condensation catalyst system is an organocatalytic system or a salt thereof.

10. The method according to claim 8, wherein said starting alcohol is selected from the group consisting of methanol, ethanol, propanol, butanol, benzyl alcohol, isopropanol, hexanol, octanol, nonanol and octadecanol.

11. The method according to claim 8, wherein said corresponding aldehyde is acetaldehyde, formaldehyde, propanal, butanal, pentanal, hexanal, octanal, 2,4-Hexadienal, cinnamic aldehyde or benzylic aldehyde.

12. The method according to any one of the previous claims, comprising:
(i) providing the starting alcohol,
(ii) providing an oxidant, such as air, $O_2$, or NaClO,
(iii) providing an oxidation catalysts system, such as TEMPO, CuBr, bpy, NMI, $O_2$; or TEMPO, $HNO_3$, HCl, $O_2$; or TEMPO, NaOCl, KBr; or a heterogeneous supported metal catalyst (Pd, Ag, Ru, Ir, or Fe); or a homogeneous catalyst system (Pd, Ag, Ru, Ir, or Fe) and converting the starting alcohol, in the presence of said oxidation catalyst system, into the corresponding aldehyde or ketone,
(iv) providing an amine catalyst system or a salt thereof,
(v) optionally including an acid, and converting the corresponding aldehyde or ketone, in the presence of said amine catalyst system or the salt thereof, optionally including an acid, into the enal or enone,

(vi) providing a reducing agent, such as formic acid, $H_2$, or ammonium formiate,
(vii) providing a reducing catalyst, which is a heterogeneous metal catalyst; and
reducing the enal or enone, optionally in the presence of said reducing catalyst, into the product.

13. The method according to any one of the previous claims, wherein the method is performed in one-pot procedure without any purification of intermediates comprising:
- providing the starting alcohol, which is a microwave-vial containing ethanol (1 mmol),
- providing an oxidation catalysts system, which is TEMPO (1 mol%) in $CHCl_2$ (2.5 ml), which is sonificated for 3 minutes and cooled to 10°C under stirring, where after cooled NaBr (10 mol%) and NaOCl (2.8 equiv.) is added and the pH adjusted to 9 by sat. $NaHCO_3$,
- providing an oxidant, which is a balloon filled with $O_2$-gas at 10°C under stirring for 3 hours, and converting the starting alcohol into the corresponding aldehyde or ketone,
- adding toluene (0.5 ml) and pyrrolidine (5 mol%) and acetic acid (5 mol%) at room temperature under stirring for 3 hours, and converting the corresponding aldehyde or ketone into the enal or enone,
- cooling to room temperature,
adding a reducing catalyst, which is MCF-AmP-Pd(0) (5 mol%), and a reducing agent, which is a balloon filled with $H_2$ gas, and under stirring for 3 hours at room temperature and reducing the enal or enone into the product.