CLAIMS

1. An oxidative dehydrogenation catalyst comprising:

(i) a structure comprising a mixed oxide of molybdenum (Mo), vanadium (V), niobium (Nb), antimony (Sb) and bismuth (Bi) having a formula $Mo_uV_vNb_wSb_yBi_zO_x$, wherein

u is 1, v is from 0.1 to 0.5, w is from 0.001 to 0.3, y is from 0.001 to 0.2, z is from 0.03 to 0.2, and x is an oxygen content required to charge-balance the structure; and

(ii) a crystallographic structure with the Pba2-32 space group, characterized by reflections determined with Cu-K_α X-ray diffraction (XRD) as follows:

2θ (± 0.3°)	**Rel. Intensity (%)**
5.3	0.2 – 10
6.6	1.5 – 15
7.84	2.5 – 45
8.95	4 – 21
22.17	100
27.2	20 – 70

2. The oxidative dehydrogenation catalyst of claim 1, wherein the oxidative dehydrogenation catalyst consists of the structure comprising oxides of molybdenum (Mo), vanadium (V), niobium (Nb), antimony (Sb) and bismuth (Bi) having a formula $Mo_uV_vNb_wSb_yBi_zO_x$, wherein u is 1, v is from 0.1 to 0.5, w is from 0.001 to 0.3, y is from 0.001 to 0.1, and z is from 0.03 to 0.2, and x is the oxygen content required to charge-balance the structure.

3. The oxidative dehydrogenation catalyst of claim 1, wherein the oxidative dehydrogenation catalyst is essentially free of tellurium (Te).

4. A method for forming an oxidative dehydrogenation catalyst, the method comprising:

adding a molybdenum-containing compound, a vanadium-containing compound, a bismuth-containing compound, a niobium-containing compound, an antimony-containing compound, and one or more organic acids to a mixture of alkylene glycol or alcohol amine and water to form a starting mixture;

treating the starting mixture by hydrothermal synthesis at a hydrothermal synthesis temperature that is from 150 °C to 250 °C; and

separating $Mo_uV_vNb_wSb_yBi_zO_x$ from retained liquids,

wherein u is 1, v is from 0.1 to 0.5, w is from 0.001 to 0.3, y is from 0.001 to 0.2, z is from 0.03 to 0.2, and x is an oxygen content required to charge-balance the structure; and

wherein the starting mixture comprises at least one of molybdenum trioxide (MoO_3) and vanadium pentoxide (V_2O_5).

5. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the one or more organic acids comprises at least one of citric acid ($C_6H_8O_7$), oxalic acid ($C_2H_2O_4$), and mixtures thereof.

6. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the niobium-containing compound is selected from the group consisting of niobium oxide, niobic acid ($Nb_2O_5 \cdot xH_2O$), ammonium niobium oxalate hydrate($(NH_4)Nb(C_2O_4)_2.nH_2O$), niobium ethoxide, and mixtures thereof.

7. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the bismuth-containing compound is selected from the group consisting of bismuth oxide (Bi_2O_3), bismuth sulfate ($Bi_2(SO_4)_3$), bismuth citrate ($BiC_6H_5O_7$), and bismuth nitrate ($Bi(NO_3)_3$).

8. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the antimony-containing compound is selected from the group consisting of antimony trioxide (Sb_2O_3) and antimony pentoxide (Sb_2O_5).

9. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the alkylene glycol is ethylene glycol ($C_2H_6O_2$).

10. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the hydrothermal synthesis temperature is from 180 °C to 220 °C.

11. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the starting mixture comprises MoO_3 and V_2O_5.

12. A method for converting paraffins to olefins, the method comprising:

contacting a feed stream comprising paraffins with a material comprising the oxidative dehydrogenation catalyst of any one of claims 1 to 3;

converting at least a portion of the paraffins to olefins, thereby yielding a product stream comprising paraffins and olefins; and

separating the olefins from the paraffins in the product stream.

13. The method of claim 12, wherein the method further comprises contacting a second stream comprising oxygen with the feed stream comprising paraffins and the oxidative dehydrogenation catalyst.

14. The method of claim 12, wherein the conversion occurs at an alkane weight hourly space velocity (WHSV) that is from 0.1/hr to 10/hr.

15. The method of claim 12, wherein the oxidative dehydrogenation catalyst has the following formula: $MoV_{0.2\text{-}0.3}Nb_{0.005\text{-}0.02}Sb_{0.05\text{-}0.15}Bi_{0.05\text{-}0.15}O_x$, where x is the oxygen content required to charge-balance the structure.

16. The method for forming an oxidative dehydrogenation catalyst of claim 4, wherein the oxidative dehydrogenation catalyst has the following formula: $MoV_{0.2\text{-}0.3}Nb_{0.005\text{-}0.02}Sb_{0.05\text{-}0.15}Bi_{0.05\text{-}0.15}O_x$, where x is the oxygen content required to charge-balance the structure.