CLAIMS

1. A dehydrogenation process, the process comprising:

(1A) providing a catalyst precursor comprising (i) an inorganic support, and (ii) 0.01 wt% to 10.0 wt% of a first metal selected from the Groups 6 to 10 metals of the Periodic Table of Elements based on the total weight of the catalyst precursor wherein step (1A) comprises:

(1A-1) providing the inorganic support;

(1A-2) impregnating the inorganic support with a solution of a salt of the first metal to obtain an impregnated support; and

(1A-3) calcining the impregnated support at a temperature in a range from 300°C to 1000°C;

(1B) obtaining an activated dehydrogenation catalyst by treating the catalyst precursor at a temperature in a range of greater than 450°C to 600°C for a period of at least 15 minutes in a H_2-containing atmosphere; and

(1C) contacting a first composition comprising cyclohexane with the activated dehydrogenation catalyst in a dehydrogenation reactor under a dehydrogenation condition to convert at least a portion of the cyclohexane to benzene and obtain a dehydrogenation reaction product.

2. The process of claim 1, wherein the temperature of step (1B) is in a range from 450°C to 550°C.

3. The process of claim 1 or claim 2, wherein the first composition in step (1C) is obtained by:

(1Ba) contacting benzene and hydrogen with a hydroalkylation catalyst under a hydroalkylation condition to form a hydroalkylation reaction mixture comprising cyclohexylbenzene, cyclohexane, methylcyclopentane, and benzene; and

(1Bb) obtaining from at least a portion of the hydroalkylation reaction mixture (i) a first composition that has a higher concentration of at least one of benzene and cyclohexane than cyclohexylbenzene; and (ii) a second composition that has a higher concentration of cyclohexylbenzene than benzene and cyclohexane.

4. The process of claim 3, further comprising:

(1D) recycling at least a portion of the benzene in the dehydrogenation reaction product to step (1Ba).

5. The process of any of the preceding claims, wherein the first metal comprises Pt and/or Pd.

6. The process of any of the preceding claims, wherein at least a portion of the first metal in the catalyst precursor in step (1A) is in an oxidation state higher than zero.

7. The process of any of the preceding claims, wherein the catalyst precursor further comprises at least one of: (iii) from 0.01 wt% to 5.0 wt% of a second metal selected from Group 14 of the Periodic Table of Elements; and (iv) from 0.01 wt% to 10.0 wt% of a third metal selected from the Groups 1 and 2 metals of the Periodic Table of Elements.

8. The process of claim 7, wherein the second metal comprises Sn and the third metal comprises K.

9. The process of any of the preceding claims, wherein in step (1B), the H_2-containing atmosphere comprises at least 90 wt% of hydrogen.

10. The process of any of the preceding claims, wherein step (1B) comprises treating the catalyst precursor in a flowing stream of H_2-containing atmosphere.

11. The process of any of the preceding claims, wherein the H_2-containing atmosphere in step (1B) has a benzene concentration of at most 1 wt%, based on the total weight of the H_2-containing atmosphere.

12. The process of any of the preceding claims, wherein in step (1Bb) the first composition further comprises hydrogen, and in step (1B) the H_2-containing atmosphere is the first composition.

13. The process of any of the preceding claims, wherein after step (1B) but before step (1C), the activated dehydrogenation catalyst is protected by a protective atmosphere free of O_2.

14. The process of claim 13, wherein the protective atmosphere comprises at least one of H_2 and CH_4.

15. The process of any of the preceding claims, wherein steps (1B) and (1C) are both conducted in the dehydrogenation reactor.

16. The process of any of the preceding claims, wherein in step (1Ba) the first composition comprises benzene and hydrogen.

17. The process of any of the preceding claims, wherein in step (1C), the first composition comprises 0.01 wt% to 5.0 wt% methylcyclopentane based on the total weight of the first composition, and at least a portion of the methylcyclopentane is converted into a paraffin.

18. The process of any of the preceding claims, wherein in step (1C), the dehydrogenation condition comprises a temperature in a range from 300°C to 600°C.

19. A process for making phenol and/or cyclohexanone, the process comprising:

(2A) producing cyclohexylbenzene from the second composition obtained in step (1Bb) according to a process of any of the preceding claims 3 to 19;

(2B) oxidizing at least a portion of the cyclohexylbenene to obtain an oxidation reaction product comprising cyclohexylbenzene hydroperoxide; and

(2C) cleaving at least a portion of the cyclohexylbenzene hydroperoxide to produce a cleavage reaction product comprising phenol and cyclohexanone.