CLAIMS

1. A process comprising:

steam cracking of one or more crude oils in a steam cracking zone to produce a first effluent comprising a heavy oil mixture comprising a steam cracker tar, a second effluent comprising a mixture of gaseous products and liquid products, and a third effluent comprising one or more bottoms products;

optionally introducing at least a portion of the first effluent from downstream of the steam cracking zone and/or at least a portion of the second effluent from downstream of the steam cracking zone and/or at least a portion of the third effluent from downstream of the steam cracking zone to one or more pretreating zones to produce a first effluent pretreated product and/or a second effluent pretreated product and/or a third effluent pretreated product;

introducing the first effluent, the first effluent pretreated product, the second effluent, the second effluent pretreated product, the third effluent, the third effluent pretreated product, or any combination thereof, to a reaction zone; and

heat treating the first effluent, the first effluent pretreated product, the second effluent, the second effluent pretreated product, the third effluent, the third effluent pretreated product, or any combination thereof, in the reaction zone to a temperature in a range of 200°C to 800°C to produce a first reaction effluent comprising a pitch product, and a second reaction effluent comprising a mixture of gaseous and liquid products,

wherein the pitch product has an MCR in a range of 40 wt.% to 95 wt.%, and a softening point T_{sp} in a range of 50°C to 400°C,

wherein the first effluent is sent directly to the reaction zone without introducing to the one or more pretreating zones and the first reaction effluent, the second reaction effluent, or both the first and second reaction effluents are sent to a separation zone after heat treating to produce at least one pitch product and a separated reaction effluent comprised of gaseous and liquid hydrocarbons; and

wherein the at least one pitch product following separation has a mesophase content from 5 vol% to 100 vol%, based on the total volume of the at least one pitch product, an MCR in the range of 40 wt.% to 95 wt.%, based on a total weight of the at least one pitch product, and a softening point T_{sp} in a range of 50°C to 400°C.

2. The process of claim 1, wherein the one or more pretreating zones are one or more hydrotreating zones, wherein at least a portion of the first effluent is hydrotreated to produce the

first effluent pretreated product, and wherein the first effluent pretreated product is a hydrotreated first effluent product.

3. The process of any one of claims 1 to 2, wherein the pitch product has a stack height (L_C) of 2 nm to 9 nm, as determined by X-ray scattering.

4. The process of claim 3, further comprising:

separating the first reaction effluent and the second reaction effluent in a separation zone to produce at least one pitch product, and a separated reaction effluent comprised of gaseous and liquid hydrocarbons, wherein the at least one pitch product has a mesophase content from 5 vol% to 100 vol%, based on a total volume of the at least one pitch product, an MCR in a range of 40 wt.% to 95 wt.%, based on a total weight of the at least one pitch product, and a softening point T_{sp} in a range of 50°C to 400°C.

5. The process of any one of claims 1 to 4, wherein the third effluent comprising one or more bottoms products is sent to a first separation zone to produce at least a first separation product and a second separation product, wherein at least a portion of the first separation product, or at least a portion of the second separation product is sent to a reaction zone to produce a reaction effluent.

6. The process of claim 5, further comprising:

separating the reaction effluent produced from at least a portion of the first separation product, or at least a portion of the second separation product to a second separation zone to produce at least one pitch product, and a separated reaction effluent comprised of gaseous and liquid hydrocarbons, wherein the at least one pitch product has an MCR in the range of 40 wt.% to 95 wt.%, based on a total weight of the at least one pitch product, and a softening point T_{sp} in a range of 50°C to 400°C.

7. The process of any one of claims 1 to 6, wherein the first effluent has at least 70 wt.% of the mixture having a boiling point at atmospheric pressure that is greater than 200°C, an MCR of 5 wt.% to 55 wt.%, a hydrogen content of 4 wt.% to 10 wt.%, a sulfur content of 5 wt.% or less, based on a total weight of the first effluent.

8. The process of any one of claims 1 to 7, wherein the pitch product has (1) a quinoline insoluble (QI) content of 60 wt.% or less, (2) a T_{sp} of 100°C or greater, (3) a T_g of 70°C or greater, or (4) a combination thereof.

9. The process of any one of claims 1 to 8, wherein the pitch product is sent to one or more heat treating zones to produce a heat treated pitch product having an MCR and a T_{sp} both greater than the MCR and the T_{sp} of the pitch product, and wherein the pitch product and/or the heat treated pitch product are suitable for spinning into carbon fiber.

10. The process of any one of claims 1 to 9, wherein the heat treated pitch product has one or more of: a mesophase content of 50 vol% or greater, based on a total volume of the heat treated pitch product; a quinoline insoluble (QI) content of 10 wt.% or greater, based on the total weight of the heat treated pitch product; and a T_{sp} of 200°C or greater.

11. The process of any one of claims 2 to 10, wherein the hydrotreated first effluent product has a T50 in a range of 225°C to 375°C, a hydrogen content of 7 wt.% to 12 wt.%, and a sulfur content of from 0 wt.% to 1 wt.%, based on a total weight of the hydrotreated first effluent product.

12. The process of any one of claims 2 to 11, further comprising:

separating the hydrotreated first effluent product downstream of a hydrotreating zone to produce at least a liquid effluent; and

recycling the liquid effluent back to an upstream of the hydrotreating zone.

13. The process of any one of claims 1 to 12, wherein the third effluent comprises one or more bottoms products and wherein the process further comprising:

separating the one or more bottoms products by deasphaltenation in the presence of a solvent to produce a first portion comprising solvent and soluble compounds, and a second portion comprising solvent and a deasphalted bottom product,

wherein the deasphalted bottom product comprises a third pitch product having a softening point T_{sp} of 25°C or greater, a hydrogen content of 4 wt.% to 12 wt.%, based on a total weight of the third pitch product, and an MCR of from 10 wt.% to 60 wt.%, based on the total weight of the third pitch product, wherein the third pitch product is suitable for spinning into carbon fiber.

14. The process of any one of claims 1 to 13, further comprising:

performing a vacuum distillation on at least a portion of the deasphalted bottom product to produce a vacuum gas oil product and a vacuum bottoms product; and

producing a fuel oil from at least a portion of the vacuum gas oil product, wherein the fuel oil has a sulfur content of 1 wt.% or less.

15. The process of any one of claims 1 to 14 further comprising:

solvent deasphalting at least a portion of the third effluent in a deasphalting unit to produce a deasphalted oil fraction and a deasphalting residue.

16. The process of any one of claims 1 to 15, further comprising:

producing a fiber from the pitch product, the hydrotreated first effluent product, the third pitch product, or any combination thereof, wherein the fiber is an oxidized fiber, carbonized fiber, graphitized fiber, fiber web, oxidized fiber web, carbonized fiber web, or graphitized fiber web.

17. The process of any one of claims 1 to 16, further comprising:

mixing the pitch product, the hydrotreated first effluent product, the third pitch product, or any combination thereof, with a needle coke to produce a carbon article capable of forming an electrode for iron and/or aluminum production.

18. The process of any one of claims 1 to 17, further comprising:

mixing the pitch product, the hydrotreated first effluent product, the third pitch product, or any combination thereof, with a carbon fiber to produce a carbon article capable of forming carbon-carbon composites.

19. The process of any one of claims 16 to 18, wherein the fiber is heat stabilized at a stabilization temperature of less than or equal to T_{sp} of the pitch product, the hydrotreated first effluent product, or the third pitch product.

20. The process of claim 19, further comprising: graphitizing the carbonized fiber.

21. The process of claim 1, further comprising:

producing high-modulus, high-strength carbon fiber fabric comprising:

spinning one or more pitch products to produce a spun fiber;

stabilizing the spun fiber with an oxidizing gas containing oxygen to produce a stabilized fiber;

weaving a fabric from the stabilized fiber to produce a stabilized fabric;

carbonizing the stabilized fabric to produce a carbonized fabric; and

optionally graphitizing the carbonized fabric.

22. A process comprising:

steam cracking of one or more crude oils in a steam cracking zone to produce a first effluent comprising a heavy oil mixture comprising a steam cracker tar, a second effluent comprising a mixture of gaseous products and liquid products, and a third effluent comprising one or more bottoms products, wherein the first effluent is sent directly to a reaction zone for heat treatment to produce a first reaction effluent and/or a second reaction effluent which are/is sent to a separation zone to produce at least one pitch product and a separated reaction effluent comprised of gaseous and liquid hydrocarbons;

introducing the first effluent, the second effluent, the third effluent, or any combination thereof, to the reaction zone; and

heat treating the first effluent, the first effluent pretreated product, the second effluent, the second effluent pretreated product, the third effluent, the third effluent pretreated product, or any combination thereof, in the reaction zone to a temperature in a range of 200°C to 800°C to produce a first reaction effluent comprising a pitch product, and a second reaction effluent comprising a mixture of gaseous and liquid products, wherein the pitch product has an MCR in the range of 40 wt.% to 95 wt.%, and a softening point T_{sp} in a range of 50°C to 400°C.

23. The process of claim 22, further comprising:

introducing at least a portion of the first effluent from downstream of the steam cracking zone and/or at least a portion of the second effluent from downstream of the steam cracking zone and/or at least a portion of the third effluent from downstream of the steam cracking zone to one or more pretreating zones to produce a first effluent pretreated product and/or a second effluent pretreated product and/or the third effluent pretreated product.