CLAIMS

WHAT IS CLAIMED IS:

1. A coke regulation and control reactor, wherein the coke regulation and control reactor comprises a coke regulation and control reactor shell, a reaction zone I, and a coke controlled catalyst settling zone;

the coke regulation and control reactor shell comprises an upper coke regulation and control reactor shell and a lower coke regulation and control reactor shell; the upper coke regulation and control reactor shell encloses the coke controlled catalyst settling zone;

the lower coke regulation and control reactor shell encloses the reaction zone I;

the reaction zone I communicates with the coke controlled catalyst settling zone;

a cross-sectional area at any position of the reaction zone I is less than a cross-sectional area at any position of the coke controlled catalyst settling zone;

n baffles are arranged in a vertical direction in the reaction zone I, bottoms of the n baffles are connected to a bottom of the coke regulation and control reactor, tops of the n baffles are located in the coke controlled catalyst settling zone, and the n baffles divide the reaction zone I into m reaction zone I subzones, wherein m and n are both integers; and

a catalyst circulation hole is formed in each of the baffles, such that a catalyst flows in the reaction zone I in a preset manner.

2. The coke regulation and control reactor according to claim 1, wherein $1 \leq n \leq 9$~~;~~ and $2 \leq m \leq 10$~~.~~;

~~3. The coke regulation and control reactor according to claim 1,~~ wherein preferably cross sections of the reaction zone I and the reaction zone I subzones are all rectangular; the catalyst circulation hole is formed in each of the n baffles; and the catalyst circulation holes on two adjacent baffles are staggered up and down, such that the catalyst flows in the reaction zone I ~~in~~ a polyline manner~~.~~;

~~4. The coke regulation and control reactor according to claim 1,~~ wherein preferably a cross section of the reaction zone I is circular; a cross section of each of the reaction zone I subzones is fan-shaped; and at least one catalyst circulation hole is formed in each of n-1 of the baffles, such that the catalyst flows in the reaction zone I in an annular manner~~.~~;

~~5. The coke regulation and control reactor according to claim 1,~~ wherein preferably a cross section of the

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reaction zone I is annular; a cross section of each of the reaction zone I subzones is fan-shaped; and at least one catalyst circulation hole is formed in each of n-1 of the baffles, such that the catalyst flows in the reaction zone I in an annular manner.

~~6~~3. The coke regulation and control reactor according to claim 1, wherein a cross-sectional area of the coke controlled catalyst settling zone is 1.5 to 3 times a cross-sectional area of the reaction zone I~~.~~;

preferably, the coke regulation and control reactor is a bubbling fluidized bed reactor.

~~7~~4. The coke regulation and control reactor according to claim 1, wherein the coke regulation and control reactor further comprises a transition zone;

the transition zone is located between the reaction zone I and the coke controlled catalyst settling zone;

a cross-sectional area at any position of the transition zone is between the cross-sectional area at any position of the reaction zone I and the cross-sectional area at any position of the coke controlled catalyst settling zone; and

the transition zone, the reaction zone I, and the coke controlled catalyst settling zone communicate with each other coaxially.

~~8. The coke regulation and control reactor according to claim 1, wherein the coke regulation and control reactor is a bubbling fluidized bed reactor.~~

~~9~~5. The coke regulation and control reactor according to claim 1, wherein the reaction zone I comprises a catalyst inlet, a coke controlled catalyst outlet, and a coke control raw material inlet;

the m reaction zone I subzones comprise a 1^{st} reaction zone I subzone, and a 2^{nd} reaction zone I subzone to an m^{th} reaction zone I subzone; the catalyst inlet is formed in the 1^{st} reaction zone I subzone; the coke controlled catalyst outlet is formed in the m^{th} reaction zone I subzone;

the coke control raw material inlet is formed at a bottom of each of the reaction zone I subzones;

the coke controlled catalyst settling zone comprises a coke control gas outlet; and the coke control gas outlet is formed at a top of the coke controlled catalyst settling zone~~.~~;

~~10. The coke regulation and control reactor according to claim 9,~~ wherein preferably, a coke regulation and control reactor distributor is provided at the coke control raw material inlet.

~~11. A method for on-line modification of a dimethyl ether/methanol to olefins (DMTO)~~

~~- catalyst using the coke regulation and control reactor according to any one of claims 1 to 10.~~

~~12. The method according to claim 11, wherein the method at least comprises feeding a catalyst and a coke control raw material into the reaction zone I to allow a reaction to generate a product with a coke controlled catalyst,~~

~~wherein the catalyst flows in a preset manner through the catalyst circulation holes on the baffles.~~

~~13. The method according to claim 12, wherein the coke control raw material comprises C_1-C_6 hydrocarbon compounds.~~

~~14. The method according to claim 13, wherein the hydrocarbon compounds are at least one selected from the group consisting of C_1-C_6 alkanes and C_1-C_6 olefins.~~

~~15. The method according to claim 13, wherein the coke control raw material further comprises at least one from the group consisting of hydrogen, alcohol compound, and water; and~~

~~a proportion of a total mass of the alcohol compound and the water in a mass of the coke control raw material is greater than or equal to 10% and less than or equal to 50%.~~

~~16. The method according to claim 15, wherein the alcohol compound is at least one selected from the group consisting of methanol and ethanol.~~

~~17. The method according to claim 12, wherein the coke control raw material comprises 0 wt% to 20 wt% of hydrogen, 0 wt% to 50 wt% of methane, 0 wt% to 50 wt% of ethane, 0 wt% to 20 wt% of ethylene, 0 wt% to 50 wt% of propane, 0 wt% to 20 wt% of propylene, 0 wt% to 90 wt% of butane, 0 wt% to 90 wt% of butene, 0 wt% to 90 wt% of pentane, 0 wt% to 90 wt% of pentene, 0 wt% to 90 wt% of hexane, 0 wt% to 90 wt% of hexene, 0 wt% to 50 wt% of methanol, 0 wt% to 50 wt% of ethanol, and 0 wt% to 50 wt% of water; and~~

~~a content of the hydrocarbon compounds is greater than 0%.~~

~~18. The method according to claim 12, wherein the catalyst comprises an SAPO-34 molecular sieve; a coke content in the catalyst is less than or equal to 3 wt%;~~

~~a coke content in the coke controlled catalyst is 4 wt% to 9 wt%;~~

~~a quartile deviation of a coke content distribution in the coke controlled catalyst is less than 1~~

~~wt%;~~

~~preferably, coke species in the coke controlled catalyst comprise polymethylbenzene and polymethylnaphthalene;~~

~~a total mass of the polymethylbenzene and the polymethylnaphthalene accounts for greater than or equal to 70 wt% of a total mass of coke;~~

~~a mass of coke species with a molecular weight greater than 184 accounts for less than or equal to 25 wt% of the total mass of coke; and~~

~~the total mass of coke refers to a total mass of coke species.~~

~~19. The method according to claim 12, wherein process operating conditions of the reaction zone I of the coke regulation and control reactor are as follows: apparent gas linear velocity: 0.1 m/s to 0.5 m/s; reaction temperature: 300°C to 700°C; reaction pressure: 100 kPa to 500 kPa; and bed density: 400 kg/m^3 to 800 kg/m^3.~~

~~20. The method according to claim 12, wherein the method comprises:~~

~~feeding a coke control raw material and a catalyst into the reaction zone I to allow a reaction to generate a coke controlled catalyst and a coke control product gas; allowing the coke controlled catalyst to pass through the m reaction zone I subzones in sequence through the catalyst circulation holes on the baffles and then flow out through the coke controlled catalyst outlet; and allowing the coke control product gas to flow out through the coke control gas outlet.~~

~~21~~6. A device for preparing light olefin from an oxygen-containing compound, wherein the device comprises a methanol conversion reactor and the coke regulation and control reactor according to claim 1.~~any one of claims 1 to 10.~~

~~22~~7. The device according to claim ~~21~~6, wherein the methanol conversion reactor comprises a methanol conversion reactor shell and a delivery pipe;

the methanol conversion reactor shell comprises a lower methanol conversion reactor shell and an upper methanol conversion reactor shell;

the lower methanol conversion reactor shell encloses a reaction zone II;

the delivery pipe is located above the reaction zone II; the delivery pipe has one end closed and the other end communicating with the reaction zone II;

the upper methanol conversion reactor shell is arranged on a periphery of the delivery pipe;

the upper methanol conversion reactor shell and a pipe wall of the delivery pipe enclose a

cavity;

the cavity is divided into a spent catalyst zone and a gas-solid separation zone from bottom to top, respectively; and

the spent catalyst zone is provided with a spent catalyst zone gas distributor~~.~~

~~23. The device according to claim 22, wherein~~ preferably, the gas-solid separation zone is provided with a first gas-solid separation unit of the methanol conversion reactor;

an upper part of the delivery pipe is connected to an inlet of the first gas-solid separation unit of the methanol conversion reactor;

a spent catalyst outlet of the first gas-solid separation unit of the methanol conversion reactor is formed in the spent catalyst zone;

a gas outlet of the first gas-solid separation unit of the methanol conversion reactor communicates with a methanol conversion reactor gas collection chamber; and

the methanol conversion reactor gas collection chamber communicates with a product gas delivery pipe~~.~~;

~~24. The device according to claim 23, wherein~~ preferably, the gas-solid separation zone is further provided with a second gas-solid separation unit of the methanol conversion reactor;

a gas inlet of the second gas-solid separation unit of the methanol conversion reactor is formed in the gas-solid separation zone;

a spent catalyst outlet of the second gas-solid separation unit of the methanol conversion reactor is formed in the spent catalyst zone; and

a gas outlet of the second gas-solid separation unit of the methanol conversion reactor communicates with the methanol conversion reactor gas collection chamber.

~~25~~8. The device according to claim ~~22~~7, wherein the spent catalyst zone gas distributor is located below the first gas-solid separation unit of the methanol conversion reactor and the second gas-solid separation unit of the methanol conversion reactor.

~~26~~9. The device according to claim ~~22~~7, wherein a spent catalyst circulation pipe and a spent catalyst inclined pipe are further arranged outside the spent catalyst zone;

the spent catalyst circulation pipe is configured to connect the spent catalyst zone and the reaction zone II; and

the spent catalyst inclined pipe is configured to output a spent catalyst.

~~27~~10. The device according to claim ~~22~~7, wherein the reaction zone II communicates with the reaction zone I through a coke controlled catalyst delivery pipe.

~~28~~11. The device according to claim ~~21~~6, wherein the device further comprises a regenerator;

the regenerator is connected to the spent catalyst inclined pipe, such that a spent catalyst is able to be delivered to the regenerator;

the regenerator is connected to a regenerated catalyst delivery pipe, such that a regenerated catalyst is able to be delivered to the coke regulation and control reactor; and

an inner bottom of the regenerator is provided with a regenerator distributor~~.~~;

~~29. The device according to claim 28, wherein~~ preferably, a bottom of the regenerator is further provided with a regenerator stripper;

an upper section of the regenerator stripper is arranged inside the regenerator, and an inlet of the upper section of the regenerator stripper is formed above the regenerator distributor; and

a lower section of the regenerator stripper is arranged outside the regenerator, and an outlet of the lower section of the regenerator stripper is connected to the regenerated catalyst delivery pipe~~.~~;

~~30. The device according to claim 28, wherein~~ preferably, the regenerator is connected to the spent catalyst inclined pipe through a spent catalyst delivery pipe and a methanol conversion reactor stripper; and

the regenerator is connected to the regenerated catalyst delivery pipe through the regenerator stripper~~.~~;

~~31. The device according to claim 28, wherein~~ preferably, the regenerator is further provided with a regenerator gas-solid separation unit and a regenerator gas collection chamber;

a regenerated catalyst outlet of the regenerator gas-solid separation unit is formed above the regenerator distributor;

a gas outlet of the regenerator gas-solid separation unit is connected to the regenerator gas collection chamber; and

the regenerator gas collection chamber is connected to a flue gas delivery pipe located outside the regenerator.

~~32~~12. A method for preparing light olefin from an oxygen-containing compound, comprising ~~the~~ a method ~~for on-line modification of a DMTO catalyst~~ using the coke regulation and control

reactor according to ~~any one of claims 11 to 20~~claim 1.

13. The method according to claim 12, wherein the method for on-line modification of the DMTO catalyst at least comprises: feeding a catalyst and a coke control raw material into the reaction zone I to allow a reaction to generate a product with a coke controlled catalyst,

wherein the catalyst flows in a preset manner through the catalyst circulation holes on the baffles;

preferably, the coke control raw material comprises C1-C6 hydrocarbon compounds;

preferably, the hydrocarbon compounds are at least one selected from the group consisting of C1-C6 alkanes and C1-C6 olefins;

preferably, the coke control raw material further comprises at least one from the group consisting of hydrogen, alcohol compound, and water; and a proportion of a total mass of the alcohol compound and the water in a mass of the coke control raw material is greater than or equal to 10% and less than or equal to 50%;

preferably, the alcohol compound is at least one selected from the group consisting of methanol and ethanol;

preferably, the coke control raw material comprises 0 wt% to 20 wt% of hydrogen, 0 wt% to 50 wt% of methane, 0 wt% to 50 wt% of ethane, 0 wt% to 20 wt% of ethylene, 0 wt% to 50 wt% of propane, 0 wt% to 20 wt% of propylene, 0 wt% to 90 wt% of butane, 0 wt% to 90 wt% of butene, 0 wt% to 90 wt% of pentane, 0 wt% to 90 wt% of pentene, 0 wt% to 90 wt% of hexane, 0 wt% to 90 wt% of hexene, 0 wt% to 50 wt% of methanol, 0 wt% to 50 wt% of ethanol, and 0 wt% to 50 wt% of water; and a content of the hydrocarbon compounds is greater than 0%.

14. The method according to claim 13, wherein the catalyst comprises an SAPO-34 molecular sieve; a coke content in the catalyst is less than or equal to 3 wt%;

a coke content in the coke controlled catalyst is 4 wt% to 9 wt%;

a quartile deviation of a coke content distribution in the coke controlled catalyst is less than 1 wt%;

preferably, coke species in the coke controlled catalyst comprise polymethylbenzene and polymethylnaphthalene;

a total mass of the polymethylbenzene and the polymethylnaphthalene accounts for greater than or equal to 70 wt% of a total mass of coke;

a mass of coke species with a molecular weight greater than 184 accounts for less than or equal to 25 wt% of the total mass of coke; and

the total mass of coke refers to a total mass of coke species.

15. The method according to claim 13, wherein process operating conditions of the reaction zone I of the coke regulation and control reactor are as follows: apparent gas linear velocity: 0.1 m/s to 0.5 m/s; reaction temperature: 300°C to 700°C; reaction pressure: 100 kPa to 500 kPa; and bed density: 400 kg/m3 to 800 kg/m3;

preferably, the method comprises: feeding a coke control raw material and a catalyst into the reaction zone I to allow a reaction to generate a coke controlled catalyst and a coke control product gas; allowing the coke controlled catalyst to pass through the m reaction zone I subzones in sequence through the catalyst circulation holes on the baffles and then flow out through the coke controlled catalyst outlet; and allowing the coke control product gas to flow out through the coke control gas outlet.

~~33~~16. The method according to claim ~~32~~12, wherein the method method for preparing light olefin from the oxygen-containing compound further comprises:

feeding a coke control product gas into a gas-solid separation zone of a methanol conversion reactor; and

feeding a coke controlled catalyst into a reaction zone II of the methanol conversion reactor~~.~~;

~~34. The method according to claim 33, wherein~~ preferably, in the reaction zone II, a raw material with the oxygen-containing compound contacts and reacts with the coke controlled catalyst to generate a stream A with light olefins and a spent catalyst~~.~~;

~~35. The method according to claim 34, wherein~~ preferably, the stream A is separated into a gas-phase stream B and a solid-phase stream C after being subjected to gas-solid separation in the gas-solid separation zone of the methanol conversion reactor;

the gas-phase stream B enters a methanol conversion reactor gas collection chamber;

the solid-phase stream C enters a spent catalyst zone; and

the gas-phase stream B comprises the light olefins, and the solid-phase stream C comprises the spent catalyst~~.~~;

~~36. The method according to claim 35, wherein~~ preferably, a spent catalyst zone fluidizing gas is fed into the spent catalyst zone;

the spent catalyst zone fluidizing gas and a coke control product gas are mixed and carry a part of the spent catalyst to produce a stream D;

the stream D is separated into a gas-phase stream E and a solid-phase stream F after being subjected to gas-solid separation;

the gas-phase stream E enters the methanol conversion reactor gas collection chamber;

the solid-phase stream F enters the spent catalyst zone;

the gas-phase stream E is a mixed gas of the spent catalyst zone fluidizing gas and the coke control product gas; and

the solid-phase stream F is the spent catalyst~~.~~;

~~37. The method according to claim 35, wherein~~ preferably, the gas-phase stream B and the gas-phase stream E are mixed in the methanol conversion reactor gas collection chamber to produce a product

gas, and the product gas enters a downstream working section through a product gas delivery pipe~~.~~;

~~38. The method according to claim 36, wherein~~ preferably, a part of the spent catalyst in the spent catalyst zone is returned to a bottom of the reaction zone II through a spent catalyst circulation pipe; and

the remaining part of the spent catalyst is discharged through a spent catalyst inclined pipe~~.~~;

~~39. The method according to claim 38, wherein~~ preferably, the spent catalyst discharged through the spent catalyst inclined pipe is fed into a regenerator; and

a regeneration gas is fed into the regenerator to contact and react with the spent catalyst to obtain a stream G with a flue gas and a regenerated catalyst~~.~~;

~~40. The method according to claim 39, wherein~~ preferably, the stream G is subjected to gas-solid separation;

a separated flue gas enters a regenerator gas collection chamber, and then enters a downstream flue gas treatment system through a flue gas delivery pipe; and

a separated regenerated catalyst is stripped and cooled, and then enters a coke regulation and control reactor.

~~41~~17. The method according to claim ~~34~~16, wherein the oxygen-containing compound comprises methanol and/or dimethyl ether (DME~~).~~);

~~42. The method according to claim 34, wherein~~ preferably, a coke content in the spent catalyst is 9 wt% to 13 wt%.

~~43~~18. The method according to claim ~~36~~16, wherein the spent catalyst zone fluidizing gas comprises nitrogen and/or water vapor~~.~~;

~~44. The method according to claim 39, wherein~~ preferably, the regeneration gas comprises 0 wt% to 100 wt% of air, 0 wt% to 50 wt% of oxygen, 0 wt% to 50 wt% of nitrogen, and 0 wt% to 50 wt% of water vapor.

~~45~~19. The method according to claim ~~33~~16, wherein process operating conditions of the

reaction zone II of the methanol conversion reactor are as follows: apparent gas linear velocity: 0.5 m/s to 7.0 m/s; reaction temperature: 350°C to 550°C; reaction pressure: 100 kPa to 500 kPa; and bed density: 100 kg/m^3 to 500 kg/m^3.;

~~46. The method according to claim 35, wherein~~ preferably, process operating conditions of the spent catalyst zone of the methanol conversion reactor are as follows: apparent gas linear velocity: 0.1 m/s to 1.0 m/s; reaction temperature: 350°C to 550°C; reaction pressure: 100 kPa to 500 kPa; and bed density: 200 kg/m^3 to 800 kg/m^3.

~~47~~20. The method according to claim ~~39~~16, wherein process operating conditions of the regenerator are as follows: apparent gas linear velocity: 0.5 m/s to 2.0 m/s; regeneration temperature: 600°C to 750°C; regeneration pressure: 100 kPa to 500 kPa; and bed density: 150 kg/m^3 to 700 kg/m^3.