CLAIMS

WHAT IS CLAIMED IS:

1. A coke-control reactor, wherein the coke-control reactor comprises a riser reactor and a bed reactor;

the bed reactor comprises a bed reactor shell, and the bed reactor shell encloses a reaction zone I, a transition zone, and a gas-solid separation zone I from bottom to top;

a bed reactor distributor is arranged in an inner lower part of the reaction zone I;

a coke controlled catalyst delivery pipe is arranged outside the reaction zone I;

an upper section of the riser reactor penetrates through a bottom of the bed reactor and is axially inserted in the bed reactor; and

an outlet end of the riser reactor is located in the transition zone.

2. The coke-control reactor according to claim 1, wherein at least one perforated plate is arranged in the reaction zone I; the plurality of perforated plates are axially arranged on a periphery of the riser reactor in sequence;

the outlet end of the riser reactor is located above the perforated plate; ~~and~~

the bed reactor distributor is located below the perforated plate~~.~~;

~~3. The coke-control reactor according to claim 2, wherein~~preferably, the perforated plate has a porosity of 1% to 30%.

~~4~~3. The coke-control reactor according to claim 1, wherein the gas-solid separation zone I is provided with a bed reactor gas-solid separator and a bed reactor gas collection chamber;

a gas outlet of the bed reactor gas-solid separator communicates with the bed reactor gas collection chamber;

a catalyst outlet of the bed reactor gas-solid separator is located above the perforated plate; ~~and~~

the bed reactor gas collection chamber communicates with a coke control product gas delivery pipe located outside the bed reactor~~.~~;

~~5. The coke-control reactor according to claim 1, wherein~~preferably, the bed reactor distributor is configured to feed a bed reactor raw material; and

the bed reactor 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 total content of methanol, ethanol, and water is greater than or equal to 10 wt%~~.~~;

~~6. The coke-control reactor according to claim 1, wherein~~preferably, the riser reactor is configured to feed a catalyst and a riser reactor raw material; and the riser reactor 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 total content of methanol, ethanol, and water is greater than or equal to 10 wt%.

~~7~~4. A device for preparing low-carbon olefins from an oxygen-containing compound, wherein the device comprises a methanol conversion reactor and the coke-control reactor according to ~~any one of claims 1 to 6~~ claim 1.

~~8~~5. The device according to claim ~~7~~ 4, wherein the methanol conversion reactor comprises a methanol conversion reactor shell and a delivery pipe;

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

the lower shell encloses a reaction zone II, and a methanol conversion reactor distributor is arranged in an inner lower part of the 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 shell is arranged on a periphery of the delivery pipe;

the upper 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 II from bottom to top; ~~and~~

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

~~9. The device according to claim 8, wherein~~preferably, the gas-solid separation zone II 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 catalyst outlet of the first gas-solid separation unit of the methanol conversion reactor is

located 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 is connected to a product gas delivery pipe~~.~~;

~~10. The device according to claim 8, wherein~~preferably, the gas-solid separation zone II 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 located in the gas-solid separation zone II; a catalyst outlet of the second gas-solid separation unit of the methanol conversion reactor is located 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~~.~~;

~~11. The device according to claim 8, wherein~~preferably, 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; and a methanol conversion reactor cooler is further provided in the spent catalyst zone~~.~~;

~~12. The device according to claim 8, wherein~~preferably, 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~~.~~;

~~13. The device according to claim 8, wherein~~preferably, the gas-solid separation zone II communicates with the bed reactor gas collection chamber through a coke control product gas delivery pipe; and the reaction zone II communicates with the reaction zone I through the coke controlled catalyst delivery pipe.

~~14~~6. The device according to claim ~~7~~ 4, wherein the device further comprises a regenerator;

the regenerator is connected to the spent catalyst inclined pipe, and a spent catalyst is delivered to the regenerator;

the regenerator is connected to the riser reactor, and a regenerated catalyst is delivered to the

coke-control reactor; and

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

15. The device according to claim 14, 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 located above the regenerator distributor; 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 riser reactor; and the regenerator stripper is further provided with a regenerator cooler.;

16. The device according to claim 15, 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 an inlet of the riser reactor through the regenerator stripper and a regenerated catalyst inclined pipe.

17. The device according to claim 14 6, wherein the regenerator is further provided with a regenerator gas-solid separation unit and a regenerator gas collection chamber;

a catalyst outlet of the regenerator gas-solid separation unit is located 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.

18. A method for on-line modification of a dimethyl ether/methanol-to-olefins (DMTO) catalyst, comprising

feeding a riser reactor raw material and a catalyst into a transition zone from a riser reactor, and feeding a bed reactor raw material into a reaction zone I; and

allowing the catalyst to contact and react with the riser reactor raw material and the bed reactor raw material to generate a coke controlled catalyst and a coke control product gas, wherein

the catalyst is a DMTO catalyst; and

~~the coke controlled catalyst is a modified DMTO catalyst.~~

~~19. The method for on-line modification of a DMTO catalyst according to claim 18, wherein an active component of the catalyst is an SAPO-34 molecular sieve.~~

~~20. The method for on-line modification of a DMTO catalyst according to claim 18, wherein the catalyst is a regenerated catalyst; and~~

~~a coke content in the regenerated catalyst is less than or equal to 3 wt%.~~

~~21. The method for on-line modification of a DMTO catalyst according to claim 18, wherein a coke content in the coke controlled catalyst is 4 wt% to 9 wt%; and~~

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

~~22. The method for on-line modification of a DMTO catalyst according to claim 18, wherein 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 the coke species.~~

~~23. The method for on-line modification of a DMTO catalyst according to claim 18, wherein process operating conditions of the riser reactor are as follows: an apparent gas linear velocity is 3 m/s to 10 m/s; a reaction temperature is 400°C to 700°C; a reaction pressure is 100 kPa to 500 kPa; and a bed density is 10 kg/m^3 to 150 kg/m^3.~~

~~24. The method for on-line modification of a DMTO catalyst according to claim 18, wherein process operating conditions of the reaction zone I of a bed reactor are as follows: an apparent gas linear velocity is 0.1 m/s to 1.0 m/s; reaction temperature is 300°C to 650°C; a reaction pressure is 100 kPa to 500 kPa; and a bed density is 150 kg/m^3 to 800 kg/m^3.~~

~~25~~8. A method for preparing low-carbon olefins from an oxygen-containing compound, comprising ~~the method for on-line modification of a DMTO catalyst according to any one of claims 18 to 24~~

a method for on-line modification of a dimethyl ether/methanol to olefins (DMTO) catalyst; wherein the method for on-line modification of a DMTO catalyst comprises: feeding a riser reactor raw material and a catalyst into a transition zone from a riser reactor, and feeding a bed reactor raw material into a reaction zone I; and allowing the catalyst to contact and react with the riser reactor raw material and the bed reactor raw material to generate a coke controlled catalyst and a coke control product gas, wherein the catalyst is a DMTO catalyst; and the coke controlled catalyst is a modified DMTO catalyst.

9. The method according to claim 8, wherein an active component of the catalyst is an SAPO-34 molecular sieve;

preferably, the catalyst is a regenerated catalyst; and a coke content in the regenerated catalyst is less than or equal to 3 wt%;

preferably, a coke content in the coke controlled catalyst is 4 wt% to 9 wt%; and 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 the coke species;

preferably, process operating conditions of the riser reactor are as follows: an apparent gas linear velocity is 3 m/s to 10 m/s; a reaction temperature is 400°C to 700°C; a reaction pressure is 100 kPa to 500 kPa; and a bed density is 10 kg/m^3 to 150 kg/m^3;

preferably, process operating conditions of the reaction zone I of a bed reactor are as follows: an apparent gas linear velocity is 0.1 m/s to 1.0 m/s; reaction temperature is 300°C to 650°C; a reaction pressure is 100 kPa to 500 kPa; and a bed density is 150 kg/m^3 to 800 kg/m^3.

~~26~~10. The method according to claim ~~25~~ 8, further comprising: feeding a coke control product gas into a gas-solid separation zone of a methanol conversion reactor.

~~27~~11. The method according to claim ~~25~~ 8, further comprising: feeding a coke controlled

catalyst into a reaction zone II of a methanol conversion reactor~~.~~;

~~28. The method according to claim 27, 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 low-carbon olefins and a spent catalyst~~.~~;

~~29. The method according to claim 28, 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 a gas-solid separation zone II 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 low-carbon olefins, and the solid-phase stream C comprises the spent catalyst~~.~~;

~~30. The method according to claim 29, 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~~.~~;

~~31. The method according to claim 30, 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.

~~32~~12. The method according to claim ~~30~~ 11, wherein 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.

~~33~~13. The method according to claim ~~32~~ 12, wherein 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~~.~~;

~~34. The method according to claim 33, 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-control reactor.

~~35~~14. The method according to claim ~~28~~ 11, wherein the oxygen-containing compound comprises methanol and/or dimethyl ether (DME).

~~36~~15. The method according to claim ~~28~~ 11, wherein a coke content in the spent catalyst is 9 wt% to 13 wt%.

~~37~~16. The method according to claim ~~30~~ 11, wherein the spent catalyst zone fluidizing gas comprises nitrogen and/or water vapor.

~~38~~17. The method according to claim ~~33~~ 13, wherein 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; and

the air, the oxygen, the nitrogen, and the water vapor are not simultaneously zero.

~~39~~18. The method according to claim ~~25~~ 8, wherein process operating conditions of the reaction zone II of the methanol conversion reactor are as follows: an apparent gas linear velocity is 0.5 m/s to 7.0 m/s; a reaction temperature is 350°C to 550°C; a reaction pressure is 100 kPa to 500 kPa; and a bed density is 100 kg/m^3 to 500 kg/m^3.

~~40~~19. The method according to claim ~~25~~ 8, wherein process operating conditions of the spent catalyst zone of the methanol conversion reactor are as follows: an apparent gas linear velocity is

0.1 m/s to 1.0 m/s; a reaction temperature is 350°C to 550°C; a reaction pressure is 100 kPa to 500 kPa; and a bed density is 200 kg/m^3 to 800 kg/m^3.

~~41~~20. The method according to claim ~~25~~ 8, wherein process operating conditions of the regenerator are as follows: an apparent gas linear velocity is 0.5 m/s to 2.0 m/s; a regeneration temperature is 600°C to 750°C; a regeneration pressure is 100 kPa to 500 kPa; and a bed density is 150 kg/m^3 to 700 kg/m^3.