~~four or more carbons obtained from the separation section is returned back to~~ the pre-carbon deposition zone in the dense phase fluidized bed reactor;

step d) in which the spent catalyst flowed out from the n^{th} secondary reaction zone, after being stripped and lifted, is passed into a dense phase fluidized bed regenerator for regeneration; said spent catalyst is passed sequentially through 1^{st} to m^{th} secondary regeneration zones; a regeneration medium is introduced in parallel from m feeding branch lines of regeneration zone into the 1^{st} to m^{th} secondary regeneration zones, and the spent catalyst is brought into contact with the regeneration medium, with the carbon content thereof decreasing gradually; the catalyst after the completion of regeneration is returned back to the 1^{st} secondary pre-carbon deposition zone via stripping and lifting; wherein the dense phase fluidized bed regenerator is divided by a material flow controller into m secondary regeneration zones, and 1^{st} to n^{th} secondary regeneration zones are connected in sequence;

wherein $k \geq 1$, $n \geq 1$, and $m \geq 2$. More preferably, $4 \geq k \geq 2$, $8 \geq n \geq 3$, $8 \geq m \geq 3$.

In a preferred embodiment, in the dense phase fluidized bed reactor, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

In a preferred embodiment, in the dense phase fluidized bed regenerator, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

In a preferred embodiment, the catalyst comprise SAPO-34 molecular sieve.

In a preferred embodiment, the reaction conditions in the dense phase fluidized bed reactor are as follows: the apparent linear velocity of gas in the pre-carbon deposition zone and reaction zone is 0.1-1.5 m/s, the reaction temperature of the pre-carbon deposition zone is 500-650 °C, the reaction temperature in the reaction zone is 400-550 °C, and the bed density of the dense phase fluidized bed reactor is 200-1200 kg/m^3.

In a preferred embodiment, the average amount of carbon deposition on

to n^{th} secondary regeneration zones are connected in sequence.

Preferably, the catalyst after the completion of regeneration in step d) is subsequently returned back to the 1^{st} secondary pre-carbon deposition zone of the dense phase fluidized bed via stripping and lifting, wherein the lifting gas in the lifting process is any one of water vapor, a hydrocarbon with four or more carbons, naphtha, gasoline, condensate oil, light diesel oil, hydrogenation tail oil or kerosene, or a mixture thereof.

Preferably, $k \geq 1$, $n \geq 1$, $m \geq 2$. Preferably, $4 \geq k \geq 2$, $8 \geq n \geq 3$, $8 \geq m \geq 3$.

Preferably, in the dense phase fluidized bed reactor, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

Preferably, in the dense phase fluidized bed regenerator, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

Preferably, the catalyst comprises SAPO-34 molecular sieve.

Preferably, the reaction conditions of the dense phase fluidized bed reactor are as follows: the apparent linear velocity of gas in the pre-carbon deposition zone and the reaction zone is 0.1-1.5 m/s, the reaction temperature in the pre-carbon deposition zone is 500-650 °C, the reaction temperature of the reaction zone is 400-550 °C, and the bed density is 200-1200 kg/m^3. Preferably, the average amount of carbon deposition on catalyst is increased in sequence from the 1st secondary pre-carbon deposition zone to n^{th} secondary reaction zone in the dense phase fluidized bed reactor, wherein the average amount of carbon deposition on catalyst in the k^{th} secondary pre-carbon deposition zone is 0.5-3 wt%, and the average amount of carbon deposition on catalyst in the n^{th} secondary reaction zone is 7-10 wt%.

Preferably, the reaction conditions in the regeneration zone of the dense phase fluidized bed are as follows: the apparent linear velocity of gas is 0.1-1.5 m/s, the reaction temperature is 500-700 °C, and the bed density is 200-1200 kg/m^3.

WHAT IS CLAIMED IS:

1. A method for preparing a light olefin using an oxygen-containing compound, comprising the following steps:

step a) in which a hydrocarbon with four or more carbons is introduced from k feeding branch lines of pre-carbon deposition zone in parallel into k secondary pre-carbon deposition zones in a dense phase fluidized bed reactor, and is brought into contact with a completely regenerated and/or fresh catalyst, so as to be converted into a light olefin product-containing stream, while forming a pre-carbon deposited catalyst; wherein the catalyst is passed sequentially through 1^{st} to k^{th} secondary pre-carbon deposition zones, with carbon content thereof increasing gradually; wherein the dense phase fluidized bed reactor is divided by a material flow controller into a pre-carbon deposition zone and a reaction zone; and wherein the pre-carbon deposition zone of the dense phase fluidized bed reactor is divided by a material flow controller into k secondary pre-carbon deposition zones, with 1^{st} to k^{th} secondary pre-carbon deposition zones being connected in sequence;

step b) in which a raw material comprising the oxygen-containing compound is introduced from n feeding branch lines of reaction zone in parallel into n secondary reaction zones of the dense phase fluidized bed reactor, and is brought into contact with the pre-carbon deposited catalyst, to generate a light olefin product-containing stream and a spent catalyst; wherein the pre-carbon deposited catalyst flowed out from the k^{th} secondary pre-carbon deposition zone is passed sequentially through 1^{st} to n^{th} secondary reaction zones, with carbon content thereof increasing gradually; wherein the reaction zone of the dense phase fluidized bed reactor is divided by a material flow controller into n secondary reaction zones, with 1^{st} to n^{th} secondary reaction zones being connected in sequence, and the 1^{st} secondary reaction zone being connected to the downstream of the k^{th} secondary pre-carbon deposition zone;

step c) in which the light olefin product-containing stream flowed out from

the pre-carbon deposition zone and the reaction zone is separated from the entrained spent catalyst; the isolated spent catalyst is passed into the n^{th} secondary reaction zone; and the light olefin product-containing stream is passed into a product separation section, in which the light olefin product is obtained by isolation and purification, and the hydrocarbon byproduct with four or more carbons obtained from the separation section is returned back to the pre-carbon deposition zone in the dense phase fluidized bed reactor; and

step d) in which the spent catalyst flowed out from the n^{th} secondary reaction zone, after being stripped and lifted, is passed into a dense phase fluidized bed regenerator for regeneration; said spent catalyst is passed sequentially through 1^{st} to m^{th} secondary regeneration zones; a regeneration medium is introduced in parallel from m feeding branch lines of regeneration zone into the 1^{st} to m^{th} secondary regeneration zones, and the spent catalyst is brought into contact with the regeneration medium, with the carbon content thereof decreasing gradually; the catalyst after the completion of regeneration is returned back to the 1^{st} secondary pre-carbon deposition zone via stripping and lifting; wherein the dense phase fluidized bed regenerator is divided by a material flow controller into m secondary regeneration zones, and 1^{st} to n^{th} secondary regeneration zones are connected in sequence;

wherein $k \geq 1$, $n \geq 1$, and $m \geq 2$.

2. The method according to claim 1, characterized in that $4 \geq k \geq 2$, $8 \geq n \geq 3$, and $8 \geq m \geq 3$.

3. The method according to claim 1, characterized in that, in the dense phase fluidized bed reactor, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

4. The method according to claim 1, characterized in that, in the dense phase fluidized bed regenerator, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

5. The method according to claim 1, characterized in that the catalyst comprises SAPO-34 molecular sieve.

6. The method according to claim 1, characterized in that the reaction conditions in the dense phase fluidized bed reactor are as follows: the apparent linear velocity of gas in the pre-carbon deposition zone and the reaction zone is 0.1-1.5 m/s, the reaction temperature in the pre-carbon deposition zone is 500-650 °C, the temperature in the reaction zone is 400-550 °C, and the bed density in the dense phase fluidized bed reactor is 200-1200 kg/m^3.

7. The method according to claim 1, characterized in that the average amount of carbon deposition on catalyst is increased in sequence from the 1^{st} secondary pre-carbon deposition zone to the n^{th} secondary reaction zone in the dense phase fluidized bed reactor, wherein the average amount of carbon deposition on catalyst in the k^{th} secondary pre-carbon deposition zone is 0.5-3 wt%, and the average amount of carbon deposition on catalyst in the n^{th} secondary reaction zone is 7-10 wt%.

8. The method according to claim 1, characterized in that the reaction conditions in the regeneration zone of the dense phase fluidized bed are as follows: the apparent linear velocity of gas is 0.1-1.5 m/s, the reaction temperature is 500-700 °C, and the bed density is 200-1200 kg/m^3.

9. The method according to claim 1, characterized in that the average amount of carbon deposition on catalyst is decreased in sequence from the 1^{st} to m^{th} secondary regeneration zones in the dense phase fluidized bed regeneration zone, wherein the average amount of carbon deposition on catalyst in the 1^{st} secondary regeneration zone is 2-10 wt%, and the average amount of carbon deposition on catalyst in the m^{th} secondary regeneration zone is 0-0.1 wt%.

10. The method according to claim 1, characterized in that the oxygen-containing compound is methanol and/or dimethyl ether; the light olefin is any one of ethylene, propylene or butylene, or a mixture thereof; the hydrocarbon with four or more carbons is any one of naphtha, gasoline,

condensate oil, light diesel oil, hydrogenation tail oil or kerosene, or a mixture thereof; and the regeneration medium is any one of air, oxygen-deficient air or water vapor, or a mixture thereof.

11. The method according to claim 1, characterized in that the catalyst after the completion of regeneration in step d) is subsequently returned back to the 1st secondary pre-carbon deposition zone of the dense phase fluidized bed via stripping and lifting, wherein the lifting gas in the lifting process is any one of water vapor, a hydrocarbon with four or more carbons, naphtha, gasoline, condensate oil, light diesel oil, hydrogenation tail oil or kerosene, or a mixture thereof.

four or more carbons obtained from the separation section is returned back to the pre-carbon deposition zone in the dense phase fluidized bed reactor;

step d) in which the spent catalyst flowed out from the n^{th} secondary reaction zone, after being stripped and lifted, is passed into a dense phase fluidized bed regenerator for regeneration; said spent catalyst is passed sequentially through 1^{st} to m^{th} secondary regeneration zones; a regeneration medium is introduced in parallel from m feeding branch lines of regeneration zone into the 1^{st} to m^{th} secondary regeneration zones, and the spent catalyst is brought into contact with the regeneration medium, with the carbon content thereof decreasing gradually; the catalyst after the completion of regeneration is returned back to the 1^{st} secondary pre-carbon deposition zone via stripping and lifting; wherein the dense phase fluidized bed regenerator is divided by a material flow controller into m secondary regeneration zones, and 1^{st} to m^{th} secondary regeneration zones are connected in sequence;

wherein $k \geq 1$, $n \geq 1$, and $m \geq 2$. More preferably, $4 \geq k \geq 2$, $8 \geq n \geq 3$, $8 \geq m \geq 3$.

In a preferred embodiment, in the dense phase fluidized bed reactor, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

In a preferred embodiment, in the dense phase fluidized bed regenerator, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

In a preferred embodiment, the catalyst comprise SAPO-34 molecular sieve.

In a preferred embodiment, the reaction conditions in the dense phase fluidized bed reactor are as follows: the apparent linear velocity of gas in the pre-carbon deposition zone and reaction zone is 0.1-1.5 m/s, the reaction temperature of the pre-carbon deposition zone is 500-650 °C, the reaction temperature in the reaction zone is 400-550 °C, and the bed density of the dense phase fluidized bed reactor is 200-1200 kg/m^3.

In a preferred embodiment, the average amount of carbon deposition on

to m^{th} secondary regeneration zones are connected in sequence.

Preferably, the catalyst after the completion of regeneration in step d) is subsequently returned back to the 1^{st} secondary pre-carbon deposition zone of the dense phase fluidized bed via stripping and lifting, wherein the lifting gas in the lifting process is any one of water vapor, a hydrocarbon with four or more carbons, naphtha, gasoline, condensate oil, light diesel oil, hydrogenation tail oil or kerosene, or a mixture thereof.

Preferably, $k \geq 1$, $n \geq 1$, $m \geq 2$. Preferably, $4 \geq k \geq 2$, $8 \geq n \geq 3$, $8 \geq m \geq 3$.

Preferably, in the dense phase fluidized bed reactor, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

Preferably, in the dense phase fluidized bed regenerator, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

Preferably, the catalyst comprises SAPO-34 molecular sieve.

Preferably, the reaction conditions of the dense phase fluidized bed reactor are as follows: the apparent linear velocity of gas in the pre-carbon deposition zone and the reaction zone is 0.1-1.5 m/s, the reaction temperature in the pre-carbon deposition zone is 500-650 °C, the reaction temperature of the reaction zone is 400-550 °C, and the bed density is 200-1200 kg/m^3. Preferably, the average amount of carbon deposition on catalyst is increased in sequence from the 1st secondary pre-carbon deposition zone to n^{th} secondary reaction zone in the dense phase fluidized bed reactor, wherein the average amount of carbon deposition on catalyst in the k^{th} secondary pre-carbon deposition zone is 0.5-3 wt%, and the average amount of carbon deposition on catalyst in the n^{th} secondary reaction zone is 7-10 wt%.

Preferably, the reaction conditions in the regeneration zone of the dense phase fluidized bed are as follows: the apparent linear velocity of gas is 0.1-1.5 m/s, the reaction temperature is 500-700 °C, and the bed density is 200-1200 kg/m^3.

WHAT IS CLAIMED IS:

1. A method for preparing a light olefin using an oxygen-containing compound, comprising the following steps:

step a) in which a hydrocarbon with four or more carbons is introduced from k feeding branch lines of pre-carbon deposition zone in parallel into k secondary pre-carbon deposition zones in a dense phase fluidized bed reactor, and is brought into contact with a completely regenerated and/or fresh catalyst, so as to be converted into a light olefin product-containing stream, while forming a pre-carbon deposited catalyst; wherein the catalyst is passed sequentially through 1^{st} to k^{th} secondary pre-carbon deposition zones, with carbon content thereof increasing gradually; wherein the dense phase fluidized bed reactor is divided by a material flow controller into a pre-carbon deposition zone and a reaction zone; and wherein the pre-carbon deposition zone of the dense phase fluidized bed reactor is divided by a material flow controller into k secondary pre-carbon deposition zones, with 1^{st} to k^{th} secondary pre-carbon deposition zones being connected in sequence;

step b) in which a raw material comprising the oxygen-containing compound is introduced from n feeding branch lines of reaction zone in parallel into n secondary reaction zones of the dense phase fluidized bed reactor, and is brought into contact with the pre-carbon deposited catalyst, to generate a light olefin product-containing stream and a spent catalyst; wherein the pre-carbon deposited catalyst flowed out from the k^{th} secondary pre-carbon deposition zone is passed sequentially through 1^{st} to n^{th} secondary reaction zones, with carbon content thereof increasing gradually; wherein the reaction zone of the dense phase fluidized bed reactor is divided by a material flow controller into n secondary reaction zones, with 1^{st} to n^{th} secondary reaction zones being connected in sequence, and the 1^{st} secondary reaction zone being connected to the downstream of the k^{th} secondary pre-carbon deposition zone;

step c) in which the light olefin product-containing stream flowed out from

the pre-carbon deposition zone and the reaction zone is separated from the entrained spent catalyst; the isolated spent catalyst is passed into the n^{th} secondary reaction zone; and the light olefin product-containing stream is passed into a product separation section, in which the light olefin product is obtained by isolation and purification, and the hydrocarbon byproduct with four or more carbons obtained from the separation section is returned back to the pre-carbon deposition zone in the dense phase fluidized bed reactor; and

step d) in which the spent catalyst flowed out from the n^{th} secondary reaction zone, after being stripped and lifted, is passed into a dense phase fluidized bed regenerator for regeneration; said spent catalyst is passed sequentially through 1^{st} to m^{th} secondary regeneration zones; a regeneration medium is introduced in parallel from m feeding branch lines of regeneration zone into the 1^{st} to m^{th} secondary regeneration zones, and the spent catalyst is brought into contact with the regeneration medium, with the carbon content thereof decreasing gradually; the catalyst after the completion of regeneration is returned back to the 1^{st} secondary pre-carbon deposition zone via stripping and lifting; wherein the dense phase fluidized bed regenerator is divided by a material flow controller into m secondary regeneration zones, and 1^{st} to m^{th} secondary regeneration zones are connected in sequence;

wherein $k \geq 1$, $n \geq 1$, and $m \geq 2$.

2. The method according to claim 1, characterized in that $4 \geq k \geq 2$, $8 \geq n \geq 3$, and $8 \geq m \geq 3$.

3. The method according to claim 1, characterized in that, in the dense phase fluidized bed reactor, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

4. The method according to claim 1, characterized in that, in the dense phase fluidized bed regenerator, the apparent linear velocity of gas in the material flow controller is less than or equals to the minimum fluidizing velocity of the catalyst.

5. The method according to claim 1, characterized in that the catalyst comprises SAPO-34 molecular sieve.

6. The method according to claim 1, characterized in that the reaction conditions in the dense phase fluidized bed reactor are as follows: the apparent linear velocity of gas in the pre-carbon deposition zone and the reaction zone is 0.1-1.5 m/s, the reaction temperature in the pre-carbon deposition zone is 500-650 °C, the temperature in the reaction zone is 400-550 °C, and the bed density in the dense phase fluidized bed reactor is 200-1200 kg/m^3.

7. The method according to claim 1, characterized in that the average amount of carbon deposition on catalyst is increased in sequence from the 1^{st} secondary pre-carbon deposition zone to the n^{th} secondary reaction zone in the dense phase fluidized bed reactor, wherein the average amount of carbon deposition on catalyst in the k^{th} secondary pre-carbon deposition zone is 0.5-3 wt%, and the average amount of carbon deposition on catalyst in the n^{th} secondary reaction zone is 7-10 wt%.

8. The method according to claim 1, characterized in that the reaction conditions in the regeneration zone of the dense phase fluidized bed are as follows: the apparent linear velocity of gas is 0.1-1.5 m/s, the reaction temperature is 500-700 °C, and the bed density is 200-1200 kg/m^3.

9. The method according to claim 1, characterized in that the average amount of carbon deposition on catalyst is decreased in sequence from the 1^{st} to m^{th} secondary regeneration zones in the dense phase fluidized bed regeneration zone, wherein the average amount of carbon deposition on catalyst in the 1^{st} secondary regeneration zone is 2-10 wt%, and the average amount of carbon deposition on catalyst in the m^{th} secondary regeneration zone is 0-0.1 wt%.

10. The method according to claim 1, characterized in that the oxygen-containing compound is methanol and/or dimethyl ether.

11. The method according to claim 1, characterized in that the light olefin is any one of ethylene, propylene or butylene, or a mixture thereof.

12. The method according to claim 1, characterized in that the hydrocarbon with four or more carbons is any one of naphtha, gasoline, condensate oil, light diesel oil, hydrogenation tail oil or kerosene, or a mixture thereof.

13. The method according to claim 1, characterized in that the regeneration medium is any one of air, oxygen-deficient air or water vapor, or a mixture thereof.

14. The method according to claim 1, characterized in that the catalyst after the completion of regeneration in step d) is subsequently returned back to the 1st secondary pre-carbon deposition zone of the dense phase fluidized bed via stripping and lifting, wherein the lifting gas in the lifting process is any one of water vapor, a hydrocarbon with four or more carbons, naphtha, gasoline, condensate oil, light diesel oil, hydrogenation tail oil or kerosene, or a mixture thereof.