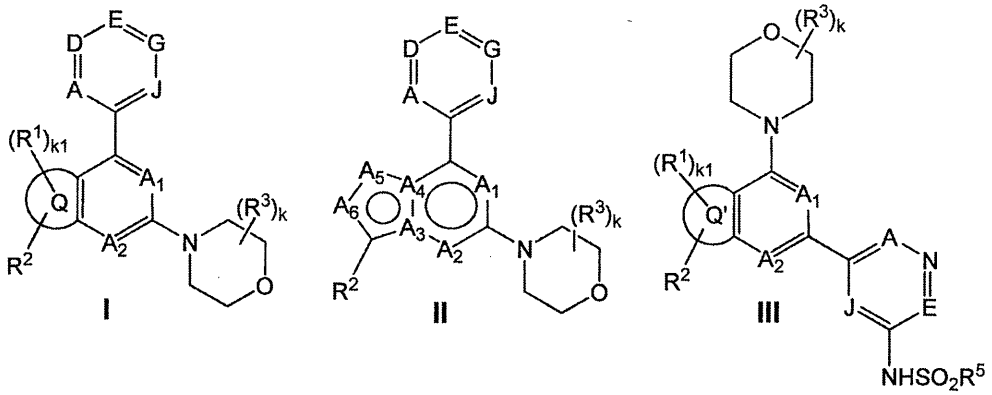
invention as an inhibitor with selectivity against PI3K δ can be used to prepare a medicament for treating cancers, infection, inflammation or cell proliferation diseases such as autoimmune diseases.

The present invention provides a fused heterocyclic compound represented by formula I, formula II or formula III, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof,



wherein,

A_1 is N or CH;

A_2 is N or CH;

A_3 is N or C;

A_4 is N or C;

A_5 is O, S, N, CR^{1a} or NR^{5a};

A_6 is O, S, N, CR^{1b} or NR^{5b};

When A_5 is O or S, A_6 is N;

When A_6 is O or S, A_5 is N;

R^{1a} and R^{1b} are each independently a hydrogen, a deuterium, a halogen, an alkyl, an alkoxy, an alkenyl, an alkynyl, a cycloalkyl, a heterocycloalkyl or CN;

R^2 is $-(CR^8R^9)_mNR^5R^6$, $-(CR^8R^9)_mNR^7C(=Y)R^5$, $-(CR^8R^9)_mNR^7S(O)_2R^5$, $-(CR^8R^9)_mOR^5$, $-(CR^8R^9)_mS(O)_2R^5$, $-(CR^8R^9)_mS(O)_2NR^5R^6$, $-C(OR^5)R^6R^8$, $-C(=Y)R^5$, $-C(=Y)OR^5$, $-C(=Y)NR^5R^6$, $-C(=Y)NR^7OR^5$, $-C(=O)NR^7S(O)_2R^5$, $-C(=O)NR^7(CR^8R^9)_mNR^5R^6$, $-NR^7C(=Y)R^6$, $-NR^7C(=Y)OR^6$, $-NR^7C(=Y)NR^5R^6$, $-NR^7S(O)_2R^5$, $-NR^7S(O)_2NR^5R^6$, $-SR^5$, $-S(O)_2R^5$, $-S(O)_2NR^5R^6$, $-SC(=Y)R^5$, $-SC(=Y)OR^5$, $-O(CR^8R^9)_mCHR^5R^6$, $-O(CR^8R^9)_mNR^5R^6$, a C_{1-12} alkyl, a C_{2-8} alkenyl, a C_{2-8} alkynyl, a C_{3-12} carbocyclic group, a C_{2-20} heterocyclic group, a C_{6-20} aryl or a C_{1-20} heteroaryl;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is independently a hydrogen, a deuterium, a halogen, a C_{1-6} alkyl, or any two of the R^3 are linked by a single bond, a C_{1-6} alkylene or a C_{1-6} alkylene substituted by one or two heteroatoms to form a ring structure, the heteroatom is O, N, or S;

A is N or CR^{4a};

D is N or CR^{4d};

E is N or CR^{4e};

G is N or CR^{4g};

J is N or CR^{4j};

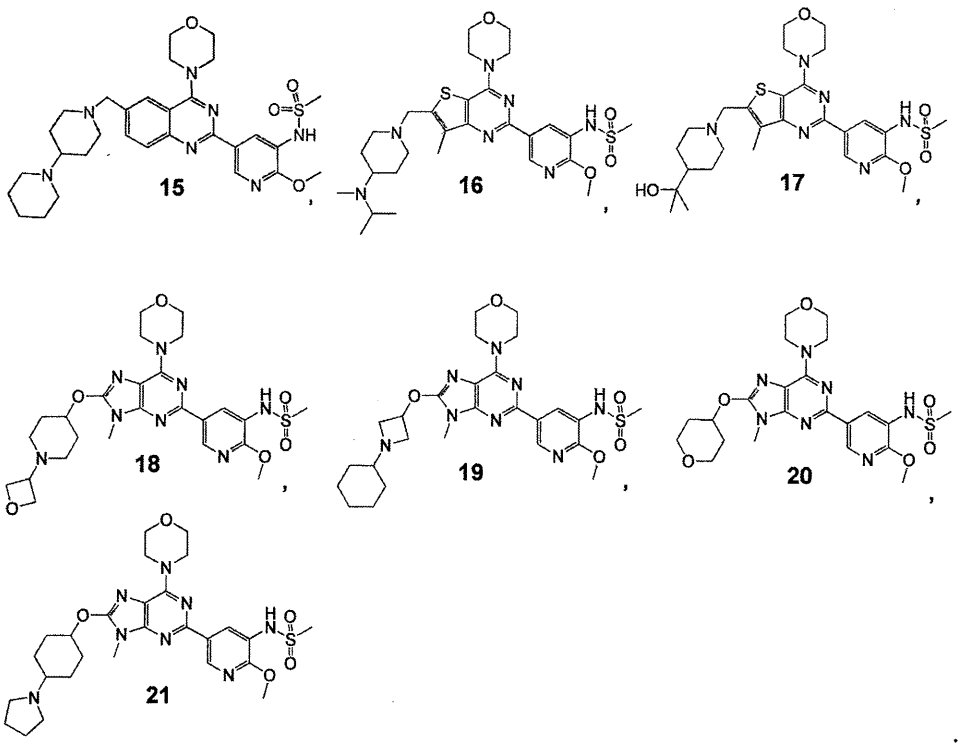
A, D, E, G and J are not N at the same time;

R^{4a}, R^{4d}, R^{4e}, R^{4g} and R^{4j} are each independently a hydrogen, a halogen, -CN, an alkyl, an alkoxy, an alkenyl, an alkynyl, a cycloalkyl, a heterocycloalkyl, $-NR^5R^6$, $-OR^5$, $-SR^5$, $-C(O)R^5$, $-NR^5C(O)R^6$, $-N(C(O)R^6)_2$, $-NR^5C(O)NR^{5'}R^6$, $-NR^7S(O)_2R^5$, $-C(=O)OR^5$ or $-C(=O)NR^5R^6$, or R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially unsaturated 5-membered or 6-membered heterocycle, the 5-membered or 6-membered heterocycle is fused to the 6-membered ring containing A, D, E, G and J;

ring Q and ring Q' are benzene, a 5- to 9-membered alicyclic ring, a 5- to 9-membered heteroalicyclic ring, or a 5- to 6-membered heterocyclic ring; ring Q is not a thiophene or a furan; $(R^1)_{k1}$ represents that the hydrogens attached to the ring Q or ring Q' are substituted by 0-k1 occurrences of R^1, at each occurrence the R^1 is the same or different from each other, and is each independently a halogen, -CN, an alkyl, an alkoxy, an alkenyl, an alkynyl, a cycloalkyl, a heterocycloalkyl, $-NR^5R^6$, $-OR^5$, $-SR^5$, $-C(O)R^5$, $-NR^5C(O)R^6$, $-N(C(O)R^6)_2$, $-NR^5C(O)NR^{5'}R^6$, $-NR^7S(O)_2R^5$, $-C(=O)OR^5$ or $-C(=O)NR^5R^6$;

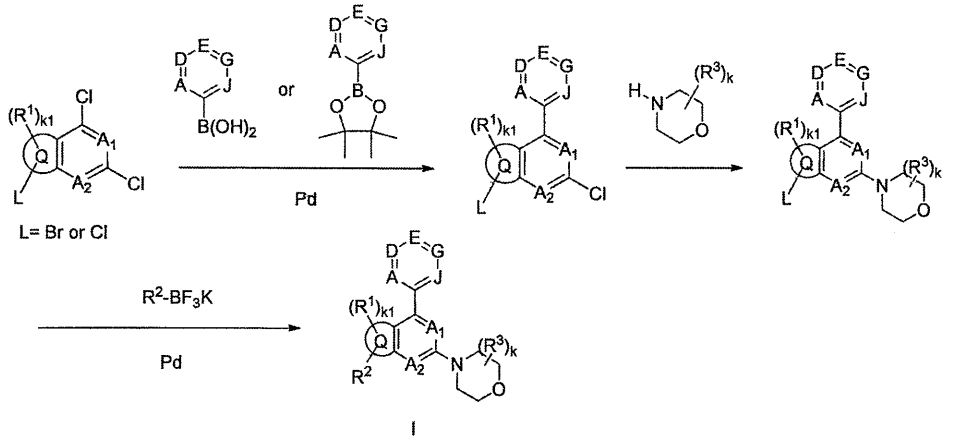
R^5, $R^{5'}$, R^{5a}, R^{5b}, R^6, R^7 and $R^{7'}$ are each independently a hydrogen, a C_{1-12} alkyl, $-(CH_2)_{2-3}NH_2$, a C_{2-8} alkenyl, a C_{2-8} alkynyl, a C_{3-12} carbocyclic group, a C_{2-20} heterocyclic group, a C_{6-20} aryl or a C_{1-20} heteroaryl, or R^5, R^6 together with the nitrogen or carbon atoms to which they are directly attached form a heterocyclic ring or a cycloalkyl, or R^7, $R^{7'}$ together with the nitrogen atom to which R^7 is directly attached form a heterocyclic ring; the heterocyclic ring or the cycloalkyl may be optionally substituted by the substituent selected from the group consisting of: oxo, $-(CH_2)_mOR^7$, $-NR^7R^{7'}$, $-CF_3$, a halogen, $-SO_2R^7$, $-C(=O)R^7$, $-NR^7C(=Y)R^{7'}$, $-NR^7S(O)_2R^{7'}$, $-C(=Y)NR^7R^{7'}$, a C_{1-12} alkyl, a C_{2-8} alkenyl, a C_{2-8} alkynyl, a C_{3-12} carbocyclic group, a C_{2-20} heterocyclic group, a C_{6-20} aryl or a C_{1-20} heteroaryl;

$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked with each other, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and are each independently a hydrogen, a deuterium, a



The present invention also provides a process for preparing the fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof, which may use commercially available raw materials, known methods in the art in combination with the contents disclosed in the present invention. Specific routes are as following:

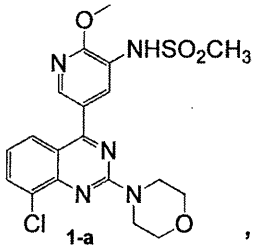
Reaction route I comprises the following steps:



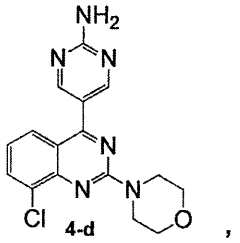
Reaction route II comprises the following steps:

subsequent editions. In addition, the compounds obtained according to the methods above can be further modified in peripheral positions to give other target compounds of the present invention according to the relevant methods disclosed in the above references.

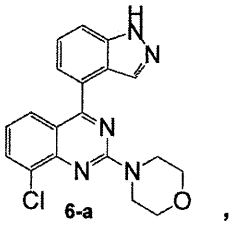
The present invention also provides a compound represented by the structure selected from the group consisting of:



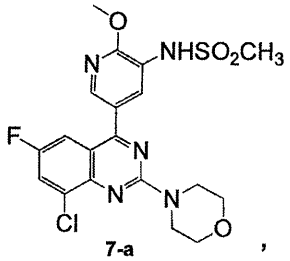
1-a ,



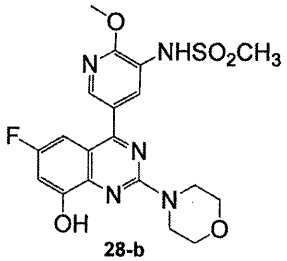
4-d ,



6-a ,



7-a ,



28-b .

At least one of the fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof prepared by the above routes can be purified by column chromatograph, HPLC, crystallization or other proper conditions.

The conditions and steps used in the purification method such as column chromatograph, HPLC and crystallization can refer to conventional conditions and steps in the art.

The above fused heterocyclic compound provided in the present invention can exhibit tautomerism, structural isomerism and stereoisomerism. The present invention includes any tautomer, structural isomer or stereo isomer of the compound and their mixtures, they have the ability of regulating the activity of the kinase and this ability is not limited to any isomer or the form of its mixture.

The present invention also provides a use of the fused heterocyclic compound represented by formula I, formula II or formula III, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof in manufacturing an inhibitor of kinase.
The present invention also provides a use of the fused heterocyclic compound represented by formula I, formula II or formula III, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof in manufacturing a medicament for treating and/or preventing a disease related to the kinase.

In the present invention, the kinase is preferably PI3 kinase (PI3K), more preferably p110 δ subtype of PI3K (PI3K).

The present invention also provides a pharmaceutical composition, which comprises a therapeutically effective dosage of one or more of the fused heterocyclic compounds represented by formula I, formula II or formula III, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof, and a pharmaceutically acceptable carrier.

In the present invention, the term "therapeutically effective dosage" means (i) the amount of the compound of the present invention required for preventing or treating the specific disease or disorder described in the application; (ii) the amount of the compound of the present invention required for attenuating, ameliorating or eliminating one or more symptoms of the specific disease or disorder described in the application; or (iii) the amount of the compound of the present invention required for preventing or delaying the onset of one or more symptoms of the specific disease or disorder described in the application. The dosage for treating human patients may range from 0.0001 mg/kg to 50 mg/kg, most typically 0.001 mg/kg to 10 mg/kg body weight, e.g. within the range from 0.01 mg/kg to 1 mg/kg. Such a dosage may be administered, for example 1-5 times a day.

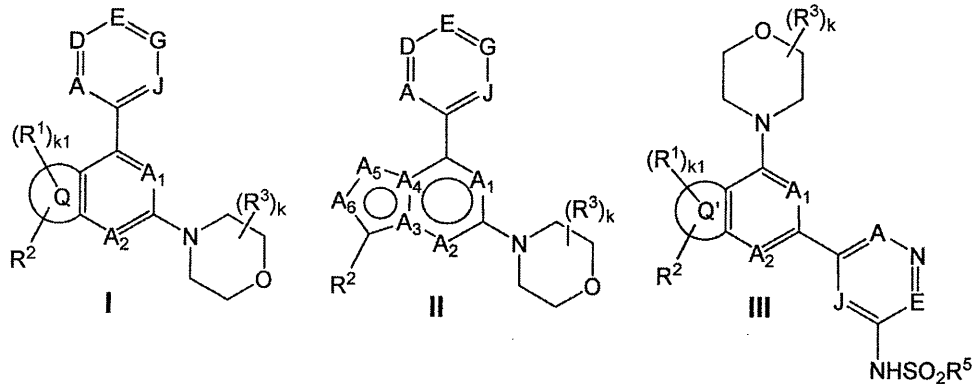
Depending on the purpose of therapy, the pharmaceutical composition can be prepared into a variety of unit dose formulations, such as tablets, pills, powder, liquid, suspensions, emulsions, granules, capsules, suppositories and injections (solutions and suspensions) and so on, and preferably liquids, suspensions, emulsions, suppositories and injections (solutions and suspensions) etc.

In order to make the pharmaceutical composition form a tablet preparation, any known and widely used excipient in the art can be used. For example, carriers (such as lactose, sugar, sodium chloride, glucose, carbamide, starch, calcium carbonate, kaolin, crystalline cellulose and silicic acid etc.), adhesive (such as water, ethanol, propanol, ordinary syrup, glucose solution, starch solution, gelatin solution , carboxymethyl cellulose, lac, methyl cellulose and potassium phosphate, Polyvinylpyrrolidone, etc.), disintegrant (such as dry starch, sodium alginate, agar powder and kelp powder, sodium bicarbonate, calcium carbonate, the polyethylene sorbitan fatty acid ester, sodium dodecyl sulfate, stearic acid monoglyceride, starch and lactose, etc.), disintegration inhibitor (such as sugar, glyceryl tristearate, coconut oil and hydrogenated oil), adsorption accelerant (such as quaternary amine base and sodium dodecyl sulfate, etc.), wetting agent (such as glycerin, starch, etc.), sorbent (such as starch, lactose, kaolin, bentonite and colloid silicic acid, etc.) and lubricant (such as pure talc, stearate, boric acid powder and polyethyleneglycol, etc.). Common coating materials can also be used according to the requirements to form sugar-coated tablets, gelatin-coated tablets, enteric coated tablets, film-coated tablets, double film coated tablets and multiple film coated tablets.

In order to make the pharmaceutical composition form a pill preparation, any known

What is claimed is:

1. A fused heterocyclic compound represented by formula I, formula II or formula III, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof,



wherein,

A_1 is N or CH;

A_2 is N or CH;

A_3 is N or C;

A_4 is N or C;

A_5 is O, S, N, CR^{1a} or NR^{5a};

A_6 is O, S, N, CR^{1b} or NR^{5b};

When A_5 is O or S, A_6 is N;

When A_6 is O or S, A_5 is N;

R^{1a} and R^{1b} are each independently a hydrogen, a deuterium, a halogen, an alkyl, an alkoxy, an alkenyl, an alkynyl, a cycloalkyl, a heterocycloalkyl or CN;

R^2 is $-(CR^8R^9)_mNR^5R^6$, $-(CR^8R^9)_mNR^7C(=Y)R^5$, $-(CR^8R^9)_mNR^7S(O)_2R^5$, $-(CR^8R^9)_mOR^5$, $-(CR^8R^9)_mS(O)_2R^5$, $-(CR^8R^9)_mS(O)_2NR^5R^6$, $-C(OR^5)R^6R^8$, $-C(=Y)R^5$, $-C(=Y)OR^5$, $-C(=Y)NR^5R^6$, $-C(=Y)NR^7OR^5$, $-C(=O)NR^7S(O)_2R^5$, $-C(=O)NR^7(CR^8R^9)_mNR^5R^6$, $-NR^7C(=Y)R^6$, $-NR^7C(=Y)OR^6$, $-NR^7C(=Y)NR^5R^6$, $-NR^7S(O)_2R^5$, $-NR^7S(O)_2NR^5R^6$, $-SR^5$, $-S(O)_2R^5$, $-S(O)_2NR^5R^6$, $-SC(=Y)R^5$, $-SC(=Y)OR^5$, $-O(CR^8R^9)_mCHR^5R^6$, $-O(CR^8R^9)_mNR^5R^6$, a C_{1-12} alkyl, a C_{2-8} alkenyl, a C_{2-8} alkynyl, a C_{3-12} carbocyclic group, a C_{2-20} heterocyclic group, a C_{6-20} aryl or a C_{1-20} heteroaryl;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is independently a hydrogen, a deuterium, a halogen, a C_{1-6} alkyl, or any

two of the R^3 are linked by a single bond, a C_{1-6} alkylene or a C_{1-6} alkylene substituted by one or two heteroatoms to form a ring structure, the heteroatom is O, N, or S;

A is N or CR^{4a};

D is N or CR^{4d};

E is N or CR^{4e};

G is N or CR^{4g};

J is N or CR^{4j};

A, D, E, G and J are not N at the same time;

R^{4a}, R^{4d}, R^{4e}, R^{4g} and R^{4j} are each independently a hydrogen, a halogen, -CN, an alkyl, an alkoxy, an alkenyl, an alkynyl, a cycloalkyl, a heterocycloalkyl, $-NR^5R^6$, $-OR^5$, $-SR^5$, $-C(O)R^5$, $-NR^5C(O)R^6$, $-N(C(O)R^6)_2$, $-NR^5C(O)NR^{5'}R^6$, $-NR^7S(O)_2R^5$, $-C(=O)OR^5$ or $-C(=O)NR^5R^6$, or R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially unsaturated 5-membered or 6-membered heterocycle, the 5-membered or 6-membered heterocycle is fused to the 6-membered ring containing A, D, E, G and J;

ring Q and ring Q' are benzene, a 5- to 9-membered alicyclic ring, a 5- to 9-membered heteroalicyclic ring, or a 5- to 6-membered heterocyclic ring; ring Q is not a thiophene or a furan; $(R^1)_{k1}$ represents that the hydrogens attached to the ring Q or ring Q' are substituted by 0-k1 occurrences of R^1, at each occurrence the R^1 is the same or different from each other, and is each independently a halogen, -CN, an alkyl, an alkoxy, an alkenyl, an alkynyl, a cycloalkyl, a heterocycloalkyl, $-NR^5R^6$, $-OR^5$, $-SR^5$, $-C(O)R^5$, $-NR^5C(O)R^6$, $-N(C(O)R^6)_2$, $-NR^5C(O)NR^{5'}R^6$, $-NR^7S(O)_2R^5$, $-C(=O)OR^5$ or $-C(=O)NR^5R^6$;

R^5, $R^{5'}$, R^{5a}, R^{5b}, R^6, R^7 and $R^{7'}$ are each independently a hydrogen, a C_{1-12} alkyl, $-(CH_2)_{2-3}NH_2$, a C_{2-8} alkenyl, a C_{2-8} alkynyl, a C_{3-12} carbocyclic group, a C_{2-20} heterocyclic group, a C_{6-20} aryl or a C_{1-20} heteroaryl, or R^5, R^6 together with the nitrogen or carbon atoms to which they are directly attached form a heterocyclic ring or a cycloalkyl, or R^7, $R^{7'}$ together with the nitrogen atom to which R^7 is directly attached form a heterocyclic ring; the heterocyclic ring or the cycloalkyl is preferably optionally substituted by the substituent selected from the group consisting of: oxo, $-(CH_2)_mOR^7$, $-NR^7R^{7'}$, $-CF_3$, a halogen, $-SO_2R^7$, $-C(=O)R^7$, $-NR^7C(=Y)R^{7'}$, $-NR^7S(O)_2R^{7'}$, $-C(=Y)NR^7R^{7'}$, a C_{1-12} alkyl, a C_{2-8} alkenyl, a C_{2-8} alkynyl, a C_{3-12} carbocyclic group, a C_{2-20} heterocyclic group, a C_{6-20} aryl or a C_{1-20} heteroaryl;

$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked with each other, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and are each independently a hydrogen, a deuterium, a halogen, -CN, a hydroxyl, an alkoxy, a C_{1-12} alkyl, a C_{2-12} alkenyl, a C_{2-12} alkynyl, a C_{3-12} cycloalkyl, a C_{6-12} aryl, a 3- to 12-membered heterocycloalkyl or a 5- to 12-membered heteroaryl; or R^8, R^9 together with the atoms to which they are attached

form a saturated or partially unsaturated C_{3-12} carbon ring or C_{2-20} heterocyclic ring;

wherein the alkyl, alkoxy, alkenyl, alkynyl, cycloalkyl, carbocyclic ring, heterocyclic ring, heterocycloalkyl, aryl, or heterocyclic group can be optionally substituted by the substituent selected from the group consisting of: a halogen, a hydroxyl, -CN, $-CF_3$, $-NO_2$, oxo, R^5, $-C(=Y)R^5$, $-C(=Y)OR^5$, $-C(=Y)NR^5R^6$, $-(CR^8R^9)_mNR^5R^6$, $-(CR^8R^9)_mOR^5$, $-NR^5R^6$, $-NR^7C(=Y)R^5$, $-NR^7C(=Y)OR^6$, $-NR^7C(=Y)NR^5R^6$, $-(CR^8R^9)_mNR^7SO_2R^5$, $=NR^7$, OR^5, $-OC(=Y)R^5$, $-OC(=Y)OR^5$, $-OC(=Y)NR^5R^6$, $-OS(O)_2(OR^5)$, $-OP(=Y)(OR^5)(OR^6)$, $-OP(OR^5)(OR^6)$, $-SR^5$, $-S(O)R^5$, $-S(O)_2R^5$, $-S(O)_2NR^5R^6$, $-S(O)(OR^5)$, $-S(O)_2(OR^5)$, $-SC(=Y)R^5$, $-SC(=Y)OR^5$, $-SC(=Y)NR^5R^6$, a C_{1-12} alkyl, a C_{2-8} alkenyl, a C_{2-8} alkynyl, a C_{3-12} carbocyclic group, a C_{2-20} heterocyclic group, a C_{6-20} aryl or a C_{1-20} heteroaryl;

Y is O, S or NR^7;

m, k or k1 is independently 0, 1, 2, 3, 4, 5 or 6.

2. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 1, wherein in the formula I,

A_1 is N;

A_2 is N;

R^2 is $-(CR^8R^9)_mNR^5R^6$, $-O(CR^8R^9)_mCHR^5R^6$ or $-O(CR^8R^9)_mNR^5R^6$;

R^3 is a hydrogen, a deuterium, a halogen or a C_{1-3} alkyl;

A is CR^{4a}; R^{4a} is a hydrogen, a halogen or a C_{1-3} alkyl;

D is N or CR^{4d}; R^{4d} is $-NR^7S(O)_2R^5$;

E is CR^{4e}; R^{4e} is a hydrogen, a C_{1-3} alkoxy or $-NR^5R^6$;

G is N or CR^{4g}; R^{4g} is $-NR^7S(O)_2R^5$;

J is CR^{4j}; R^{4j} is a hydrogen, a halogen or a C_{1-3} alkyl;

or, R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially unsaturated 5- or 6-membered heterocyclic ring, the 5- or 6-membered heterocyclic ring is fused to the 6-membered ring containing A, D, E, G and J; the 5-membered heterocyclic ring is a 5-membered nitrogen-containing heterocyclic ring;

A, D, E, G and J are not N at the same time;

ring Q is a benzene;

$(R^1)_{k1}$ represents that the hydrogens to which attached to the ring Q are substituted by 0-k1 occurrences of R^1, at each occurrence the R^1 is the same or different from each

other, and is each independently a halogen;

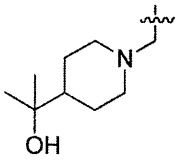
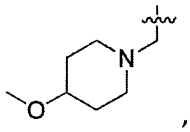
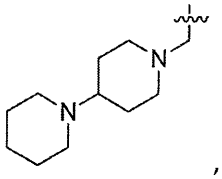
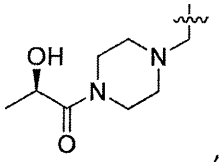
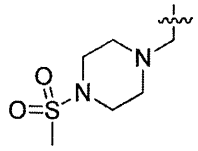
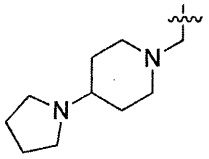
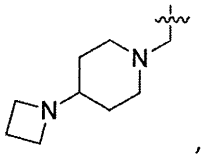
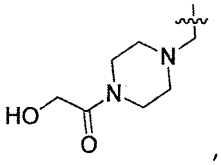
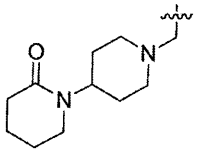
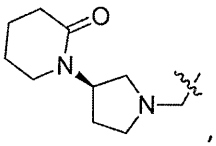
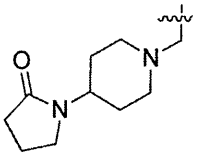
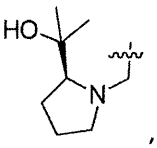
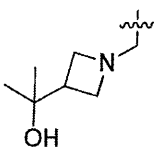
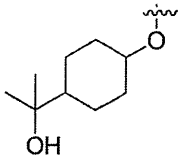
R^5, R^6 and R^7 are each independently a hydrogen, $-(CH_2)_{2-3}NH_2$ or a C_{1-6} alkyl, or R^5, R^6 together with the nitrogen or carbon atoms to which they are directly attached form a heterocyclic ring or a cycloalkyl, the heterocyclic ring or the cycloalkyl is preferably optionally substituted by the substituent selected from the group consisting of: $-(CH_2)_mOR^7$, $-SO_2R^7$, $-C(=O)R^7$, a C_{1-3} alkyl, a C_{3-6} carbocyclic group and a C_{2-5} heterocyclic group; wherein the heterocyclic ring is a nitrogen-containing or an oxygen-containing 4- to 6-memebered heteroalicyclic ring, the cycloalkyl is a 4- to 6-membered cycloalkyl;

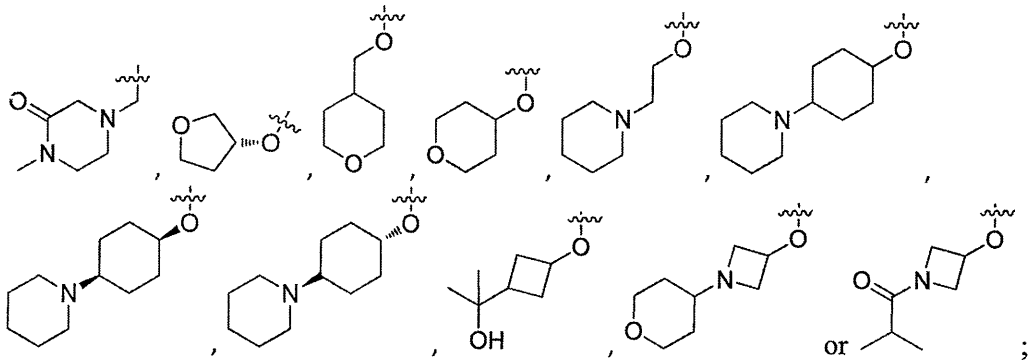
$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and are each independently a hydrogen, a deuterium, a halogen or a C_{1-3} alkyl;

m, k or k1 is independently 0 or 1.

3. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 1, wherein in the formula I,

A_1 and A_2 are N at the same time;

R^2 has a structure selected from the group consisting of 
















R^3 is a hydrogen;

A is CR^{4a}; R^{4a} is a hydrogen;

D is N;

E is CR^{4e}; R^{4e} is a hydrogen, a methoxy or $-NH_2$;

G is N or CR^{4g}; R^{4g} is ;

J is CR^{4j}; R^{4j} is a hydrogen;

or, R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially unsaturated 5- or 6-membered heterocyclic ring, the 5- or 6-membered heterocyclic ring is fused to the 6-memebered ring containing A, D, E, G and J;

A, D, E, G and J are not N at the same time;

ring Q is a benzene;

$(R^1)_{k1}$ represents that the hydrogens attached to the ring Q are substituted by 0-k1 occurrences of R^1, at each occurrence the R^1 is the same or different from each other, and is each independently fluorine;

m, k or k1 is independently 0 or 1.

4. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 2, wherein in the formula I,

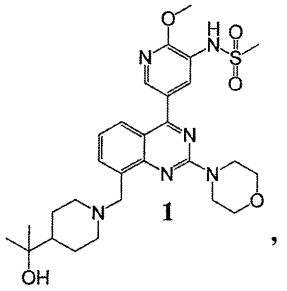
R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially saturated 5-membered heterocyclic ring, the 5-membered

heterocyclic ring is fused to the 6-membered ring containing A, D, E, G and J; the 5-membered heterocyclic ring is 5-membered nitrogen-containing heterocyclic ring; the 5-membered nitrogen-containing heterocyclic ring is a pyrazole or a pyrrole;

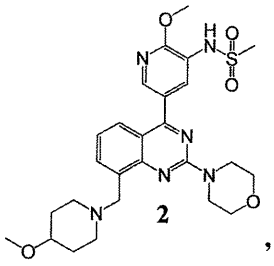
the heterocyclic ring fomed by R^5, R^6, with the nitrogen atom to which they are directly attached is a nitrogen-containing 6-membered heteroalicyclic ring; the nitrogen-containing 6-membered heteroalicyclic ring is a piperidine or a piperazidine.

5. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 1, wherein

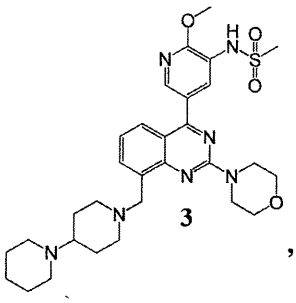
formula I is a compound selected from the group consisting of:



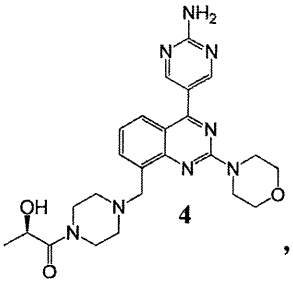
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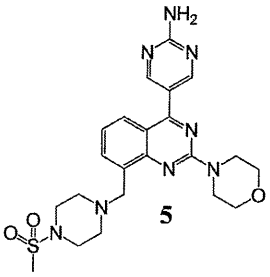
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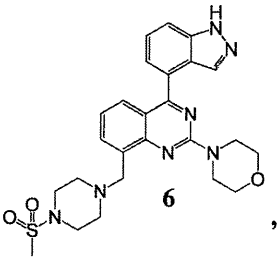
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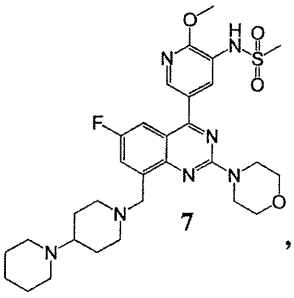
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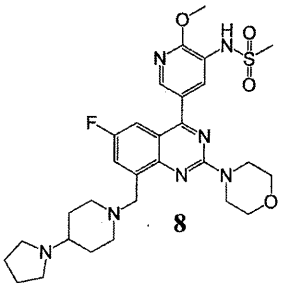
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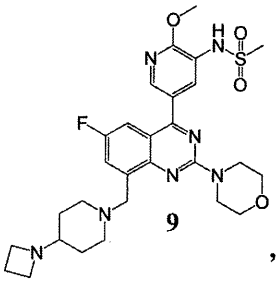
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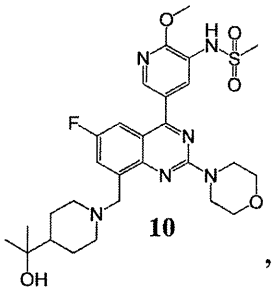
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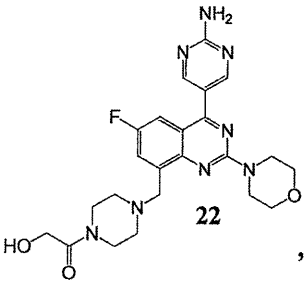
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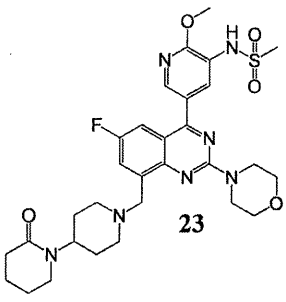
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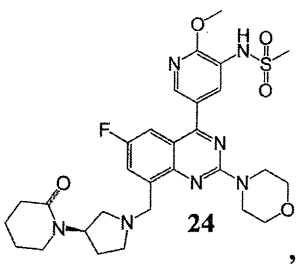
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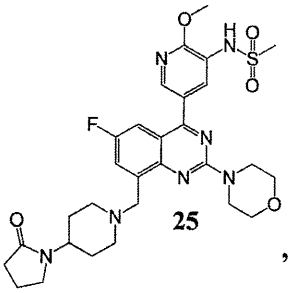
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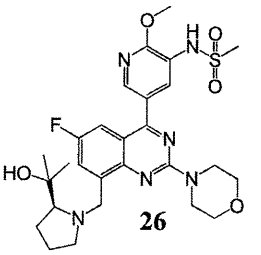
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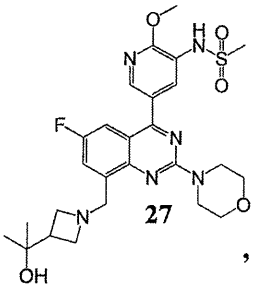
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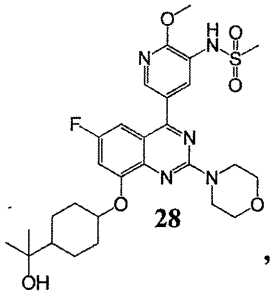
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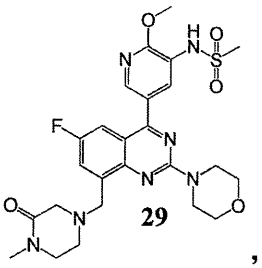
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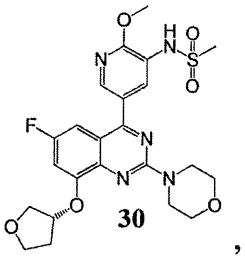
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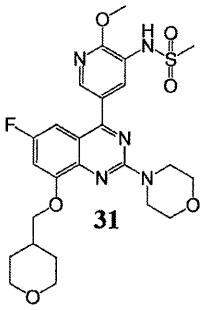
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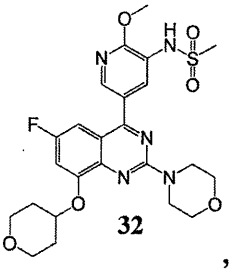
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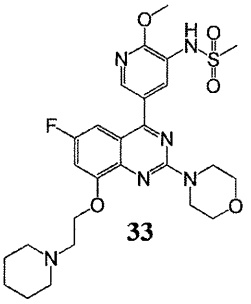
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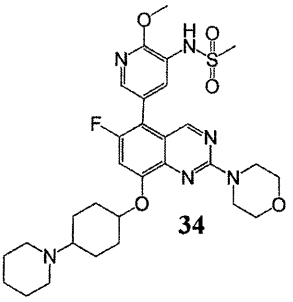
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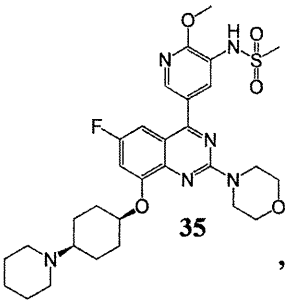
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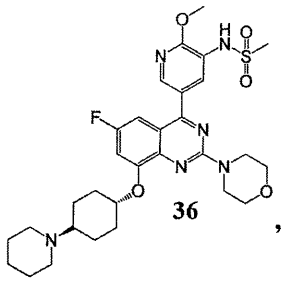
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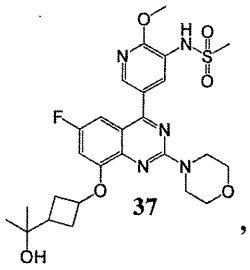


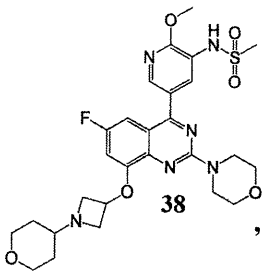
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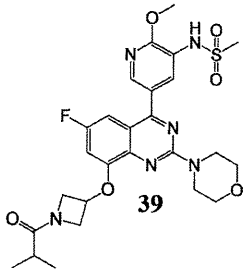


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6. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 1, wherein in the formula II,

A_1 is N or CH;

A_2 is N or CH;

A_3 is N or C;

A_4 is N or C;

A_5 is N;

A_6 is CR^{1b}; R^{1b} is a hydrogen or a deuterium;

R^2 is $-(CR^8R^9)_mNR^5R^6$;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is each independently a hydrogen, a deuterium, a halogen, or a C_{1-3} alkyl;

A is CR^{4a}; R^{4a} is a hydrogen, a halogen or a C_{1-3} alkyl;

D is N or CR^{4d}; R^{4d} is a hydrogen, a halogen or a C_{1-3} alkyl;

E is CR^{4e}; R^{4e} is a hydrogen, a halogen or a C_{1-3} alkyl;

G is CR^{4g}; R^{4g} is $-NR^7S(O)_2R^5$;

J is CR^{4j}; R^{4j} is a hydrogen;

or, R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially unsaturated 5-membered heterocyclic ring, the 5-membered heterocyclic ring is fused to the 6-membered ring containing A, D, E, G and J;

wherein the 5-membered heterocyclic ring is a 5-membered nitrogen-containing heterocyclic ring;

R^5, R^6 and R^7 are each independently a hydrogen, a C_{1-6} alkyl, $-(CH_2)_{2-3}NH_2$, a C_{2-4} alkenyl or a C_{2-4} alkynyl, or R^5, R^6 with the nitrogen atom to which they are attached form a heterocyclic ring which is preferably optionally substituted by the substituent selected from the group consisting of: oxo, $-(CH_2)_mOR^7$, $-CF_3$, a halogen, $-SO_2R^7$, $-C(=O)R^7$, a C_{1-3} alkyl, a C_{3-6} carbocyclic group or a C_{2-5} heterocyclic group; wherein the heterocyclic ring formed by R^5, R^6 and with the nitrogen atom to which they are attached is a nitrogen-containing 6-membered heteroalicyclic ring;

$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and are each independently a hydrogen, a deuterium, a halogen, -CN, a hydroxyl or a C_{1-3} alkyl;

wherein the alkyl, alkenyl, alkynyl, carbocyclic group, heterocyclic ring or heterocyclic group is preferably optionally substituted by the substituent selected from the group consisting of: a halogen, a hydroxyl, -CN, $-CF_3$, $-NO_2$ or oxo;

m or k is independently 0 or 1.

7. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 6, wherein in the formula II,

A_1, A_3 and A_5, or, A_2, A_4 and A_5 are N at the same time;

when A_1, A_3 and A_5 are N, A_2, A_4 and A_6 are CH at the same time;

when A_2, A_4 and A_5 are N, A_1, A_3 and A_6 are CH at the same time;

R^2 is $-(CR^8R^9)_mNR^5R^6$;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is each independently a hydrogen or a deuterium;

A is CR^{4a}; R^{4a} is a hydrogen;

D is N or CR^{4d}; R^{4d} is a hydrogen;

E is CR^{4e}; R^{4e} is a hydrogen;

G is CR^{4g}; R^{4g} is $-NR^7S(O)_2R^5$;

J is CR^{4j}; R^{4j} is a hydrogen;

or, R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially unsaturated 5-membered nitrogen-containing heterocyclic ring, the 5-membered nitrogen-containing heterocyclic ring is fused to the 6-membered ring containing A, D, E, G and J; wherein the 5-membered nitrogen-

containing heterocyclic ring is a pyrazole or a pyrrole;

R^5, R^6 and R^7 are each independently a hydrogen, a C_{1-3} alkyl, $-(CH_2)_2NH_2$, or R^5, R^6 and with the nitrogen atom to which they are directly attached form a heterocyclic ring which is preferably optionally substituted by the group consisting of: $-SO_2R^7$ or a C_{1-3} alkyl; wherein the heterocyclic ring formed by R^5, R^6 and with the nitrogen atom to which they are directly attached is a nitrogen-containing 6-membered heteroalicyclic ring, the nitrogen-containing 6-membered heteroalicyclic ring is a piperidine or a piperazidine;

$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and are each independently a hydrogen or a deuterium;

wherein the alkyl, heterocyclic ring or heterocyclic group is preferably optionally substituted by the substituent selected from the group consisting of: a halogen, a hydroxyl, -CN, $-CF_3$, $-NO_2$ or oxo;

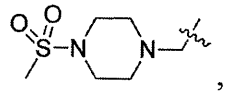
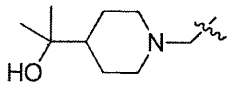
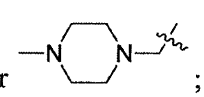
m or k is independently 0 or 1.

8. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 7, wherein in the formula II,

A_1, A_3 and A_5, or, A_2, A_4 and A_5 are N at the same time;

when A_1, A_3 and A_5 are N, A_2, A_4 and A_6 are CH at the same time;

when A_2, A_4 and A_5 are N, A_1, A_3 and A_6 are CH at the same time;

R^2 is , , or ;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is each independently a hydrogen or a deuterium;

A is CR^{4a}; R^{4a} is a hydrogen;

D is N or CR^{4d}; R^{4d} is a hydrogen;

E is CR^{4e}; R^{4e} is a hydrogen;

G is CR^{4g}; R^{4g} is $-NR^7S(O)_2R^5$;

J is CR^{4j}; R^{4j} is a hydrogen;

or, R^{4j} and R^{4g}, together with the atoms to which they are attached form a saturated, unsaturated or partially unsaturated 5-membered nitrogen-containing heterocyclic ring, the 5-membered nitrogen-containing heterocyclic ring is fused to the 6-membered ring containing A, D, E, G and J; wherein the 5-membered nitrogen-

containing heterocyclic ring is a pyrazole or a pyrrole;

R^5 and R^7 are each independently a hydrogen or a C_{1-3} alkyl;

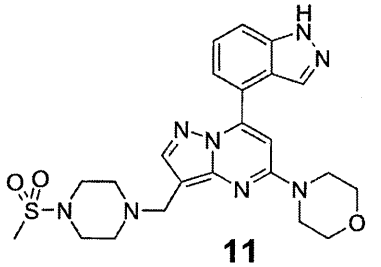
$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and independently a hydrogen or a deuterium;

wherein the alkyl is substituted by a hydroxyl;

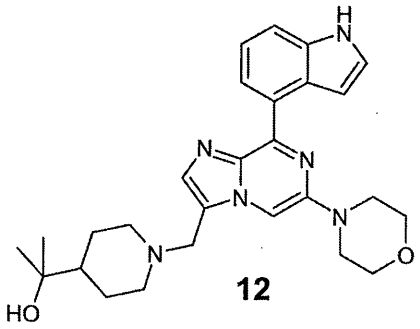
m or k is independently 0 or 1.

9. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 1, wherein

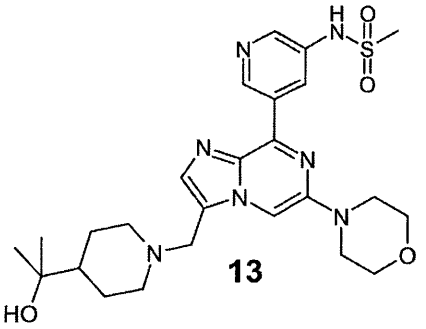
formula II is a compound selected from the group consisting of:



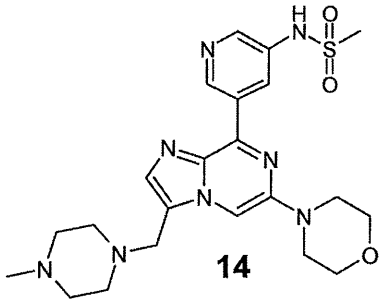
11 ,



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14 .

10. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 1, wherein in the formula III,

A_1 is N;

A_2 is N;

R^2 is $-(CR^8R^9)_mNR^5R^6$ or $-(CR^8R^9)_mOR^5$;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is each independently a hydrogen, a deuterium, a halogen or a C_{1-3} alkyl;

A is CR^{4a}; R^{4a} is a hydrogen, a halogen or a C_{1-3} alkyl;

E is CR^{4e}; R^{4e} is a C_{1-6} alkoxy;

J is CR^{4j}; R^{4j} is a hydrogen;

ring Q' is a benzene or a 5-memebered heterocyclic ring; $(R^1)_{k1}$ represents that the hydrogens attached to the ring Q' are substituted by 0-k1 occurrences of R^1, at each occurrence the R^1 is the same or different from each other, and is each independently a halogen, -CN or a C_{1-12} alkyl;

R^5, R^6, R^7 and $R^{7'}$ are are each independently a hydrogen, a C_{1-6} alkyl, $-(CH_2)_{2-3}NH_2$, a C_{3-6} carbocyclic group or a C_{2-5} heterocyclic group, or R^5, R^6 and the nitrogen atom to which they are directly attached form a heterocyclic ring which is preferably optionally substituted by the substituent selected from the group consisting of: $-NR^7R^{7'}$, a C_{1-3} alkyl, a C_{3-6} carbocyclic group or a C_{2-5} heterocyclic group;

$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and are each independently a hydrogen, a deuterium or a C_{1-3} alkyl;

m, k or k1 is independently 0 or 1.

11. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 10, wherein in the formula III,

A_1 is N;

A_2 is N;

R^2 is $-(CR^8R^9)_mNR^5R^6$ or $-(CR^8R^9)_mOR^5$;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is each independently a hydrogen or a deuterium;

A is CR^{4a}; R^{4a} is a hydrogen;

E is CR^{4e}; R^{4e} is a C_{1-3} alkoxy;

J is CR^{4j}; R^{4j} is a hydrogen;

ring Q' is a benzene or a 5-membered heterocyclic ring, the 5-membered heterocyclic ring is a thiophene or an imidazole;

$(R^1)_{k1}$ represents that the hydrogens attached to the ring Q' are substituted by 0-k1 occurrences of R^1, at each occurrence the R^1 is the same or different from each other, and is each independently a C_{1-3} alkyl;

R^5, R^6, R^7 and $R^{7'}$ are each independently a hydrogen, a C_{1-3} alkyl, $-(CH_2)_{2-3}NH_2$, a

C_{3-6} carbocyclic group or a C_{2-5} heterocyclic group, or R^5, R^6 and the nitrogen atom to which they are directly attached form a heterocyclic ring which is preferably optionally substituted by the substituent selected from the group consisting of: $-NR^{7}R^{7'}$, a C_{1-3} alkyl, a C_{3-6} carbocyclic group or a C_{2-5} heterocyclic group; the C_{2-5} heterocyclic group is a piperidine, a pyran, a tetrahydropyrrole or an oxetane;

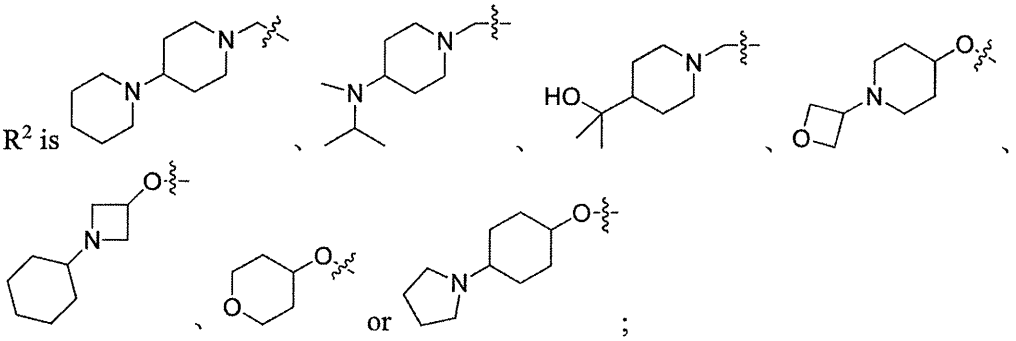
$(CR^8R^9)_m$ represents that 0 to m (CR^8R^9) are linked, R^8 and R^9 are the substituents attached to the formed carbon chain, wherein each R^8 and R^9 are the same or different from each other, and are each independently a hydrogen or a deuterium;

m, k or k1 is independently 0 or 1.

12. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 11, wherein in the formula III,

A_1 is N;

A_2 is N;

R^2 is 

;

$(R^3)_k$ represents that the hydrogens attached to the morpholine ring are substituted by 0-k occurrences of R^3, at each occurrence the R^3 is the same or different from each other, and is each independently a hydrogen or a deuterium;

A is CR^{4a}; R^{4a} is a hydrogen;

E is CR^{4e}; R^{4e} is a methoxy;

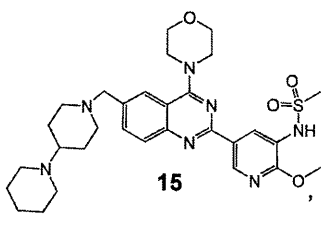
J is CR^{4j}; R^{4j} is a hydrogen;

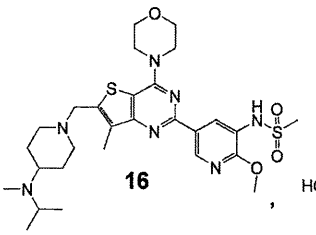
ring Q' is a benzene or a 5-membered heterocyclic ring, the 5-membered heterocyclic ring is a thiophene or an imidazole; $(R^1)_{k1}$ represents that the hydrogens attached to the ring Q' are substituted by 0-k1 occurrences of R^1, at each occurrence the R^1 is the same or different from each other, and is each independently a methyl;

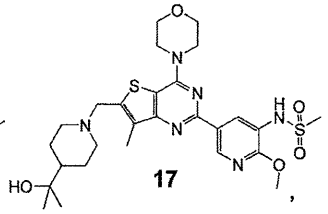
m, k or k1 is independently 0 or 1.

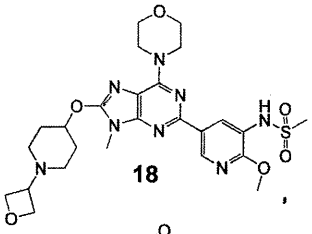
13. The fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in claim 1, wherein

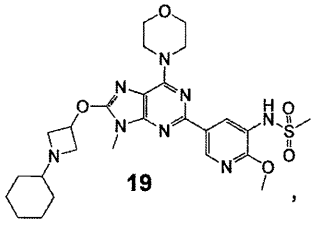
formula III is a compound selected from the group consisting of:

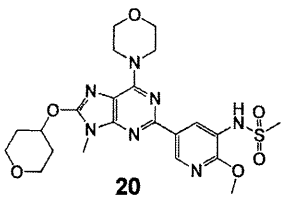

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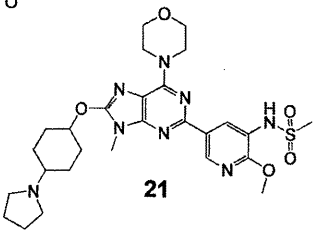

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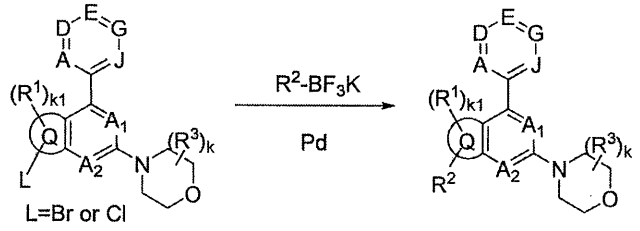

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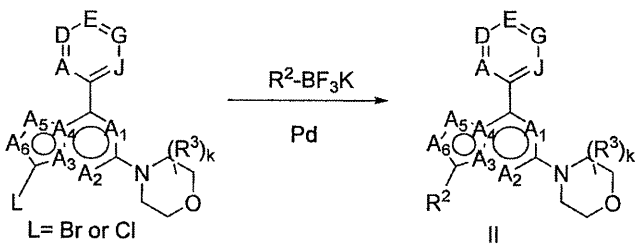
14. A process for preparing the fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in any one of claims 1-13, wherein

reaction route I comprises the following steps:



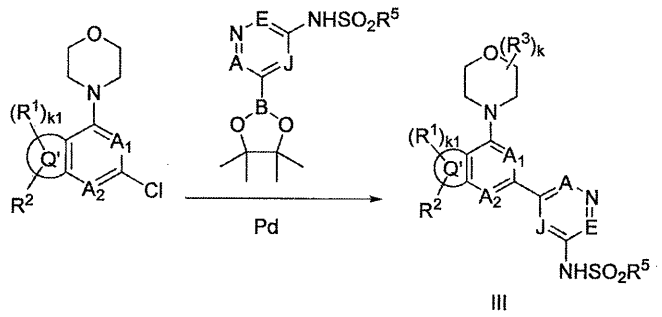
I

reaction route II comprises the following steps:



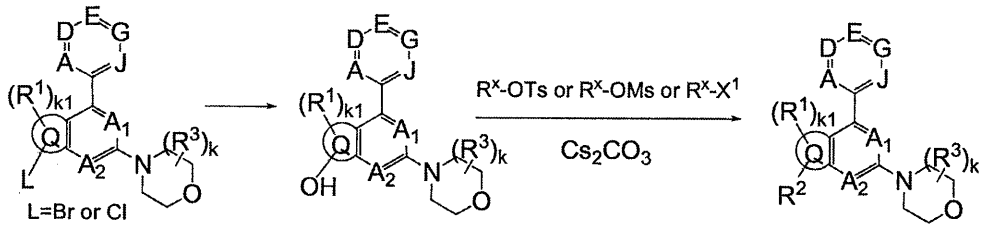
II

reaction route III comprises the following steps:



III

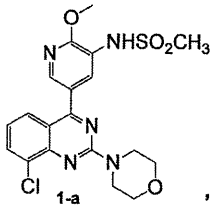
reaction route IV comprises the following steps:



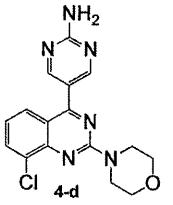
I

wherein R^x is $-(CR^8R^9)_mCHR^5R^6$ or $-(CR^8R^9)_mNR^5R^6$, when R^2 is $-O(CR^8R^9)_mCHR^5R^6$ or $-O(CR^8R^9)_mNR^5R^6$ in the formula I, the reaction route IV is utilized to synthesis, when R^2 is not $-O(CR^8R^9)_mCHR^5R^6$ or $-O(CR^8R^9)_mNR^5R^6$ in the formula I, the reaction route I is utilized to synthesis; X^1 is Cl, Br or I.

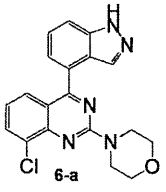
15. A compound as shown below:



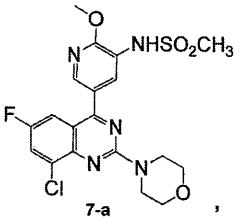
1-a ,



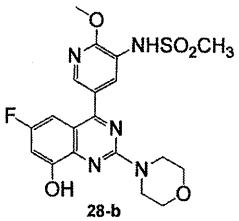
4-d ,



6-a ,



7-a ,



28-b .

16. A pharmaceutical composition comprising a therapeutically effective dosage of the fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate

or polymorph thereof as defined in any one of claims 1 to 13, and a pharmaceutically acceptable carrier.

17. A use of the fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in any one of the claims 1 to 13, or the pharmaceutical composition as defined in claim 16 in manufacturing an inhibitor of kinase.

18. The use as defined in claim 17, wherein the kinase is PI3 kinase.

19. The use as defined in claim 18, wherein the kinase is p110 δ subtype of PI3 kinase.

20. A use of the fused heterocyclic compound, pharmaceutically acceptable salt, hydrate, solvate or polymorph thereof as defined in any one of the claims 1 to 13, or the pharmaceutical composition as defined in claim 16 in manufacturing a medicament for treating and/or preventing a disease related to kinase.

21. The use as defined in claim 20, wherein the kinase is PI3 kinase.

22. The use as defined in claim 21, wherein the kinase is p110 δ subtype of PI3 kinase.

23. The use as defined in claim 20, wherein the "disease related to kinase" is a disease selected from the group consisting of cancer, immunological diseases, metabolic and/or endocrine dysfunction, angiocardiopathy, virus infections and inflammation, and nerve diseases.

24. The use as defined in claim 23, wherein the immunological disease is a disease selected from the group consisting of rheumatoid arthritis, psoriasis, ulcerative colitis, Crohn's disease and systemic lupus erythematosus; the angiocardiopathy is neoplastic hematologic disorder; the virus infection and inflammation is asthma and/or atopic dermatitis.