Specific and similar reactants can be selectively identified by the indexes of known chemicals prepared by the Chemical Abstracts Service of the American Chemical Society, wherein the indexes are available in most public libraries or university libraries and online. Chemicals that are known but not commercially available in the catalog are optionally prepared by custom chemical synthesis plants, wherein many of standard chemical supply plants (for example, those listed above) provide custom synthesis services. Reference document for the preparation and selection of the pharmaceutically acceptable salts of the compounds described herein is P. H. Stahl & C. G. Wermuth "Handbook of Pharmaceutical Salts", Verlag Helvetica Chimica Acta, Zurich, 2002.

Term

Unless otherwise specified, the terms of the present invention have the following meanings.

The carbon, hydrogen, oxygen, sulphur, nitrogen and halogen involved in the groups and compounds of the present invention all comprise isotopes thereof, and are optionally further substituted with one or more of the corresponding isotopes thereof, wherein the isotopes of carbon comprise ^{12}C, ^{13}C and ^{14}C; the isotopes of hydrogen comprise protium (H), deuterium (~~deuterium~~D, also known as heavy hydrogen), and tritium (T, also known as superheavy hydrogen); the isotopes of oxygen comprise ^{16}O, ^{17}O and ^{18}O; the isotopes of sulphur comprise ^{32}S, ^{33}S, ^{34}S and ^{36}S; the isotopes of nitrogen comprise ^{14}N and ^{15}N; the isotope of fluorine comprises ^{19}F; the isotopes of chlorine comprise ^{35}Cl and ^{37}Cl; and the isotopes of bromine comprise ^{79}Br and ^{81}Br.

The expression "C_{x-y} group" refers to a group comprising x to y carbon atoms, for example, "C_{1-6} alkyl" refers to an alkyl group comprising 1-6 carbon atoms.

The term "halogen" refers to fluorine (F), chlorine (Cl), bromine (Br), iodine (I) or isotopes thereof.

The term "halo" or "substituted with halogen" means that the hydrogen atoms are substituted with one or more groups selected from F, Cl, Br, I, or isotopes thereof, wherein the upper limit of the number of halogen substituents is equal to the sum of the number of hydrogens that can be substituted in the group to be substituted. Without particular limitation, the number of halogen substituents is any integer between 1 and the upper limit, preferably 1-5 halogen, 1-3 halogen, 1-2 halogen, and 1 halogen; and when the number of halogen substituents is greater

The term “alkenyl” refers to a straight or branched hydrocarbon group comprising at least one carbon-carbon double bond (C=C), and the main chain comprises 2 to 18 (such as 2 to 8, further such as 2 to 6, and more further such as 2 to 4) carbon atoms unless otherwise specified. Examples of alkenyl include, but are not limited to vinyl, allyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 1-pentenyl, 2-pentenyl, 3-pentenyl, 4-pentenyl, 1-methyl-1-butenyl, 2-methyl-1-butenyl, 2-methyl-3-butenyl, 1-hexenyl, 2-hexenyl, 3-hexenyl, 4-hexenyl, 5-hexenyl, 1-methyl-1-pentenyl, 2-methyl-1-pentenyl, 1-heptenyl, 2-heptenyl, 3-heptenyl, 4-heptenyl, 1-octenyl, 3-octenyl, 1-nonenyl, 3-nonenyl, 1-decenyl, 4-decenyl, 1,3-butadiene, 1,3-pentadiene, 1,4-pentadiene, 1,4-hexadiene, etc.; and the alkenyl can be optionally further substituted with any group.

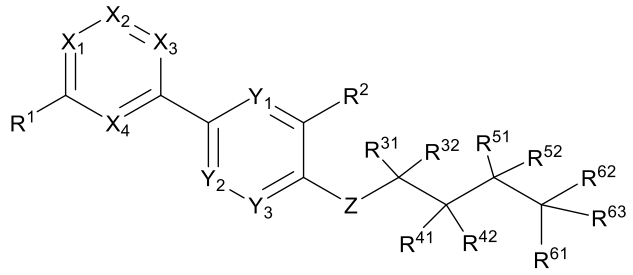
The term “alkynyl” refers to a straight or branched hydrocarbon group containing at least one carbon-carbon triple bond (C≡C). The main chain comprises 2 to 18 (such as 2 to 8, further such as 2 to 6, and more further such as 2 to 4) carbon atoms. “Alkynyl” includes but is not limited to e~~E~~thynyl, 1-propynyl, 2-propynyl, butynyl, 2-butynyl, 3-butynyl, 1-methyl-2-propynyl, 4-pentynyl, 3-pentynyl, 1-methyl-2-butynyl, 2-hexynyl, 3-hexynyl, 2-heptynyl, 3-heptynyl, 4-heptynyl, 3-octynyl, 3-nonynyl, 4-decynyl, etc. The alkynyl can be optionally further substituted with any substituent.

The term “alkoxy” or “alkyloxy” refers to -O-alkyl. Without particular limitation, alkoxy or alkyloxy is -O-C_{1-8} alkyl, preferably -O-C_{1-6} alkyl, more preferably -O-C_{1-4} alkyl, and further preferably -O-C_{1-2} alkyl. Non-limiting examples of alkoxy or alkyloxy include methoxy, ethoxy, n-propoxy, isopropoxy, n-butoxy, secbutoxy, tert-butoxy, n-pentoxy, n-hexyloxy, cyclopropoxy, cyclobutoxy, etc. The alkoxy can be optionally further substituted with any substituent.

The term “haloalkoxy” refers to -O-haloalkyl. Without particular limitation, haloalkoxy is -O-halo C_{1-8} alkyl, preferably -O-halo C_{1-6} alkyl, more preferably -O-halo C_{1-4} alkyl, and further preferably -O-halo C_{1-2} alkyl, wherein the upper limit of the number of halogen substituents is equal to the sum of the number of hydrogens that can be substituted in the group to be substituted. Without particular limitation, the number of halogen substituents is any integer between 1 and the upper limit, preferably 1-5 halogen, 1-3 halogen, 1-2 halogen, and 1 halogen; and when the number of halogen substituents is greater than 1, the group to be substituted can be substituted with the same or different halogen. Non-limiting examples of

CLAIMS

1. A compound of formula (I), or a stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof,



(I)

characterised in that

X_1, X_2, X_3 and X_4 are each independently selected from N or CR^x;

Y_1, Y_2 and Y_3 are each independently selected from N or CR^y;

Z is selected from NR^z or O;

R^z is selected from H, deuterium, halogen, C_{1-6} alkyl, halo C_{1-6} alkyl, or deuterated C_{1-6} alkyl;

R^x and R^y are each independently selected from H, deuterium, halogen, amino, nitro, cyano, hydroxyl, sulphonyl, C_{1-6} alkyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, deuterated C_{1-6} alkoxy, hydroxy C_{1-6} alkyl, C_{3-6} cycloalkyl, or 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the alkyl, cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

R^1 and R^2 are each independently selected from H, deuterium, halogen, amino, -COOH, cyano, sulphonyl, aminoacyl, C_{1-6} alkyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, deuterated C_{1-6} alkoxy, hydroxy C_{1-6} alkyl, C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, -NHC(O)C_{1-6} alkyl, -NHC(O)C_{3-6} cycloalkyl, -NHC(O)C_{4-6} heterocycloalkyl, -NHC(O)NHC_{1-6} alkyl, or -NHC(O)OC_{1-6} alkyl, wherein the alkyl, cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

R^{31} and R^{32} are each independently selected from H, deuterium, halogen, cyano, hydroxyl, C_{1-6} alkyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, deuterated C_{1-6} alkoxy, or hydroxy C_{1-6} alkyl; or R^{31} and R^{32} together with the carbon atom to which they are attached form C_{3-6} cycloalkyl or 4- to 6-

membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

R^{41} and R^{42} are each independently selected from H, deuterium, amino, C_{1-6} alkyl, halogen, cyano, hydroxyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, -C_{1-6} alkyl-C_{3-6} cycloalkyl, C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-6} alkoxy, or hydroxy C_{1-6} alkyl;

or R^{41} and R^{42} together form C_{3-6} cycloalkyl or 4- to 6-membered heterocycloalkyl containing 1 heteroatom selected from O or S, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

R^{51} and R^{52} are each independently selected from H, deuterium, amino, halogen, C_{1-6} alkyl, cyano, hydroxyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, -C_{1-6} alkyl-C_{3-6} cycloalkyl, C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-6} alkoxy, or hydroxy C_{1-6} alkyl;

or R^{51} and R^{52} together with the carbon atom to which they are attached form C_{3-6} cycloalkyl or 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

R^{61}, R^{62} and R^{63} are each independently selected from H, deuterium, halogen, amino, cyano, hydroxyl, C_{1-6} alkyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, -C_{1-6} alkyl-C_{3-6} cycloalkyl, C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-6} alkoxy, or hydroxy C_{1-6} alkyl;

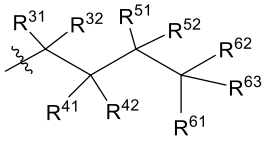
or, R^{31} and R^{41}, or R^{41} and R^{51} together with the carbon atoms to which they are each attached form C_{3-6} cycloalkyl or 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

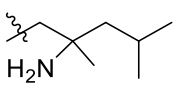
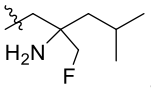
or, R^{41} and R^{61}, or R^z and R^{41} together with the atoms to which they are each attached form C_{4-6} cycloalkyl or 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

or, R^{51} and R^{61}, or R^{61} and R^{62} together with the carbon atom(s) to which they are each attached form C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, or a double bond, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

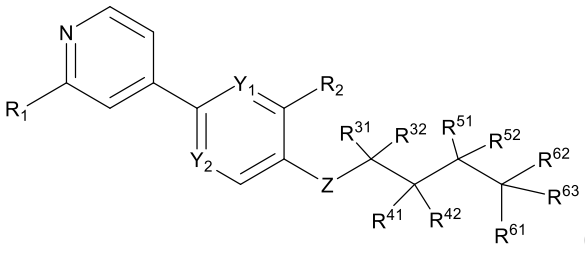
or, R^{61}, R^{62} and R^{63} together with the carbon atom to which they are attached form C_{5-10} bridged ring or C_{5-11} spiro ring, wherein the bridged ring and spiro ring are optionally further substituted with 1-3 R^A substituents;

R^A is selected from deuterium, halogen, amino, cyano, hydroxyl, C_{1-6} alkyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, deuterated C_{1-6} alkoxy, or hydroxy C_{1-6} alkyl,

provided that when Z is selected from O,  does not form the following structures:

 and .

2. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to claim 1, having a structure of formula (Ia):

 (Ia).

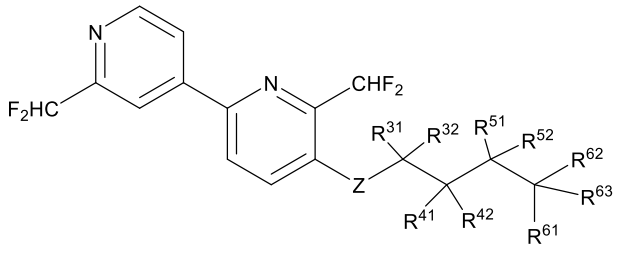
3. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to claim~~s~~ 1 or ~~-~~2, characterised in that

R^1 is selected from sulphonyl, aminoacyl, halo C_{1-3} alkyl, -NHC(O)C_{1-4} alkyl, -NHC(O)C_{3-6} cycloalkyl, -NHC(O)C_{4-6} heterocycloalkyl, -NHC(O)NHC_{1-4} alkyl, or -NHC(O)OC_{1-4} alkyl, wherein the alkyl, cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 R^A substituents;

R^2 is selected from cyano, C_{1-3} alkyl, halo C_{1-3} alkyl, or deuterated C_{1-3} alkyl;

R^A is selected from deuterium, F, Cl, amino, cyano, hydroxyl, C_{1-3} alkyl, halo C_{1-3} alkyl, deuterated C_{1-3} alkyl, C_{1-3} alkoxy, halo C_{1-3} alkoxy, deuterated C_{1-3} alkoxy, or hydroxy C_{1-3} alkyl.

4. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to claim 1, having a structure of formula (II):



(II).

5. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to any one of claims 1-4, characterised in that

Z is selected from NR^z or O;

R^z is selected from H, deuterium or C_{1-4} alkyl;

R^{31} and R^{32} are each independently selected from H, deuterium, F, Cl, cyano, hydroxyl, C_{1-4} alkyl, halo C_{1-4} alkyl, deuterated C_{1-4} alkyl, C_{1-4} alkoxy, halo C_{1-4} alkoxy, deuterated C_{1-4} alkoxy, or hydroxy C_{1-4} alkyl; or R^{31} and R^{32} together with the carbon atom to which they are attached form 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, or 4- or 5-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1, 2 or 3 substituents selected from R^A;

R^{41} and R^{42} are each independently selected from H, deuterium, amino, C_{1-4} alkyl, halogen, cyano, hydroxyl, halo C_{1-4} alkyl, deuterated C_{1-4} alkyl, C_{1-4} alkoxy, halo C_{1-4} alkoxy, -C_{1-4} alkyl-3-membered cycloalkyl, -C_{1-4} alkyl-4-membered cycloalkyl, -C_{1-4} alkyl-5-membered cycloalkyl, 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, 4-, 5- or 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-4} alkoxy, or hydroxy C_{1-4} alkyl; or R^{41} and R^{42} together form 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, 4- or 5-membered

heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1, 2 or 3 substituents selected from R^A;

R^{51} and R^{52} are each independently selected from H, deuterium, amino, halogen, C_{1-4} alkyl, cyano, hydroxyl, halo C_{1-4} alkyl, deuterated C_{1-4} alkyl, C_{1-4} alkoxy, halo C_{1-4} alkoxy, -C_{1-4} alkyl-3-membered cycloalkyl, -C_{1-4} alkyl-4-membered cycloalkyl, -C_{1-4} alkyl-5-membered cycloalkyl, 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, 4-, 5- or 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-4} alkoxy, or hydroxy C_{1-4} alkyl; or R^{51} and R^{52} together with the carbon atom to which they are attached form 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, or 4-, 5- or 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1, 2 or 3 substituents selected from R^A;

R^{61}, R^{62} and R^{63} are each independently selected from H, deuterium, halogen, amino, cyano, hydroxyl, C_{1-4} alkyl, halo C_{1-4} alkyl, deuterated C_{1-4} alkyl, C_{1-4} alkoxy, halo C_{1-4} alkoxy, -C_{1-4} alkyl-3-membered cycloalkyl, -C_{1-4} alkyl-4-membered cycloalkyl, -C_{1-4} alkyl-5-membered cycloalkyl, 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, 4-, 5- or 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-4} alkoxy, or hydroxy C_{1-4} alkyl;

or, R^{31} and R^{41}, or R^{41} and R^{51} together with the carbon atoms to which they are each attached form 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, or 4-, 5- or 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1, 2 or 3 substituents selected from R^A;

or, R^{41} and R^{61} together with the carbon atom(s) to which they are each attached form 4-membered cycloalkyl, 5-membered cycloalkyl, 6-membered cycloalkyl, or 4-, 5- or 6-heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1, 2 or 3 substituents selected from R^A;

or, R^z and R^{41} together with the carbon atom(s) to which they are each attached form 4-, 5- or 6-membered heterocycloalkyl containing 1-3 heteroatoms selected

from N, S and O, wherein the heterocycloalkyl is optionally further substituted with 1, 2 or 3 substituents selected from R^A;

or, R^{51} and R^{61}, or R^{61} and R^{62} together with the carbon atom(s) to which they are each attached form 3-membered cycloalkyl, 4-membered cycloalkyl, 5-membered cycloalkyl, 4-, 5- or 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, or a double bond, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1, 2 or 3 R^A substituents;

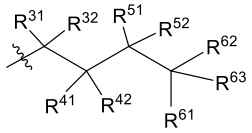
or, R^{61}, R^{62} and R^{63} together with the carbon atom to which they are attached form 5-membered bicyclic bridged ring, 6-membered bicyclic bridged ring, 7-membered bicyclic bridged ring, 8-membered bicyclic bridged ring, 5-membered spiro ring, 6-membered spiro ring, 7-membered spiro ring, 8-membered spiro ring, 9-membered spiro ring, or 10-membered spiro ring, wherein the bridged ring and spiro ring are optionally further substituted with 1, 2 or 3 substituents selected from R^A;

R^A is selected from deuterium, F, Cl, amino, cyano, hydroxyl, C_{1-4} alkyl, halo C_{1-4} alkyl, deuterated C_{1-4} alkyl, C_{1-4} alkoxy, halo C_{1-4} alkoxy, deuterated C_{1-4} alkoxy, or hydroxy C_{1-4}alkyl.

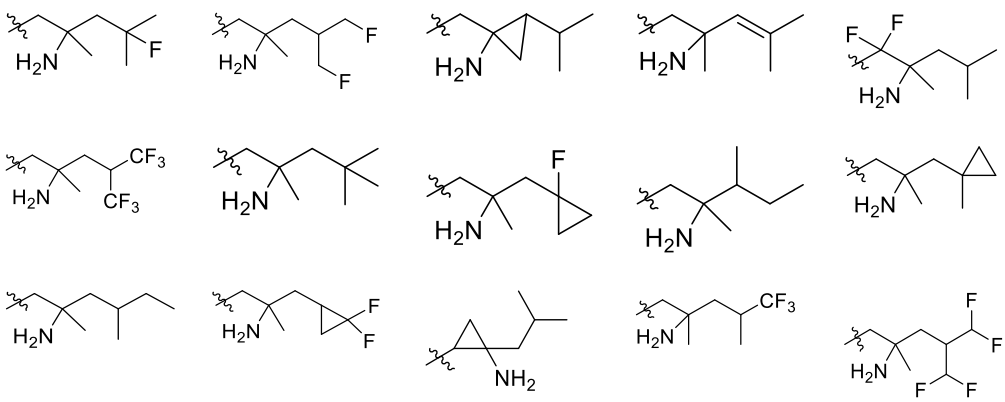
6. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to any one of claims 1-4, characterised in that

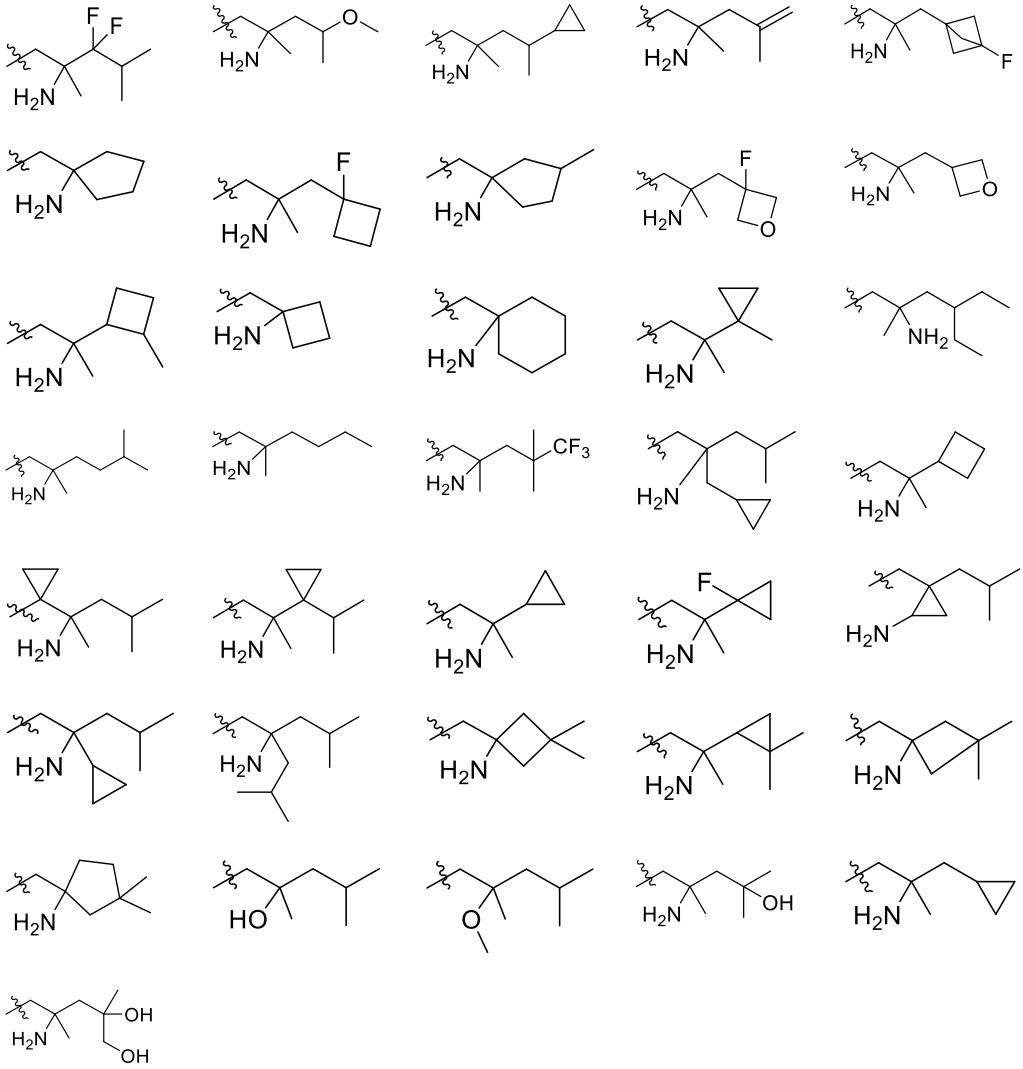
Z is selected from NR^z or O;

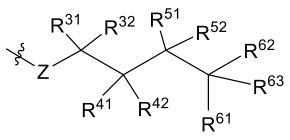
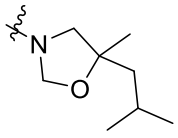
R^z is selected from H, deuterium, methyl, ethyl, n-propyl or isopropyl;



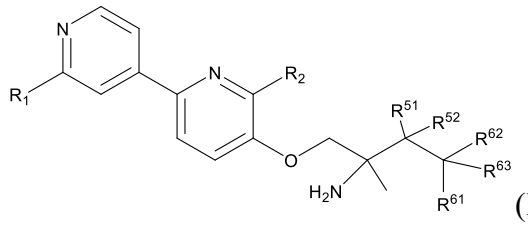
is selected from the following groups:





or,  is selected from .

7. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to claim 1, having a structure of formula (Ib):



(Ib)

R^1 is selected from halo C_{1-3} alkyl, -NHC(O)C_{1-4} alkyl, -NHC(O)C_{3-6} cycloalkyl, -NHC(O)C_{4-6} heterocycloalkyl, -NHC(O)NHC_{1-4} alkyl, or -NHC(O)OC_{1-4} alkyl, wherein the alkyl, cycloalkyl and heterocycloalkyl are

optionally further substituted with 1-3 substituents selected from deuterium, F, Cl, amino, cyano, or hydroxyl;

R^2 is selected from cyano, halo C_{1-3} alkyl or deuterated C_{1-3} alkyl;

R^{51} and R^{52} are each independently selected from H or deuterium;

R^{61} is independently selected from H, deuterium, halogen, amino, cyano, hydroxyl, C_{1-6} alkyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, -C_{1-6} alkyl-C_{3-6} cycloalkyl, C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-6} alkoxy or hydroxy C_{1-6} alkyl;

R^{62} and R^{63} are each independently selected from halogen, amino, cyano, hydroxyl, C_{1-6} alkyl, halo C_{1-6} alkyl, deuterated C_{1-6} alkyl, C_{1-6} alkoxy, halo C_{1-6} alkoxy, -C_{1-6} alkyl-C_{3-6} cycloalkyl, C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, deuterated C_{1-6} alkoxy, or hydroxy C_{1-6} alkyl;

or, R^{61} and R^{62} together with the carbon atom(s) to which they are each attached form C_{3-6} cycloalkyl, 4- to 6-membered heterocycloalkyl containing 1-3 heteroatoms selected from N, S and O, or a double bond, wherein the cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 substituents selected from deuterium, F, Cl, amino, cyano, or hydroxyl.

8. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to claim 7, characterised in that

R^1 is selected from halo C_{1-3} alkyl, -NHC(O)C_{1-4} alkyl, -NHC(O)C_{3-6} cycloalkyl, or -NHC(O)OC_{1-4} alkyl, wherein the alkyl, cycloalkyl and heterocycloalkyl are optionally further substituted with 1-3 substituents selected from deuterium, F, Cl, amino, cyano, or hydroxyl;

R^2 is selected from cyano or halo C_{1-3} alkyl;

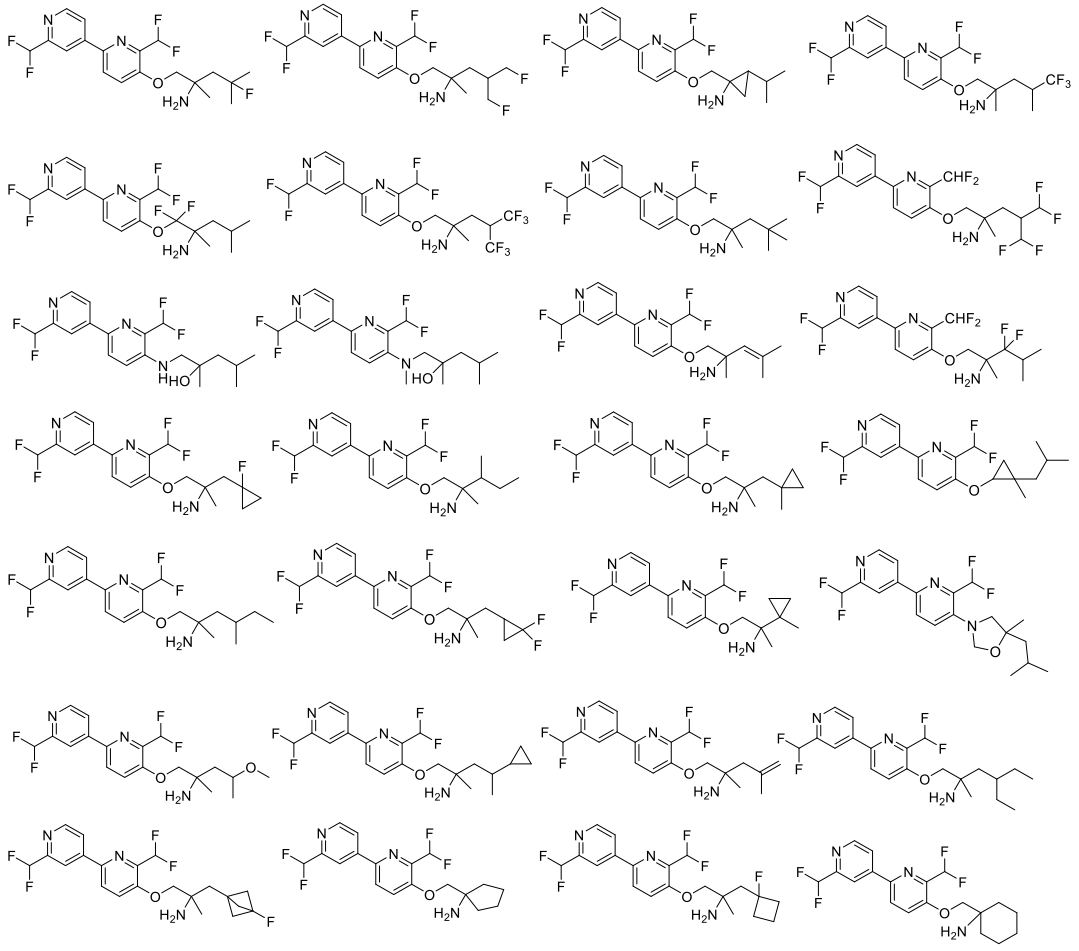
R^{51} and R^{52} are each independently selected from H or deuterium;

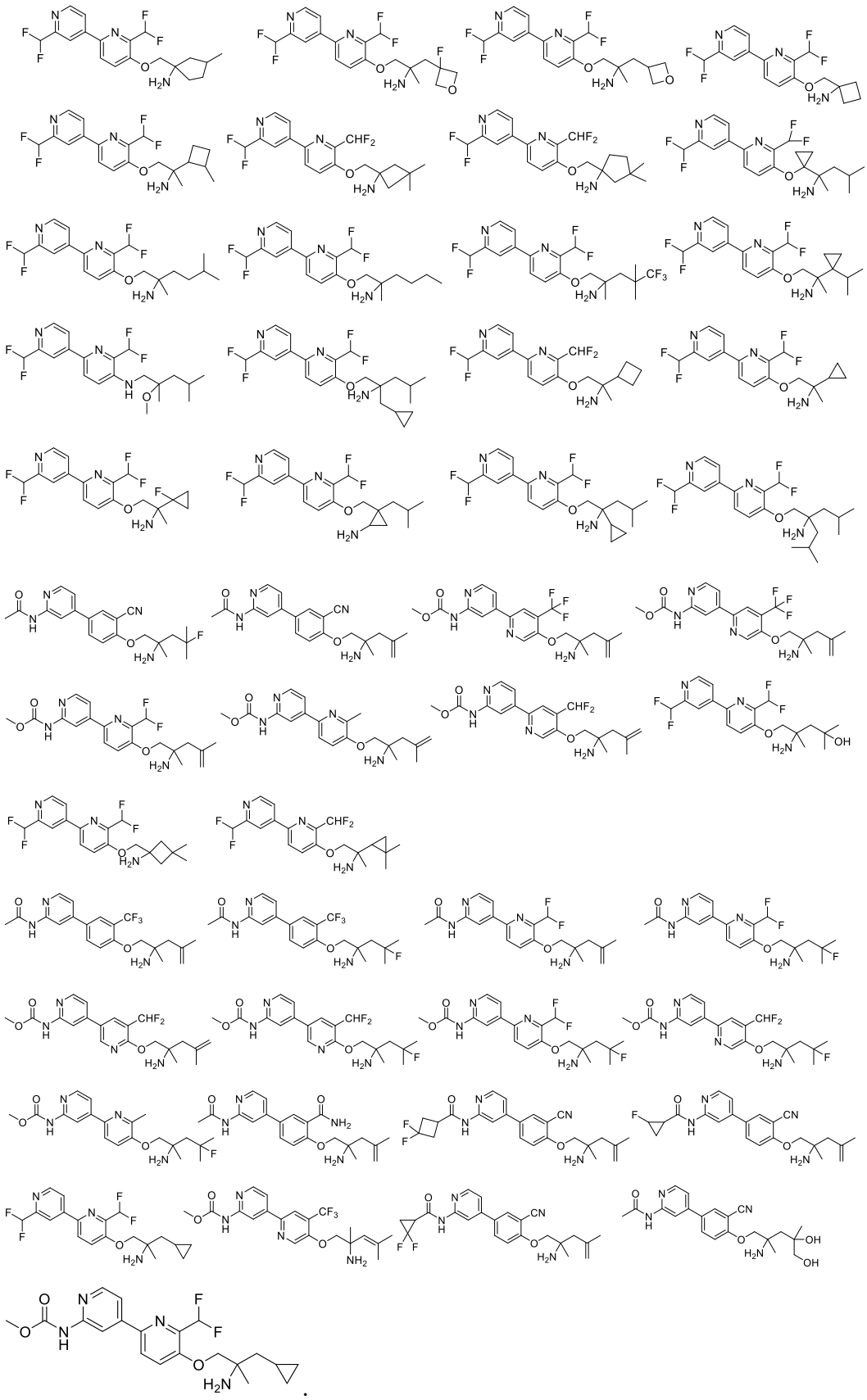
R^{61} is independently selected from H, deuterium, halogen, amino, cyano, hydroxyl, C_{1-3} alkyl, or hydroxy C_{1-3} alkyl;

R^{62} and R^{63} are each independently selected from halogen, amino, cyano, hydroxyl, C_{1-3} alkyl, halo C_{1-3} alkyl, deuterated C_{1-3} alkyl, or hydroxy C_{1-3} alkyl;

or, R^{61} and R^{62} together with the carbon atom(s) to which they are each attached form C_{3-6} cycloalkyl or a double bond, wherein the cycloalkyl is optionally further substituted with 1-3 substituents selected from deuterium, F, Cl, amino, cyano, or hydroxyl.

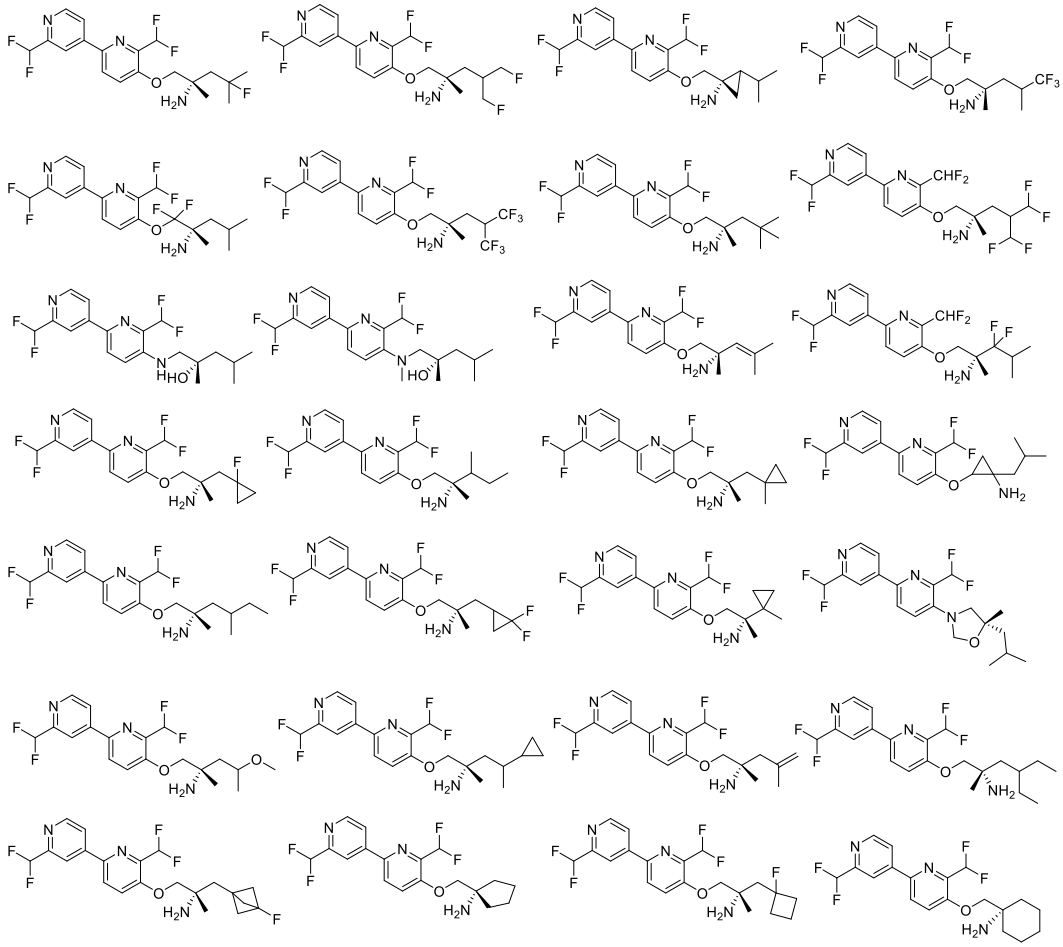
9. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to claim 1, characterised in that the compound is selected from the following structures:



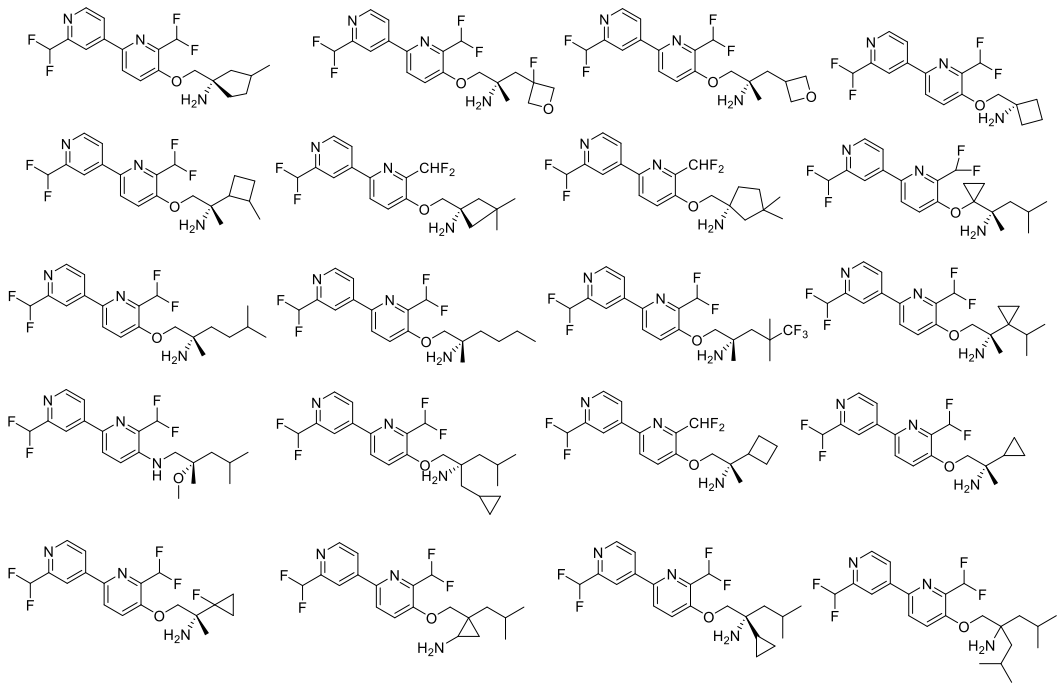


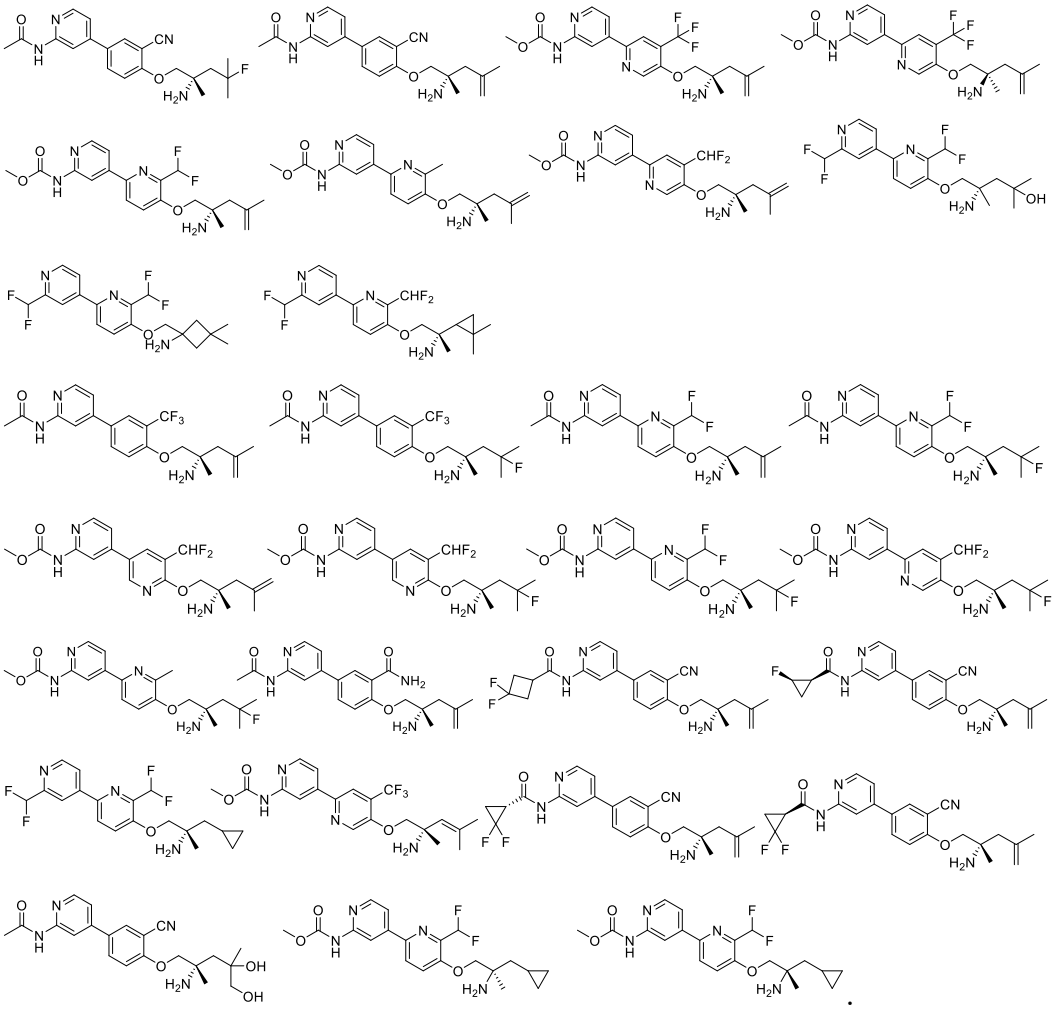
10. The compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof

according to claim 1, characterised in that the compound is selected from the following structures:



5





.

11. A pharmaceutical composition, comprising the compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to any one of claims 1-10, and a pharmaceutically acceptable carrier and/or excipient.

12. The pharmaceutical composition according to claim 11, comprising ~~1-1500 mg of~~ the compound, or the stereoisomer, deuterated compound, solvate, pharmaceutically acceptable salt or co-crystal thereof according to any one of claims 1-10 in an amount selected from 1-1500 mg, and a carrier and/or excipient.

13. Use of the compound, or the stereoisomer, deuterated compound, solvate, prodrug, metabolite, pharmaceutically acceptable salt or co-crystal thereof according to any one of claims 1-10, or the composition according to claim~~s~~ 11 or ~~-~~ 12 in the preparation of a drug for treating an AAK1-mediated disease.

14. The use according to claim 13, characterised in that the AAK1-mediated disease is diabetic neuropathic pain or post-herpetic neuralgia.

15. ~~A method for treating a disease in a mammal, characterised in that the method comprises administering to a subject a therapeutically effective~~ The use according to claim 13, wherein, the amount of the compound, or the stereoisomer, deuterated compound, solvate, pharmaceutically acceptable salt or co-crystal thereof ~~according to any one of claims 1-10, or the composition according to claim 11 or 12, wherein the therapeutically effective amount~~ is ~~preferably~~ 1-1500 mg~~, and the disease is preferably diabetic neuropathic pain or post-herpetic neuralgia~~.